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The Client Perspective on Factors in The Retrofitting of Sustainable Technologies to Traditional Rural Homes in North East Scotland.

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Abstract: Through the study of a project completed in 2009, the paper seeks to determine what barriers can be encountered by home-owners when trying to improve the performance of older properties with regard to energy use and CO2 emissions. The scope of the study is determined by the type of dwelling that is its focus; the traditional farmhouse as constructed during the late 19th and early 20th centuries in NE Scotland, along with the boundary set by the client's interpretation of 'sustainability'. Within this scope, the paper aims to report on the decision-making process that resulted in real-world "solutions" to the identified barriers.

Learning that results from the study relates to findings reported in the literature, particularly with regard to types of barriers encountered when attempting to mitigate against climate change by retrofitting technologies and materials to existing housing. In addition, there is learning related to the manner in which homeowners may make decisions in response to the identified barriers that result in a series of revisions of the initial list of technologies and materials. Such revisionary activity suggests that there remain significant problems to be addressed before substantial reductions in CO2 emissions from traditional dwellings can be achieved.

Keywords: retrofitting; skills; client decision-making; sustainable technologies.

Introduction:

Sustainability cab be defined in many different ways and therefore seems capable of being all things to all people. There is also much guidance, from a wide range of organisations and individuals, on how to crack the problem of achieving it. For an individual home-owner seeking to make some form of sustainable contribution to protecting the planet, this situation can appear to be both complex and intimidating. At worst, this may lead to home-owners to conclude that they do not have sufficient understanding to feel confident of successfully implementing any "solutions" beyond simple actions such as changing to low-energy bulbs, turning down the thermostat a few degrees and insulating the loft.

This study focuses on the decision-making process undergone by one home-owner as he struggled to achieve a more sustainable lifestyle in the context of a traditional (circa 1900) rural property that was built in a relatively remote Scottish location. The decisions faced by the home-owner were typical of almost all construction projects: definition of clear project outcomes; determination of the true project duration, and the dilemma of how to get the most ‘value’ out of their budget. Value for money is a particular concern when an individual is spending money that has not been easily come by and probably does not amount to a particularly generous budget. Nonetheless, the individual may feel the need to use the budget wisely, particularly in terms of integrating as many sustainable materials and technologies into the completed work as possible.

One strategy for seeking to maximise value is, for those individuals who are capable of carrying out some work on a DIY basis, to identify the appropriate balance between paying one or more contractors and doing work themselves for “free”. Any given budget can be stretched further by increasing the proportion of DIY work within a project. However, the proportion itself has to be constrained by a realistic self-assessment of skill and ability, along with an awareness of any legal constraints (such as certification requirements). This can be a particular constraint when considering the use of specific technologies that attract grant support; the requirement to use both specific hardware and installers or contractors is a common feature of the technologies that may be regarded as being “good” examples of sustainable technologies, and are therefore supported by government funded grants. Recent changes to government strategy in this area have resulted in a different emphasis, and the funding focus is moving to provide what may be referred to as an operational income stream rather than the previous installation grant approach. The newly introduced feed-in tariffs are one example of this change (Feed-in Tariffs Ltd, 2010)

Unfortunately, the more desirable (and expensive) technologies may be discounted when an individual realises that the cost, even after allowing for any up-front grant support, represents a disproportionate amount of the total budget. The changed approach represented by feed-in tariffs may, for some clients, make the situation worse in that they are faced with covering the full installation costs (possibly around £12,500) themselves prior to accessing an income stream that is estimated to result in a pay-back period of 10 years (FoE, 2010). Such constraints effectively reduce the “palette” of technologies that the home-owner has available to them. When combined with the situation where there may also be a need to stretch the budget in terms of adding more living space, along with other factors that contribute to the day-to-day quality of life in a home environment, the extent to which sustainability remains evident may be further reduced. Thus it can be posited that the decision as to what represents *effective* sustainability varies considerably between individual home-owners.

Scoping the Project

When the perspective of the home-owner is considered, the project can appear to be much more daunting than it does to an experienced contractor. The majority of clients in this sector of the construction industry are generally regarded as ‘naïve’; they do not have sufficient understanding of the construction process or the various possible routes to procuring construction work to fully appreciate what they are actually undertaking. Consequently, they will either overestimate or underestimate the scope of the project. They may not even have a fully-formed concept of the end product, which may simply be the desire to become more ‘sustainable’ with regard to their home environment. Reference to guidance as to what constitutes a ‘competent’ construction client (CCG, 2010) indicates the difficulties faced by a naive (or non-competent) client.

