MILESTONE EIGHT
THE FOLLOW UP AUDIT

WREN
&
BELL

CONTENTS

1 THE PROJECT

The project set out to try something different, to build a building that was sustainable, practical and purchasable. Three or four years ago when the project was first conceived, Sustainable housing was almost unknown by the general public. Green issues were firmly on the map (CFC's were being banned and global climate change was high on the agenda) but the housing sector was largely unaffected. This project was a first for Scotland, in that it was trying to use the backbone of conventional building practices to create a sustainable building that people could afford to buy and afford to live in.

Four years later, the building is now complete and people have started to move in. From both the outside and the inside it will be hard for them to see too many radical design changes. Sustainable housing has become far more common in the space of this development but the issue of extra cost has been addressed by few, with BRE's ecohouse costing 3 times the conventional price of an ordinary building.

This report highlights the issues that have not worked out as planned and should not be viewed in isolation. Other reports will show the work that has gone into the project and successes. It is hoped that this report may be used so that others may learn from the mistakes that were made or the changes that would have made the project better.

The project was ambitious as it sought to prove sustainable construction need not "cost the earth" setting out its plans as follows.

> *"Sustainability has recently become a political catch phrase and is in some danger of growing into a meaningless cliché. However, it is self-evident that practices which are not sustainable cannot be sustained, and must therefore change or cease. This is equally true for any kind of sustainability, whether economic, environmental or something quite different. Some practices of the construction industry fall into the category of unsustainable in economic terms: flats are no longer built out of solid stone because no-one would pay the price on completion. Other practices are similarly unsustainable from an environmental point of view: the use of certain tropical hardwoods is now plainly unacceptable.*
>
> *Some construction practices may not be so clear cut. People are prepared to pay for a certain additional level of build quality and similarly, the environment can cope with a certain amount of pollution. In these areas, a certain amount of subjective judgement is required. In economic terms, accountancy has been developed to assist with this judgement and this technique has been common now for several centuries. In environmental terms, the equivalent life cycle analysis (LCA) has become a useable tool only in the last few years. Part of the reason that environmental issues have not been treated as seriously as economic issues in the past is simply because it was not possible to account for them. It is now possible to get a clearer idea of the relative environmental costs of various activities and to make an informed decision on that basis.*
>
> *The Comely Green Sustainable Housing Project is the first major sustainable housing project in Scotland to use these techniques to find a better way of building the kind of houses that people want to live in.*

Too often, shiny new projects are launched which proclaim their adoption of sustainable principles, then wind up with a cosmetic "green" finish in an attempt to cover a lack of any real substance. This may be a result of the way in which environmental projects are usually financed; in effect, whoever can provide the greenest project for the least money wins the prize. This approach inevitably leads to the promotion of trivial issues at the expense of those which may be more prosaic but which are also more effective.

This programme is a collaborative effort undertaken by Link Homes, Hart Builders, Norman Gray & Partners Architects and Wren & Bell Civil, Structural and Environmental Consultants. The aim of the programme is to build a block of traditional timber-frame tenement flats, much the same as those being built all over the country on a daily basis. The difference is that Comely Green will be built to have the lowest practicable environmental impact throughout the lifetime of the development. This will require the life cycle environmental aspects of every major component and activity to be considered during design, construction and use.

The lessons learned from this programme will be of enormous value to future developments, since Comely Green is not a high-flying architectural extravaganza but a normal housing development being built in a better way."

The project is now complete and tenants are moving into their new houses. The question is put forward, has this project succeeded in producing a building that is sustainable?

2 MATERIALS AND DESIGN

2.1 The Original Materials and Design

A detailed report has previously been written on the materials selected and the reasons behind the decisions. This was published to the web to encourage debate and allow others access to the research carried out. The background to this work is shown in the extract from the final material report.

