A case for Eco-minimalism

"Making the simple complicated is commonplace; making the complicated simple, awesomely simple, that's creativity." ***Charles Mingus***

Eco-minimalism, as applied to building design, is a phrase coined by the architect Howard Liddell, in an article that questioned the effectiveness of thoughtlessly applied eco-clichés such as micro wind turbines, photovoltaic panels (PV), heat pumps and reed beds[1]. Six years on and the clichés are thriving. Nick Grant, of AECB member company, Elemental Solutions and a long-time advocate of eco-minimalism, gives us his thoughts on the subject.

This article starts from the assumption that the reader is serious about improving the environmental performance of buildings which, in the UK, account for around 50% of carbon emissions. I have chosen to focus on climate change but the principles can be applied to all aspects of environmental impact and performance and need not be limited to buildings or products. Whilst studying buildings in use, Bill Bordass finds that complication tends to be the enemy of good performance, and so advocates eco-minimalism. In a recent interview, he hits the nail on the head: "Good sustainable design can be simple. We need to follow through from construction into operation, help to understand users, find out what works and what must be improved, and stop spending money on the wrong things. And we need to do it now – there's no time left"[2].

What is eco-minimalism?

Wikipedia defines minimalism as: '. . . movements in various forms of art and design, especially visual art and music, where the work is stripped down to its most fundamental features'. Such definitions usually refer to the outer form but an eco-minimalist design must be judged by how successfully it minimises environmental impacts and maximises human benefits – not by how minimal it is. Einstein said ***"things should be as simple as possible – but no simpler"***.

Eco-minimalism is an approach - not a style, or set of new clichés. Sadly, the eco-minimal approach of stripping back to essentials and debunking green icons is often seen as boring by those not bitten by the bug. However, to the eco-minimalist seeking honest expression of ecological function, the clichés stand out as just that.

It would be possible for a building to have an eco-minimal function and a kitsch or postmodern style, but it is wrong to claim that a sustainable building could have any form. What is true is that a green building doesn't have to look particularly green. An analogy might help. It would be easy to conclude that almost anything is possible in nature, for at first appearance there is no obvious style, rhyme or reason. And yet the need for ancestors to have survived and successfully reproduced sets very tight constraints on such things as size, surface area to volume ratio and colour. Even a small change in the environment can lead to a species dying out or, given sufficient time and luck, being selected for an altered form that allows survival. If a creature's 'design' didn't work it wouldn't exist. By contrast we can build a snow-dome in the desert if we throw enough energy at it. This is the antithesis of sustainability. We are learning that in order to achieve very low energy use, a simple compact building form is a necessity. A simple box is the obvious solution and architects such as Peter Zumthor have demonstrated that even boxes can look refined and elegant.

Eco minimalism principles

1. Question

Critical thinking is never final; it is an iterative process. Scepticism is open and creative and is the opposite of cynicism, which has already decided the answer. Start by questioning the questions. 'How do we achieve a zero carbon building?' should lead to the question 'is it the right system boundary[3]?' and even 'do we need this building?'

2. Reduce

A smaller house uses fewer resources and will need less stuff to fill it. This is not a moral stance, simply a statement of fact. Adding extra insulation and renewable energy systems to compensate for an excessive footprint is chasing our tail in environmental terms. If we are successful visitors will exclaim 'Tardis' rather than 'rabbit hutch'. The reduction applies to quantity and complexity. Most processes generate clutter. Just as our kitchen cupboards are full of grubby, unused gadgets, our designs might contain unnecessary complexities and redundancies that seemed like a good idea at the time but which end up squandering valuable resources.

The artist Constantin Brancusi said: ***"The difficulty does not lie in making things but in creating the conditions under which one can do without those things"*** .

A nice feature of the reduction process is that it can lead to a satisfied feeling of a job well done. By contrast, increasing complexity is an open-ended process that can get truly out of hand.

"There is no problem, no matter how complex, which if looked at in the right way cannot be made even more complex." *Paul Anderson*

3. Order

As with spring-cleaning, we clear out the clutter, then order what remains. Building examples include arranging the services to minimise hot water pipe runs and subsequent energy and water wastage, or ordering rooms to maximise useful living area, perceived space or solar gain.

Another crucial consideration is the ordering of building layers to avoid the structure penetrating the thermal envelope. Ignoring this apparently simple rule will lead to thermal bridges and tricky air tightness details which increase cost and can more than double heat loss[4]. Unfortunately the apparently simple Segal method, which has inspired many green architects, is a textbook example of how not to achieve this. The problem with the Segal method is that things got complicated when insulation is added. The original concept did not consider insulation or air-tightness and so the problem of the structural components impinging and penetrating the thermal envelope was not considered. Compare this to the Passivhaus (PH) approach of the air barrier being drawn as a continuous line and thermal insulation being 'like a warm fur'. We need to keep the structure on the inside OR the outside of the insulation.