When seeking to determine the scope of the project unfolding in front of them, the client will be faced with a range of questions. The answers to these will ultimately lead the client to certain potential contractors, from which the "best" will have to be selected. This proposition has a basis in the assumption that there are many contractors to choose from. However, in a country such as Scotland, with large rural areas having relatively low population densities, the situation may actually be one where there is, from the perspective of integrating sustainable technologies into the project, a shortfall in the number of contractors available. Depending upon the extent and nature of sustainable technologies and materials that the client would like to include in the project, there may in fact be no "best" contractors readily available.

A typical question encountered in rural locations would be 'does the project involve a change of use?' The conversion of disused and surplus farm buildings, such as steadings (Figure 1) has been quite a popular route to securing a more rural lifestyle for a number of years. However, is it also a more sustainable lifestyle? These buildings were never intended for human habitation; cows may well enjoy a centrally heated steading but how many farmers would be of the opinion that the investment would be a good one? In addition, there may be an attendant requirement to conserve aspects of the structure, and from a cultural perspective this is perfectly reasonable. However, it can require the client to find contractors having specialist skills and further reduce the size of the resource pool. If nothing else this can impact on cost; competitive tendering only works if there is real competition. In the absence of competition, the client becomes vulnerable in that the contractor is increasingly able to determine the conditions of engagement.

Figure. 1 A typical steading undergoing conversion.

A final point to clarify is that this study is not concerned with the issue of fuel poverty. It is acknowledged that this issue represents an increasing problem and is particularly problematic in rural areas, given that there may only be a single energy source available (usually oil), but for this particular client fuel poverty was not a motivating issue. There was a desire to reduce energy consumption and also an initial desire to move away from oil as the primary heating fuel. However, the difficulty of comparing fuels and energy sources on the basis of CO2 emissions caused the client to decide that a key objective would be simply to reduce the amount of heating oil used, on the basis that this would result in a reduced level of CO2 production.

Project Overview:

The study is focused on an extension and refurbishment project in northeast Scotland which was completed in 2009. The client had purchased the property (a farmhouse) a number of years previously and freely admitted that the main attraction was its location, particularly the resultant uninterrupted views to the south and east of the property. While the views from the property are outstanding, the dwelling itself is typical of the genre that can be found throughout the region. These farmhouses are of 1.5 storey construction and usually comprise 2-3 bedrooms with dormer windows, a bathroom on the ground floor, kitchen/dining area, sitting/living room, and a central staircase. The walls are of solid construction (stone), usually around 0.60m thick (but this can vary considerably), with the roof being timber boarded and then covered in slate (Figures 2 and 3), and the floors being suspended timber construction. In their original form, there would have been an open fire in each of the main rooms (including bedrooms) but in the majority of cases these will now usually be closed off. This basic layout can be found across many of the former estates and will usually only vary with regard to the scale of the building (being either increased or decreased in overall size, possibly according to the budget originally available). In this case, the farmhouse had been built circa 1900 on one of the formerly large farming estates. Within a radius of approximately 3 miles there are several further examples of this “standard” farmhouse.

Figure 2. An examplar farmhouse (front elevation).

Figure 3. An exemplar farmhouse (rear elevation).

This was the first rural property that the client had lived in, and consequently there was a fairly steep learning curve experienced as the reality of living in this kind of property gradually emerged. It readily became apparent that the property was particularly ‘leaky’ with regard to the ingress of cold air. The true extent of this problem only emerged prior to commencing the refurbishment project when the client had the building pressure tested; the reading was off the scale on the instrument used! This information was a key factor in the client moving their focus away from the initial intention to incorporate energy generation technologies, which would have been used to heat the property, and toward the reduction of ventilation losses along with increasing the insulation level within the structure. Thus the proposed mix of sustainable technologies within the project scope began to change as more information concerning the “behaviour” of the property was gathered.