> *"In addition to research undertaken independently by Wren & Bell, the Project has been managed largely through the forum of the design team meetings, which have routinely been attended by the following parties:*
>
> - *Link Housing Association*
> - *Hart Builders*
> - *Wren & Bell Structural, Civil and Environmental Consultants*
> - *Norman Gray & Partners, Architects*
> - *Pottie Wilson Partnership, Quantity Surveyors*
>
> *This forum has encouraged the active participation of all members of the design team in discussions regarding material choice. This participation has proved essential for the correct specification of many materials. For example, a cheap material that has excellent environmental performance may be inappropriate for operational reasons that might not occur to an environmental scientist and conversely, materials that are routinely used in construction may have environmental issues that would not have occurred to other members of the design team. In these situations the forum has proved essential but it has also been useful in situations where there is a delicate trade-off between the three criteria, as in these situations it is vital for all points of view to be aired, so that the best overall option can be chosen.*
>
> *The discussions have been largely based on background research and life cycle assessment undertaken by Wren & Bell to provide an unbiased comparison of environmental impacts of materials during raw material extraction, manufacture, use and re-cycling or disposal. In essence, this choice has depended on the performance of rival materials in environmental, operational and financial terms. The main principle of the project has always been to minimise the environmental impact of the development over its design life. Secondary to this principle is that the decision-making process should be easily understandable, to remove as far as possible the barriers that might prevent a non-technical team from building another more sustainable development. Observing these principles requires a sensible trade-off of sometimes contradictory considerations for each material, while at the same time ensuring that the reasons for each decision are clearly stated.*
>
> *An early decision in the project was to extend the design life of the building from the usual 60 years to 100 years. There are arguments for and against this decision, which will be discussed at greater length elsewhere. However, for the purposes of this document, the decision had a profound knock-on effect on the selection of materials, since some inaccessible items like roofing had to have an extended working life, as replacing them would be impractical.*

We do not expect everyone to agree with our interpretation of the available information but we do aim to show all the assumptions and decisions we have made, so that disagreement need not proceed from a position of ignorance. We hope that this approach will help to advance the practice of sustainable building and welcome discussion from any interested party."

2.2 The Actual Design and Material

A gap between the go ahead for the project and the start of the construction meant that the research had dated by almost 12months in which time a number of new products had come onto the market and also views on certain issues had either hardened or changed. Overall, the majority of the materials specified and issues raised had not shifted before the build began.

2.2.1 Material Issues

Prior to the start of the construction a number of talks were held to promote the concept of sustainable construction, and also, should people have wanted to, for issues concerning the panels selection of materials to be voiced, but none were. The use of PVC was mentioned during these meetings but the outcome was generally to further vilify the substance. The PVC argument has intensified since, partly due to Green Peace actively targeting the PVC sector and referring to it as the bad boy of the plastic industry. The industry has only recently started to fight back, realising that its image has been hit hard by this attack.

If the panel were to sit again to decide whether or not to use PVC it would be more likely that PVC would be completely eliminated because alternatives are more freely available and the issues surrounding the argument have been publicised so much.

2.2.2 Material Specification

The use of reconstituted slates were selected as opposed to the use of old slates partly to highlight them as a possibility and partly because this was the reuse of a waste product. The original material specifications that were provided on the slates showed that over 65% of the material within the slates was slate dust. Sadly the slates were on the roof before Harts were informed that the slates that they had actually been supplied with contained less than 50% slate dust. In the period between selecting materials and the construction phase starting a new

product came onto the market which contained in excess of 80% slate dust which would have been the preferred choice. The number of new and improved sustainable products that have reached the market place in recent years has increased rapidly. Many of these are standard products with a "green edge", however a number are truly sustainable products.

Plasterboard is manufactured from the by-products of flu-gas de-sulphurisation, and has been for a number of years, however it is only in recent years that this has been highlighted. Block manufacturers are increasingly highlighting the use of recycled materials but can often contain as little as 5% recycled material. Products that are seen to have just "green edges" are frowned on by many but the important issue is that this is a step in the right direction. A lot of time was spent by the team researching the materials for this construction project. At the time the knowledge of many suppliers as to the environmental impact of their materials was limited. Most manufacturers are able to supply detailed information but those reading this information are strongly advised to check wording as "high recycled quotient" with the slates for this project turned out to be less than 50% due to changes in their manufacturing processes.

2.2.3 Material Use

Most of the building techniques used at Comely Green are identical to those that would be involved in a standard build. This was intentional as this would prevent the build time being extended for training and also reduce barriers to acceptance by other developers. The one process that slowed the construction down considerably was the fitting of the cellulose insulation.

As is mentioned in previous reports, the entire building had to be thoroughly swept before the insulation could be fitted. This is required because the insulation is sprayed onto the walls and then excess material is trimmed off. To reduce wastage the excess material that has been trimmed off is then swept up and re-used but this may only be done once or the material gets too wet and will not adhere to surfaces properly. If the floors had not been previously swept, nails and similar would enter the machinery and cause damage. During this period the entire area of the site was required to be cleared of personnel due to of the high levels of dust resulting in all other work being brought to a stand still for extended periods. When insulation such as rock wool is fitted none of the above problems are encountered allowing two or three different trades to work together unhindered.