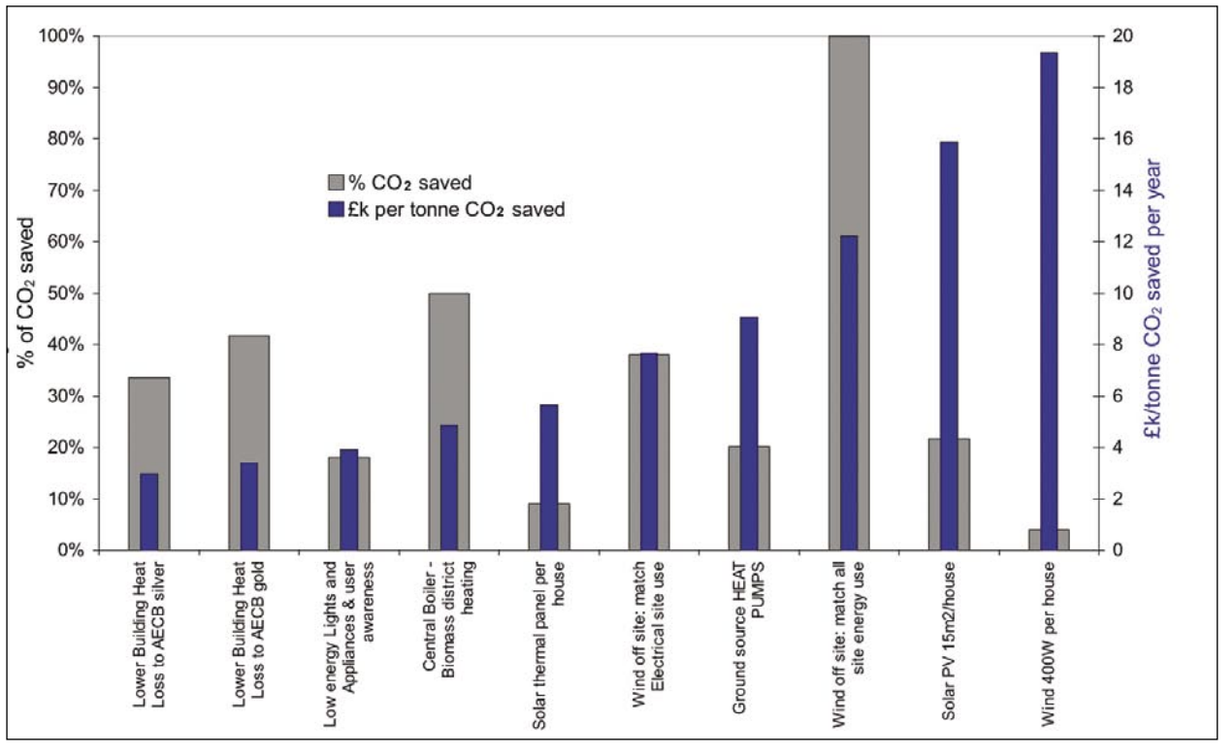


Figure 1. Graph showing cost to save a tonne of carbon per year. Micro wind was the most expensive measure with the lowest yield. Low energy appliances and improvements to the building shell were the cheapest.[10]

Figs 1 and 2 courtesy of Peter Warm and Nick Grant for NBT Consult and Elemental Solutions.

4. Model

Intuition is a great way to get the initial idea, but an unreliable way to judge its merit. Even a simple model can be used to perform very powerful 'what-if' scenarios. Indeed, the simpler the model, the clearer the conclusions. The key is to develop a sense for the essence of each problem, a tetchy frustration with unnecessary detail, and a sense of the limitations to models and modelling[5].

It is not unusual for expensive environmental measures to be built without even a back of the envelope feasibility check. I was once asked to visit a doctor who lived in a water mill. It was 'self evident' that the large water wheel could power his home from the rushing stream, so he had commissioned engineers to attach a tractor gearbox and alternator to generate electricity. When the switch was thrown, a 60W bulb started to glow and the wheel dragged to a halt. Two minutes with a calculator, a basic recollection of 'O' Level physics and a few assumptions about flow rates and efficiencies would have predicted this and saved him around £10,000[6]. This is not an isolated example, which is why consultancy can be so worthwhile and such easy money.

The most important environmental performance measure is energy consumption and so, indirectly, carbon emissions. A good, robust, and (compared to some) relatively uncomplicated tool such as the Passivhaus Planning package[7] allows the designer to optimise the built form for minimal energy consumption and optimum comfort.

5. Monitor

If we don't measure actual performance against our design predictions we miss the opportunity to fine tune or to learn from our mistakes. As it is very likely that performance will fall short of expectations it takes a brave designer to ask the client about utility bills or user satisfaction. Bill Bordass[8] suggests that as a rule of thumb, energy use in (non-domestic) eco-buildings is typically around three times what design predicts. Closing the gap between theory and reality will save more carbon than any number of building-mounted wind generators.

Is eco-minimalism anti-technology?