The client was aware that the property had been refurbished around four years prior to him purchasing it, but the only step this had taken toward making the building work in a more sustainable manner had been the addition of double-glazed windows and storm doors. Some time previous to that refurbishment one of the suspended timber floors had been replaced with a concrete floor. While this undoubtedly reduced ventilation losses, it is unlikely that there was any insulation placed under the concrete, and therefore conduction losses were deemed to inevitably be higher than desired. Other work previously carried out included the “trimming” of ground floor joists that had suffered wet rot.

As the client carried out further research over a period of several months, the scope of the project began to become clearer. This led to a decision that there were, in effect, two projects involved in achieving the desired outcome: a complete refurbishment of the existing original structure; the demolition of later (functional but visually unappealing) additions to the structure and the construction of a new extension that would be integrated visually with the original building. The refurbishment project would be focused on making some minor changes to the internal layout, upgrading some of the facilities available, and improving the performance of the structure in terms of reducing ventilation and thermal losses. In a more contemporary building some aspects of the proposed changes would have been relatively straightforward. However, in a traditional farmhouse building of this period there is, for example, no real loft space and therefore insulation of the roof space becomes particularly difficult to achieve. Likewise, the external walls are of solid construction and there is therefore no cavity to fill with insulation. Alternative approaches have to be considered but these also have to be aware of constraints such as properties being largely reliant upon an oil-fired central heating system (rural Scottish properties typically have no alternative to the use of oil or electric heating systems), as was the case here. A small multi-fuel stove was also available in one room, but this was not deemed capable of heating the whole house to a satisfactory level. The oil-fired boiler was relatively inefficient and some way below the performance of modern A rated boilers. Overall, the property was considered to be cold, draughty and difficult to heat efficiently.

After some initial research had been completed, the client drew up what can be referred to as a "wish-list"; the key objectives for the project and thoughts on appropriate technologies. At this point there was no formal consideration of the implication for the project budget of each of the items listed. However, as the research progressed it became apparent that the wish-list contained several items for which a viable argument could not be produced. One example of this was the desire to incorporate micro-generation of energy using a domestic scale windmill.

The property's location had been identified as a prime site for wind-powered micro-generation (at the highest point of a gradual, uninterrupted slope of approximately 1Km in largely open terrain). The supplying company surveyed the property and determined the most suitable location. Two problems then emerged. Firstly, the local planning authority required that such a windmill be submitted for planning consent. Secondly, a straw-poll of neighbouring owners determined that even such a relatively small windmill would not be regarded as appropriate, possibly to the point of making any such equipped property difficult to sell. Both of these problems were unexpected by the client and caused him to examine other "easier" alternatives.

The use of photovoltaic cells was one alternative considered and was regarded as an "improvement" by neighbouring owners in that such cells are considerably less visible than a windmill. However, the quantity of electricity that could be achieved through use of PV cells was negatively affected after further investigation determined that the property was of the wrong orientation and the most suitable roof areas were largely in a solar 'shadow' for most of the year. Placing the panels in a more favourable location elsewhere on the site was considered until professional advice confirmed that a high voltage drop would result, once more reducing the feasibility of the proposal.

A final technology discounted was heat pumps. Both ground and air source heat pumps were considered and were discounted for different reasons. The air source pump identified after researching the market was relatively expensive at around £3,000. While these pumps have been proven to work effectively even in the lower winter temperatures of Scandinavian countries, the client became increasingly concerned by suggestions within online communities that they were unsuitable for a traditional farmhouse given that it comprises a relatively high number of small spaces. This was a concern because air source heat pumps seemed to be most effective when used in open-plan properties. While this could not be determined to be absolutely the case, there remained sufficient doubt as far as the client was concerned to switch the focus onto larger output ground source heat pumps. By this point, the client had spent approximately 11 months researching the various alternative technologies and revising the objectives for the project as the various real-world constraints became evident. He then decided that final decisions had to be made if the project was ever to reach the implementation phase, and thus a final evaluation was carried out.

Evaluation: The client's initial wish-list had been reduced substantially with regard to the use of sustainable technologies and materials by the point at which detailed design commenced. However, as further information was developed the wish list was to reduce again. This was due to the addition of a number of factors that had not previously been considered. Some of these factors are particularly good examples of five of the seven barriers to home improvement noted in the CLCG report on existing housing and climate change (The Stationery Office, 2008).

