

International Conference on Ecological Structure
July 2001 Marin County USA

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Prioritising Ecological Building Actions: Re-using Existing Buildings and Zero Impact Materials.
Experience of Eco-Renovation and Hemp building.

The principle concern of this paper is that too much attention is paid to the question of designing new buildings at the expense of the existing building stock. Far less attention is paid to the issue of re-using, renovating, converting and conserving existing buildings. The continued energy wastage and carbon emissions from existing buildings far outweigh the tiny savings achieved in new 'green' buildings. However there is also a potential synergy between the worlds of green building and historic building conservation as quite a few ecological methods have been learnt from traditional vernacular building techniques and materials. The traditional uses of lime, thatch, straw, hemp and earth have been adapted in innovative ways but insufficient work is devoted to how ecological techniques can be applied to existing buildings.

Our work in the UK and on the island of Ireland involves trying to balance the importance of re-invigorating existing buildings as well as exploring methods like strawbale and hemp building. This has grown out of an analysis of the environmental damage caused by most conventional building materials and products, detailed in the Green Building Handbook (1)

We are looking for ways of creating durable zero emission buildings made from renewable materials but also ways of re-using existing structures in a sustainable way. It is suggested that while hemp building has a lot of potential for new building, it could also have a very valuable role in working with existing buildings. Finally this paper outlines other work we are involved in to promote the idea of ecological building.

The Existing Building Stock

Statistics vary but, in most developed countries, the existing building stock accounts for more than 50% of carbon emissions. Ranging from the smallest house to large office buildings, shops and factories, heating or cooling energy is wasted on heating the surrounding air. The 'energy crisis' involves producing more and more energy, whether from fossil fuels or renewables, to meet this increasing and guzzling demand. In addition to this the economists see new construction as a sign of a healthy growing economy. The Irish tiger economy led to a shortage of cranes in Dublin, new quarries and cement factories have been opened up to meet the voracious demands of the construction industry. We are told by Government that as many as half a million new homes are required in the Dublin commuter belt and a further quarter of a million around Belfast.

All this new development leads to further wastage of energy with more cars on the roads and new infrastructure to provide facilities in the new areas. Yet at the same time there are hundreds of thousands of empty, dilapidated and underused buildings. Many of these are demolished, not because they are unsatisfactory as structures but because of changes in fashion and the demand for newness. In most UK and Irish cities, apartments over shops are left unlet, old factories and mills are abandoned and sub standard social housing schemes are demolished rather than being upgraded. Similar problems can be found throughout Europe.

Much of the existing built stock requires refurbishment, particularly to reduce energy usage and to improve indoor air quality. It is not always easy to achieve better standards and some research and ingenuity is required. Governments have provided small insulation grants for old people in an effort to relieve 'fuel poverty' (2) but there has been little monitoring of the effectiveness of such measures. A far more vigorous programme of upgrading is required but the literature on how to do this in an ecological way is surprisingly rare. (3) In the UK the Blair Government is more concerned with creating *more* energy than saving it by massive programmes of off shore wind farms (owned by multi national power companies) and power generation incinerators to dispose of unsorted waste. Sustainable building and regeneration is still a low priority in terms of Government policy.

While quite a lot of resources are devoted to repairing and refurbishing existing buildings, this rarely follows ecological principles. Often interiors are stripped out and sent to landfill. Toxic chemicals and inappropriate methods are used to deal with dampness and timber decay even though non-toxic and non-destructive methods are available. Concrete and cement is often used in preference to lime. There can be a conflict between the need to meet modern standards of energy efficiency and the requirements of conservation and planning authorities that want to retain single glazing and not allow extra insulation. It can be difficult to achieve better standards of energy efficiency, to avoid air leakage and cold bridging in renovating old buildings but a willingness to tackle these problems can lead to Eco solutions.