We mentioned our concerns to the insulation manufacturers and it would appear that we were not the only company to do so. Still in development but already experimented with in a number of buildings is a new pressure method of cellulose insulation filling. This requires an extra layer of wood to be put in place to create a hollow box into which the cellulose is pumped at pressure. This creates a number of benefits for the user not least the fact that other work can continue while this work goes on. This process also creates a gap between the wall insulation and the plasterboard which can be utilised for the utilities, which prevents insulation being moved or compressed something that often occurs during the fitting of these. Waste is also reduced as the need to sweep up is eliminated completely which previously had to be swept up and resprayed.

This issue highlights how young the sustainable construction industry is. New practices and materials are coming on the market not all of which have been fully tested or appraised for all

circumstances and it is essential that comments and criticisms (or praise) is fed back to the appropriate persons.

2.2.4 Material Over-Specification

It was decided that a condensing combi-boiler should be fitted to all the flats after the proposal of fitting a community CHP plant was stopped because of billing issues. The boilers that were purchased were the smallest condensing boiler on the market at the time however they take up a very large space within each kitchen area. The chosen size of the condensing boiler provides both heat and water, way in excess of each flat's requirements and therefore the extra efficiencies gained by the combined unit is lost by the fact that it will not be operating at its optimal efficiency. With a SAP rating of 95+ the flats should have minimal requirements for heating and therefore each flat should only require a boiler for the water.

The desire to have the most energy efficient materials and products used resulted in this overspecification. It will be interesting to see how much the residents of the new flats use the heating provided by the condensing boilers. In theory they should require only rarely to use them as the house should maintain adequate ventilation and heat from appliances and residents however it is likely that some will open windows and heat the house thus negating all the work that has been done.

2.2.5 Variable Specifications

The original specifications that were agreed with Harts stated that a low flow shower should be fitted in each flat. The showers that were eventually fitted did have a low flow (5 l/min) setting however they also had the potential to have a very high flow (18 l/min). It is human nature to turn the power on the shower up and so the shower will most likely be used on a high water flow setting. Mira sold the shower as a "low flow" however it is unlikely that this will save any water.

3 CONSTRUCTION PHASE

It was agreed by all that a disproportionate amount of environmental damage would be caused at the construction phase and therefore this area should be targeted for waste minimisation. Various projects were set in place that were designed to minimise the waste of materials through better storage or handling and also to encourage material re-use.

3.1 The Original Work plan

The original work plan for the site was to have had a wood skip permanently as well as a general waste skip. The waste that was produced was to be monitored by the site agent identifying the type of materials being discarded. On site special storage areas were to be created for goods in to minimise possible waste and any materials that had the possibility for re-use to be stored separately and re-used when a use was found. Metering was going to allow for the monitoring of utilities on the site and these figures were hopefully to be compared with a similar project.

3.2 The Real Work Issues

It is in this section that the project has produced the least hard data. The level of data available from Harts is limited by the fact that the majority of the work on site was carried out by sub-contractors (almost 80%). This has meant that we are unable to monitor the utilities usage on the site and also made the training of all staff on environmental issues almost impossible. The site agent had to balance between the environmental pressures and the economic pressures that he was placed under by this project. As a result a number of issues arose through this apparent conflict of interests. (The level of information obtained has been a major disappointment to Wren & Bell and the information that has been obtained points to a project that was only slightly better than an equivalent.)

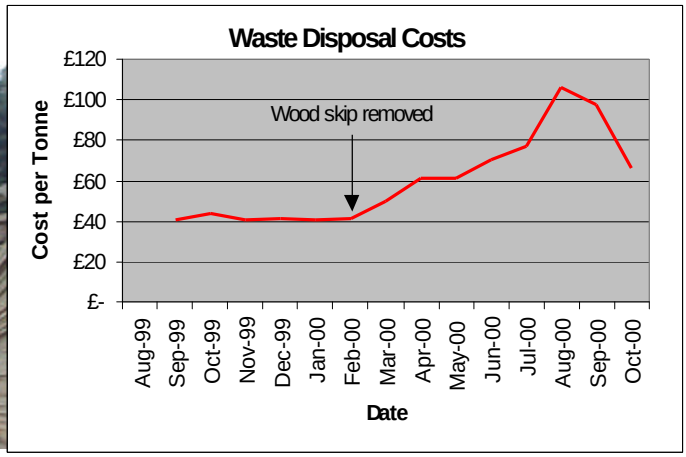
3.2.1 Storage and Disposal

A storage and disposal plan was compiled by Wren & Bell for the site manager to allow him to utilise the limited space to the maximum. This worked well initially but with rapidly decreasing space available storage space decreased. The time involved in maintaining a tidy, methodical storage area was financially offset by the cost of loss of materials or damage. Storage of materials did become slightly haphazard as space became more restricted and materials were often seen to be stored directly on the muddy ground. Most of the problems had been foreseen in the initial report however a solution to the problem was not found