Commencing with the *hassle-factor* barrier; this was particularly encountered with regard to the installation of insulation to the external walls (solid walls with no "true" cavity). They do, however, possess what may be regarded as a “partial” cavity in that the lath and plaster wall finish is separated from the stone of the wall by a timber framework. This creates a gap ranging typically between 30 and 60mm. While this is not a particularly large in the context of a cavity, it could be filled with a variety of materials and the client researched several possibilities. Some of the more granular materials could in theory be poured into the cavity. Unfortunately, gaining access to the top of the cavity was not possible without creating an opening in the lath and plaster wall; a difficult task to complete without some risk of damaging the original decorative cornice. Also, the cavity was “open” at the bottom, and any material poured into it would trickle through into the space under the suspended timber floor. At this point the client considered the use of ‘thin film’ insulation materials, largely because of an initial perception of convenience. As he researched this material further it became apparent that there was much conflicting information about its performance with a resulting uncertainty concerning its suitability. This situation can be deemed an example of the *information/knowledge* barrier.

The sole sustainable material that seemed to remain a possibility was sheep-wool insulation. In order to fit the insulation into a vertical cavity, the lath and plaster finish to the walls would have to be removed (Figure 4). This represented a considerable amount of work (the *hassle-factor* barrier)as far as the client was concerned, particularly as it had already been decided that the majority of the work within the refurbishment project would be carried out on a DIY basis, so as to preserve most of the budget for use on the extension project. There was also a conservation consideration involved with regard to the original cornice. A final consideration was that the client remained concerned about the build-up of dampness if the cavity was effectively closed. The combination of all these points led to his decision not to use sheep-wool insulation.

An alternative sustainable material was identified in the form of recycled newspaper insulation. This is considered here in the context of the *trust* barrier in that the problem was, as far as the client was concerned, being unable to trust the guidance supplied by the specialist contractors who would install the material. The low level of trust arose because of the inconsistency in the guidance offered. One of the more experienced installers offered the opinion that he would not use it on his own listed property which shared similar construction details with the client’s property. The authoritative nature of this guidance was enough to convince the client that newspaper insulation should not be used in anything other than an open horizontal situation such as in a loft space. Also, some aspects of the manufacturer’s guidance added to the certainty of the client in this regard (Low Impact, no date). Two items that the client became particularly focused on were the guidance to fluff-up the insulation and try to avoid compression (a concern the client felt in a vertical use of the material), and the need to keep it dry; a potential problem when used in conjunction with relatively cold solid external walls.

After evaluating a range of possibilities the client decided that the optimum compromise was to retain the internal lath and plaster to all vertical walls (excluding the dormer windows and sloping ceilings) and cover with solid insulation boards within a timber framework sized to allow for plasterboards to be overlaid and then skimmed (Figure 5). The thickness of the insulation board varied from 35-100mm depending upon its location within the dwelling. Further insulation was added to the ground-floor suspended timber floors. This was in the form of recycled plastic ‘wool’ placed between the floor joists (Figure 6). In addition to improving the insulation, the client became convinced that this wool had a further benefit in reducing unwanted ventilation (leaks/draughts) through the floor.

The client had, at this stage, a provisional budget of £50,000. While this is not especially a small budget, there was considerable emphasis on seeking to maximise it in terms of the outcomes achieved. This was one of the constraints that worked against the use of ground source heat pumps in the final evaluation of possible technologies, even though they were regarded by the client as the sole remaining significant sustainable technology that could have been incorporated into the project. However, while there are a number of benefits claimed for the technology (of which the client felt reasonably certain), the uncertainty arose around a combination of factors in the implementation of grant criteria and thus can be regarded as an example of the *up-front costs* barrier. The key problems here were the requirements to use accredited installers and to work from a list of accredited pumps. The client determined that even if the maximum grant was achieved, the remaining cost would use up too large a proportion of the budget, and thus ground source heat pumps were rejected.

Having decided against both air and ground source heat pumps as sustainable technologies for heating the property, the client was directed toward the use of wood-pellet stoves. These stoves are capable of running full central heating systems and can achieve high levels of efficiency. However, from the client's perspective they were regarded as an example of the *technological immaturity* barrier, primarily due to the perceived immaturity of the supply infrastructure for the required wood pellet fuel, along with some very specific production and storage requirements (Stove Experience, no date). These, combined with the cost of the larger and more efficient systems, along with concerns expressed by some online communities of the validity of processing one fuel (wood logs) into a second, more specialist fuel (wood pellets), were enough to convince the client that this technology was not sufficiently mature as to merit the investment required for its inclusion in the project.