In our own house in County Down we have not achieved the levels of energy efficiency that we would have liked, though we were fortunate that our building was not 'listed' and we did not have to be so precious about existing features. However we have been able to create a large house with substantially less new materials than would have been required in a new building of the same size. We were able to use many materials from the site, others were locally obtained and some were recycled out of other buildings. Unfortunately there is a problem with recycled materials in that the growing demand for architectural salvage, to feed the fake heritage industry, is leading to the demolition of many satisfactory buildings.(4)

Sadly in Northern Ireland in particular, many old buildings and houses fall prey to the bulldozer. Grants, planning and tax policies encourage people to build new and countless millions of tonnes of demolition materials and their associated embodied energy end up as hard core or landfill. Hundreds of beautiful buildings were listed each year in the Ulster Architectural Heritage Society catalogue of 'Buildings at Risk' (5). The vernacular and industrial heritage of Ireland is being lost at a rapid rate and developers demolish even listed buildings, as the fines they incur are little more than out of pocket expenses.

At Queens University in 2000 a project carried out by 5th year architecture students on the sustainable building elective, examined the possibilities for Eco-renovation of an old cottage in the Mourne Mountains. Currently such historic renovation and tourism projects largely ignore green issues but the students demonstrated how a whole range of Eco technologies could be incorporated. Their work won first prize in the International Design Resource Awards competition.(6)

In 2002 we hope to challenge a multi national spinning and weaving company which wants to demolish a whole complex of mill buildings outside Belfast simply because they no longer have a use for them. Even where old industrial buildings are being renovated like in the centre of Manchester where 'loft' living has become trendy, a few miles away, huge areas of Victorian low rise housing in Salford are about to be comprehensively cleared. As this paper is being written, plans to demolish the innovative Brynmawr Dunlop factory have become headline news in the UK not just because of its engineering importance as a pioneering concrete shell construction, but because local people recognise the huge waste of resources involved.

There is much popular support for the demolition of 1960s and 70s social housing estates where substandard pre-cast concrete tower blocks have created misery for many people, but even these structures can be re-used. Once blown up, the crushing and re-use of concrete for aggregate, while marketed as an environmental solution is far more wasteful than renovating these buildings. While there are many good examples of the creative re-use of existing buildings (7) these are the exception rather than the rule. Growing emphasis on the importance of life cycle analysis, the flexibility and 'dismantleability' of buildings are very important in sustainable thinking as all buildings change throughout their life. (8)

Over production and consumption of building materials

Various Government figures suggested that in the UK every man woman and child consumes over 12 tonnes of building materials per annum...the bulk being in cement, sand and aggregates. This growth in the use of building materials is generally seen as good for the economy but it means more use of petrochemicals and energy, more holes in the ground, forests cut down and high transportation costs. Even many so-called green buildings contribute to this over use of resources. On a global scale, Rees has argued that our ecological footprint is already larger than that of the earth. He says that we have to reduce the intensity of consumption in industrialised countries by a factor of ten in order to cope with the growth in less developed countries. (9)

There is an important debate to be had about whether buildings are really green if, by and large, they are made from concrete, steel, aluminium and other high embodied energy, high resource use materials, even if they are little more energy efficient or adopt some bio-climatic design principles. At Green Building Challenge 2000 it was hard to see how some of the best practice examples could really be called green. (10)

Despite the proliferation of environmental assessment methodologies and Government policies on sustainable building, there is no clear consensus on how far we need to go with building designs to make a genuine contribution to the well being of the planet. The Sustainable Building 2000 Conference in Maastricht was sponsored by Rockwool, but no one asked the question whether Rockwool was a sustainable material or not! Niklaus Kohler has raised these issues and questioned the use of the term 'green building.' He argues for the concept of ecological sustainability, based on protection of resources and the Eco system. (11)

One response to this issue is to create new buildings from fully renewable materials and to re-use what we already have more efficiently. This will require a huge change in cultural and industrial attitudes. Set in this context, the efficient use of our existing built resources becomes even more important.