Poor Material Storage

3.2.2 The Wood Skip

The wood skip was supposed to be on site for the duration of the project but was only on until February 1999. The site manager decided that it was no longer space for it even though he now had increased the number of general skips to two. This was not as major an issue as it



would first appear as the majority of the timber frame had been completed and therefore the majority of the waste wood (though by no means all) had been produced. The wood skips when on site collected around 36 tonnes of wood saving Harts around £1,500. Following the removal of the wood skip from the site, the cost per tonne of waste can be seen to rise rapidly from around £40 per tonne to £60. This rise is attributed to an increase in light weight materials being placed in the skips which results in the cost of the uplifting having a greater influence than the costs associated with weight. It is possible that the light weight material is wood, and therefore the savings if the cost per skip had maintained at £40 per tonne would have been around £6,000 greater.

The use of a wood skip on a site such as this is economically advantageous to the developer as they save £60 per skip. Harts have, since this work, put wood skips onto all its sites in an attempt to cut costs and to encourage those on site to recycle give £20 of the saving directly to the workers on the site.

3.2.3 Re-use of Cut-offs

Cut-offs were planned to be stored for re-use during the development. It was quickly seen that all the joiners already practice this and therefore it was unnecessary for this to be encouraged. When they did move from one building to the next they did abandon a considerable amount of cut timber however the time required to move all this round to the next work area would have made it uneconomic.

3.2.4 Site Aesthetics

City centre sites are always going to be challenged by a lack of space and this one was no exception. The general housekeeping of the site has to be questioned at various points in the latter stages of the project at a time when the site should have been becoming cleaner and tidier.

4 SUSTAINABLE CONSTRUCTION

Overall, it is unlikely that anyone would challenge that the building is a success. Sustainable housing has been built for only a 4% increase in costs which is a fraction the cost generally associated with this type of development. For those who move into the properties, it is hoped, they will benefit from reduced costs of living both in the short and long term. The building stands out, not because of its looks, but because of the materials it has used in its construction. Even so, the design is by no means a radical one and could easily be copied by any developer.

The failure of certain aspects of this project is seen as a disappointment but the majority of the ideas and practices are a success. In the competitive building market, ideas will only be accepted if they have an economic benefit or at least have no economic cost. With workers costing so much more than materials, waste minimisation is going to be a lower priority than finishing the project. The general public is becoming more aware of the damage to the world around us and people now are willing to pay a small premium for environmentally friendly goods. If the demand for the flats at Comely Green is to be taken as a willingness to embrace sustainable building practices then a market definitely exists for this type of building.

At the same time as Comely Green was being built, a similar project was being developed at Gorgie Park on the other side of Edinburgh. Though similar in size the Gorgie Road Project has cost around £66,000 per flat to develop compared to the £47,000 for the Comely Green project with both projects being constructed under the pretext of sustainable construction yet differing considerably in the driving force behind them. Those involved in the development at Gorgie Park have described the development as an "ideological" sustainable building and the development is ecologically faultless. With each flat costing almost £20,000 more than the Comely Green project it is difficult to see how this project has examined the social or economic aspects. Similarily, BRE has recently developed a project that epitomises everything that is environmentally sound in the building sector currently. It is however being shown to the world as a sustainable housing project, which it is clearly not. Economics and Social considerations should have an equal weighting to Environmental ones, which cannot be the case with a project that had a build cost in excess of £180,000 for a three bedroom house.

Sustainable construction has for too long been the construction of buildings that are too expensive for the masses. One off constructions such as the one by BRE show a possible solution but are buildings that are environmentally friendly construction not sustainable. It is important that the three aspects of sustainability are examined and not just the green one. Economics has to be considered as an equal to the social and the environmental aspects to move sustainable construction into the mainstream. Sustainable Construction is a common sense step forward for the construction sector and developments such as Comely Green which are no cost / low cost examples should be highlighted to all.