Contractor Selection: Having narrowed down the list of possible technologies for inclusion in the project, the client then moved to the problem of identifying possible contractors to carry out the work not scheduled for completion on a DIY basis.

Given that the property is located in a rural area, with the nearest reasonably-sized town approximately 20 miles away, the client was concerned that there would not be a sufficiently large pool of contractors to create a level of competition regarding quotations for the various packages of work comprising the project. A search through a number of sources (Yellow Pages, Google, etc.) produced a list of 82 possible contractors within a 20 mile radius of the property. However, the client soon realised that the topography around the property was not working in its favour with regard to indicated travel times. The property is located in a hilly region with few reasonably sized roads; the majority of roads are little more than single-track carriageways and tend to follow meandering routes along contour lines. By eliminating those contractors with an indicated travel time from their address to the property greater than 1.5 hours (each way), the list was reduced to 39 contractors.

The client then proceeded to determine the suitability of the remaining companies on the list. After discounting surveying and architecture practices, builder's merchants and plant-hire companies (on the basis that they did not undertake actual construction work) the list was further reduced to 28; 34% of the original list. The remaining 28 were further examined in terms of any specialisms, in that the client was ideally looking for contractors capable of dealing with several functional specialisms. 12 contractors were identified as being single-specialism builders (slaters, electricians, and so on), thus leaving only 16 “general” contractors that were available to the client. Of these, only 3 took the opportunity to tender for the work on offer. One of these provided a price that was 49% higher than the next highest price and immediately ruled that contractor out as the price exceeded the budget available by a considerable margin. The next cheapest contractor was found not to be available for at least another 7 months, and thus the client was effectively left with the cheapest contractor. However, going with the cheapest price is not always the most effective way of getting the job done.

Project Performance: After engaging the contractor and commencing work on the extension project, the client encountered examples of the contractor exhibiting what may be referred to as skill poverty; the absence of specific skills required for certain tasks. This problem has been identified in a wider sense by reports such as the Low Carbon Construction Innovation and Growth Team’s report (LCCIGT, 2010) where the gaps in low carbon skills provision within the construction industry are outlined. One example of skill poverty/skill gap became apparent in connection with what should have been the most straight-forward sustainable technology remaining in this part of the overall project; a solar tube.

While some sustainable technologies, such as the installation of photovoltaics, have specific recognised competences linked to them, such as are identified in the documentation for the Micro-generation installer scheme (MCS, no date), solar tubes are generally regarded as being installable by a competent DIY enthusiast and therefore should not present a problem to an experienced general contractor. None the less, this particular contractor made mistakes that resulted in delays to the project while replacement and additional parts were purchased and delivered. One of the parts had to be sourced from America and took several weeks to arrive.

The contractor acknowledged prior to commencing the installation that they had no previous experience with this kind of technology. While this caused the client some concern, all the information available from the manufacturer and various ‘how-to-do-it’ videos on YouTube, provided reassurance in the form of the assertion that such tubes are quite straightforward to install, and thus the client allowed the contractor to proceed.

Conclusion: The extent of sustainable technologies actually incorporated by the client varied in certain respects from the original wish-list. Those items that remained were the creation of more space, reduced ventilation losses, free solar energy for space heating, more efficient appliances, and increased insulation. All of these achieved objectives have made an impact on the running costs of the property, and have created a living space that is both more practicable and enjoyable in terms of comfort and aesthetics.

The impact of solar gain, achieved through the inclusion of a glazed (including the roof) conservatory, has been noticeable throughout the year. On any reasonably clear and sunny day, the conservatory heats up quite quickly and can achieve temperatures of 28 ^{o}C during the winter months. During the summer months, temperatures of over 40 ^{o}C have been recorded. This has been particularly beneficial during the summer months in that by opening the doors into the main house, heat can be “convected” throughout the house and the heating system rarely has to be used. Given the location of the property the client is in no doubt that designing in a solar gain element to the extension project resulted in a more worthwhile contribution than would have been achieved by covering the same area with photovoltaics.