In order to measure and justify building activity, it will be necessary to have some simple methodology than can be understood by professionals and clients. Current environmental assessment and LCA methodologies are far too complicated and assumptions can easily be adjusted to give the required answer, as there are no genuine international benchmarks.

Lothar Meyer, chairman of the German Schumacher Society, has put forward a model for tying the use of natural resources to a limited CO2 budget. The 'CO2 economy' would come with a built in operational and verifiable standard of sustainability

"...A simple CO2 index summarising the environmental impact of products would serve as a useful guide and incentive..... a CO2 quota would have the advantage of saving the individual from all the negative emotions that environmentally conscious people experience in their consumer choices." (12)

But in addition to devising a way to do the sustainable sums, these issues cannot be purely related to mathematical formulae. Frequently the ethical dimension is ignored and discussions at sustainable

building meetings take place in an artificial 'value free' environment dominated by discussion of technocratic solutions. (13) Finding an approach to discuss questions of social and political responsibility are as important as finding a simple formula for CO2 labelling. This will not always be an easy process if we are concerned to get ecological ideas accepted into a mainstream construction industry dominated by purely profit driven multi national companies. Such global business interests can now operate independently of democratic government control so even legislation and building standards can be a weak tool in enforcing ecological standards. (14)

There is a potentially fascinating PhD topic on the way in which multi-national vested interests are currently manipulating Governments in the setting of green and sustainable building policies. While the European parliament has voted to ban uPVC for instance, few people in the construction industry see any end to the use of uPVC for many years to come because of vested interests. As innovative technologies become main stream, the patents and manufacturing are being bought up by larger conglomerates. At the moment we only have anecdotal evidence of this, but it holds dangers for the development of sustainable products. There are parallels in the way the organic food industry has developed. We have been successful at Queens University in obtaining limited funds for a research project into the opportunities and barriers for the increased uptake of ecological materials and will be working over the coming years with about a dozen small and medium enterprises that are trying to get a foothold in the market and learning from their experiences.

We are also working with Richard Douthwaite, author of "Short circuit" and "The Growth Illusion"(15) to examine and test models of sustainable development and to see how these might be applied in Ireland to challenge current damaging development practice. We have even been offered a site for a sustainable new town but we have to start by questioning such a concept! Plans are in train for an international summer school in 2002 to take this project forward.

Zero emission materials

On the assumption that re-using existing buildings will give a much better CO2 score, the complimentary step is to seek ways of building that use only renewable resources and thus come near to having a zero emission impact. This drew us initially to looking at strawbale building and then hemp. While strawbale has caught on as an idea in England and Ireland, it has largely been adopted by enthusiastic amateur self-builders and few projects have gone through the regulatory processes. Much of the design and detailing and construction quality has been of questionable standard, leading to a few disasters and potential failures. Tainted by an unprofessional image, we have begun to look for a natural material which can more readily be adopted by main stream construction and where higher standards of quality control can more easily be achieved. Strawbale building still has a future in the British Isles but needs to grow up first. However it at least has the advantage that it can't be hi-jacked by multi nationals!

We have moved onto hemp as a renewable agricultural crop which can be used in building.

Hemp is attractive because it provides a potentially more lucrative crop for farmers. Straw is often in short supply and is widely used by the mushroom industry and increasingly as a bio-fuel whereas hemp offers a cash crop with a range of end added value uses. The fibre can be turned into cloth or used for paper manufacture. A number of EU funded projects are in progress to develop this and we have begun research to see how the hurd or core of the plant, which is left over, can be used in building.

Perhaps because of its association with Marijuana, hemp attracts an almost cult like following and much of the literature on hemp sees it as an answer to all the world's problems! Already we have instant experts in Ireland claiming that hemp building is the answer to all ecological aims, even though not a single hemp building has been constructed here. Meanwhile we are trying to distance ourselves from the hype and

embark on a careful three-year programme to try out the various applications and establish how well they work. This work is at an early stage and it is not possible to present technical results yet.