The purchase of new, more efficient appliances has reduced the use of water and the amount of energy used. The most significant impact achieved resulted from the purchase of an A rated oil-boiler. While this was a relatively expensive purchase, it was a straight-forward technology to incorporate and did not suffer from the constraints of either contractor availability or skill poverty (in that there is extensive use of oil-boilers in this region of Scotland and therefore it is essentially a "known" technology). In combination with the increased insulation and decreased ventilation leakage, there has been a reduction of approximately one third in the quantity of oil used. Given that the property has also increased in volume, the overall impact is greater than indicated simply by the decreased use of oil.

Over the duration of the project the client became increasingly aware of the impact of the DIY element. This was initially in terms of the positive impact on the budget, allowing more work to be carried out than would have been possible if all the work had been contracted out. A particular example of this was the addition of insulation to the walls of the property and under the suspended timber floors. This work, when priced by the contractor was considerably more expensive than when carried out largely on a DIY basis (other than the plastering of the insulated and sheeted walls) by the client. The client was able to use the budget savings to carry out more insulation work than initially intended and also to purchase materials for use elsewhere in the project.

A further value was in dealing with some of the problems flowing from the low level of contractor availability and, to a lesser extent, contractor skill poverty. While this was no doubt an advantage, it has to be acknowledged that it was entirely dependent upon the client being fortunate in possessing a suitable level of DIY ability, and also being able to make the time available to apply it. A further point that is important to note is that the client was suitably cautious in exercising this ability and did not undertake to carry out work which was either proscribed (in the form of requiring certified individuals) or outwith his experience. This factor in the completion of the project can be interpreted as indicating the degree to which SME contractors are leaving gaps in provision, particularly with regard to work that may be described as being "main stream" in sustainable technology terms. There appears to be a gap in the market in rural locations that is not being filled by SMEs. While this may be regarded as a possible opportunity that SMEs have chosen to ignore (on the basis that they have sufficient work anyway), the more problematic aspect of the situation is that it can also be regarded as evidence of slowing down the adoption of sustainable technologies by anyone who is either not fortunate enough to be within the catchment area of an appropriate SME, or is insufficiently DIY capable to carry out the work themselves.

A further consideration in the contractor versus DIY decision relates to the impact of VAT on the work carried out. At present clients are operating in an environment where a DIY approach will result in more VAT being incurred than if a contractor was engaged (assuming of course that one is actually available) in that professionally installed energy-saving materials attract a 5% VAT rate. In effect, the client who cannot engage a professional installer is further de-motivated from the adoption of quite basic sustainable technologies by the fact that they will have to pay a higher rate of VAT (HBS Solarwarm, No date).

The work carried out in order to complete both the refurbishment and the extension projects has had negative and positive impacts from the client's perspective. Positive impacts include the reduction in running costs, particularly the reduced quantity of heating-oil used, which has resulted in the determination of payback times for some of the technologies involved that are shorter than initially calculated.

The work undertaken to reduce the extent of "leakage" into and out of the property has ensured a more comfortable living environment in that the living spaces do not feel as cold. Draughts can be one of the most disconcerting aspects of living in any space and the reduction of them is a factoring improving the quality of life. While there was no intention within the two projects to achieve anything close to Passive Haus standards of draught-proofing, there has been a significant reduction and this has allowed other technologies to make more of an impact. In addition, the property has increased in usable volume and floor space. While this makes for a more practicable habitat, some components of the additional space have incorporated sustainable "design", as evidenced by the solar gain considerations in the positioning of the conservatory.

A final positive impact has been the increase in the value of the property. Even within the context of the current depressed housing market, the work added approximately 28% to the value of the property and covered the combined cost of the projects.

On the 'negative' side of the scales, the client is in no doubt that the most significant negative was the amount of stress involved in managing the "main" contractor along with a mix of various specialist SMEs. The overall project can be considered as a classic example of a contractor being aware of their strong bargaining position and using it to the detriment of the client.

Probably the most disappointing aspect of the project from the client's perspective is that it was not possible to incorporate the variety of sustainable technologies that had initially been considered. Increased adoption of sustainable technologies will only be possible if the kinds of problems encountered in this case are addressed, particularly by SME contractors.

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Figures

Figure 1.

Figure 2.

Figure 3.

Figure 4. Solid external wall with internal lath and plaster removed.

Figure 5. Use of insulation board internally.

Figure 6. Addition of insulation to suspended timber floor.