Hemp building has been successfully developed in France but has not been widely accepted, even within the hemp industry. Several companies in France have developed methods of combining a mixture of hemp and lime cast around a lightweight timber frame. Walls of two storeys can easily be built giving a standard of insulation acceptable within current building regulations. While a solid hemp-lime wall does not give very high levels of insulation, it does provide a breathing structure which absorbs and emits moisture very successfully. It is also very warm to the touch with a high surface temperature once rendered with lime sand; the wall can look like a conventional masonry structure.

It is labour intensive in construction, but can be used by self-builders. It appears to have the potential for a long life and lack of deterioration. One French company has invented a secret process for 'mineralising' the hemp hurds and claim that untreated hemp will deteriorate, however two test blocks made from untreated hemp, that we have left outside in the rain, show no sign of deterioration after several months. We are working with two groups of farmers growing hemp in Ireland and the Northern Ireland Agricultural Research Institute, to carry out a pilot project, with two demonstration .We will be in a better position to report on the technical performance in a couple of years time. We plan to investigate further work done in Canada on mixing the hemp with earth rather than lime in order to reduce the embodied energy costs. Small amounts of lime may be added to stabilise the earth. We also want to investigate ways of reducing the timber frame which is used in the French system. Quite significant amounts of sawn softwood are required and we can reduce this by trying forest thinnings, engineered lumber I-beams or even eliminating the timber altogether.

Two housing association hemp houses designed by English architect, Ralph Carpenter are currently under construction in Haverhill, Essex and are being monitored by the Building Research Establishment. Hemp lime mixes also appear to be very useful as plasters, particularly on old buildings with uneven surfaces. The hemp lime mix is claimed to cope with varying levels of moisture and can provide a reasonable insulating, warm to the touch finish. Indeed the original use of hemp/lime began with restoration work on historic buildings, as infill for half timbering. Experience has shown that the hemp/lime doesn't shrink or crack.

Hemp/lime mixes have been used for floors cast directly onto hardcore without a damp proof membrane and the hemp material can be loose laid as roof, floor and cavity insulation. Hemp appears to have a great deal of potential as an alternative to many synthetic products in plastering and insulating rehabilitated buildings.

Because of its relationship with cannabis, the industrial hemp plant is banned in many parts of the world such as the USA and strictly controlled, with police licenses in the UK. Its ability to grow without the need for pesticides and no more than a normal dose of organic fertiliser makes it an attractive proposition, though the seed is expensive. Harvesting and processing the plant is also costly as it involves investment in new machinery. Part of our project will be to look at other uses and ways of simplifying the drying and processing. However hemp is being grown at a profit for luxury *horse bedding* and so higher value uses seem to have a great potential.

Some final thoughts

In the UK there are many different views about what constitutes green or ecological building. Fierce debates rage about the nature of 'breathing walls', the merits of lime against cement, and the characteristics of 'natural' materials. Currently such a debate takes place in a haphazard way, partly through the essential pages of Building for a Future Magazine but not through rigorous scientific discussion. Often technical claims are based on faith, belief or hope. Manufacturers attacking products circulate scurrilous

documents, such as a recent one, which has undermined confidence in borax treated cellulose insulation. Many activists create a false consensus that we all agree on what green or ethical means while debate is often stifled to avoid giving ammunition to the opposition!. Many rival green companies are involved in some unhealthy competition. Yet on the positive side the interest in sustainable building has grown enormously. Public sector bodies are adopting green purchasing policies and interest from architects, engineers and even contractors is on the increase. The demand for and the availability of ecological materials is growing. We have been asked to work on a feasibility study for a major Recycling building/facility in North Dublin, where the argument that it should be a 'green' building did not have to be made. However how far we can go in achieving this, is still to be established. We live in exciting times!

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