I'm rather partial to high technology, but I try to remember to oppose inappropriate or unnecessary technology. For example, it's often a good thing to replace pumps with gravity, although it might require more care at the design stage. However, 'passive' is an eco-cliché that must not be adopted without thinking. For example, in well-insulated buildings most of the heat is lost in the ventilation air, so a relatively simple (but efficient) fan and heat exchanger provides a good payback on invested energy, and can introduce other advantages, such as humidity control and excellent air quality. If the same eco-performance could be achieved passively then all well and good, but it is worth repeating that minimalism is only the means to the end. Another Einstein quote that is worth mulling over: ***"I wouldn't give a nickel for the simplicity on this side of complexity, but I would give my life for the simplicity on the***

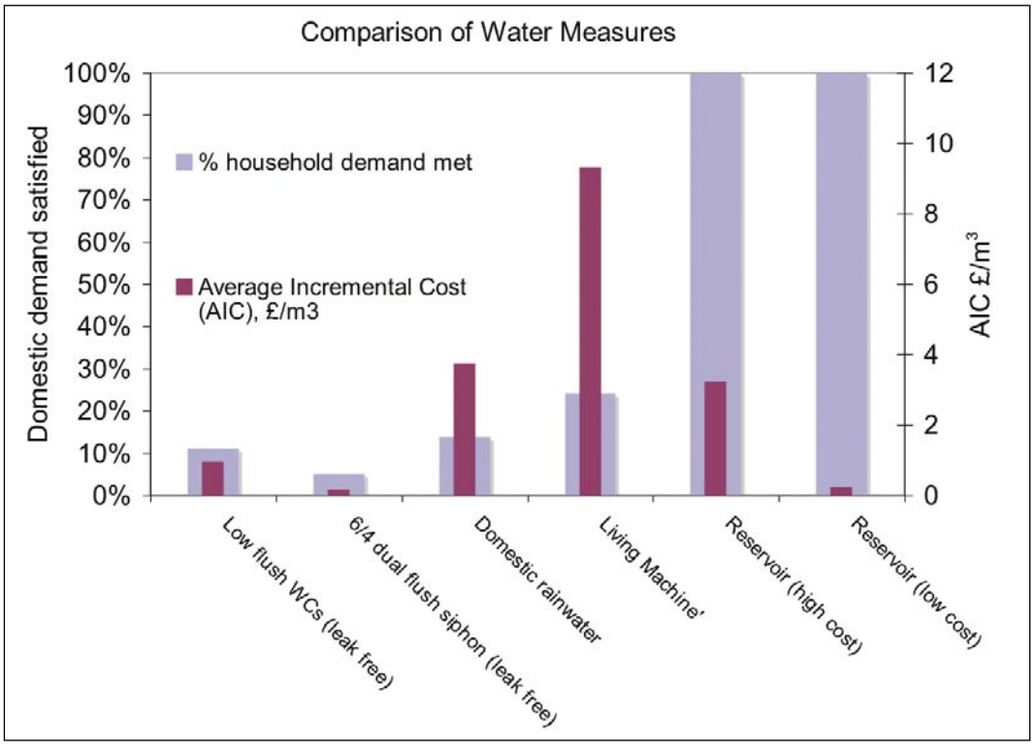


Figure 2. Graph showing the cost of saving, recycling or harvesting water as calculated for a development of 118 dwellings. Water company reservoir costs are shown for comparison[11].

other side of complexity."

The Code for Sustainable Homes;
the antithesis of eco-minimalism?

The UK government has set the target of zero carbon homes by 2016 and the roadmap to get us there is the Code for Sustainable Homes (CSH). In a strangely ironic twist, the very people who have been complaining that the energy efficiency requirements of the Building Regulations are 'too little too late' are now suggesting that this is 'too much too soon'. This objection comes from people striving for an ultra low carbon Britain, who are concerned that carbon 'neutrality' at the individual building level makes little economic or ecological sense. Not only are we likely to miss this target, but also we will be taking our eye off more pressing challenges, such as refurbishment of existing buildings, transport, food and large-scale renewable energy.

By contrast, mainstream developers are tripping over each other to deliver the highest level (5 and 6) housing, but of course only as demonstration projects with 'formula one' budgets, unproven performance and little hope of replication. Obviously, it is not possible to get to zero carbon on the household scale by efficiency measures alone. Thus all Code level 5 and 6 homes are forced to bolt on the dubious and expensive technologies that were questioned in the original eco-minimalism articles.

By contrast, the tried and tested non-governmental German passivhaus standard is thought by many in the field to represent the current sensible limit to ultra low energy building. The Passivhaus approach is very sophisticated, but leads to simpler solutions than required for the higher levels of the CSH and consciously stops short of requiring zero carbon at the individual building level. At the time of writing I know of no completed buildings in the UK that would meet this very demanding standard so what would a state of the art passivhaus score for the energy section of the Code[9]? The answer might be as low as a mere level 3. However I would be happy to wager that none of the UK Code 5 and 6 houses so far designed or built would achieve passivhaus certification.

The life and death question is, 'at what scale can we most easily achieve the extremely challenging reductions in carbon emission that climate experts are urging?' Clearly, efficiency works at the individual building level, but energy generation and water supply benefit greatly from economies of scale, as shown in Figures 1 and 2. Yet the CSH forces us to install ineffective building-mounted microgeneration at the expense of more robust and cost effective efficiency measures and sensible off-site renewables.

The second problem is the Code's requirement for percentage improvements in carbon emissions over the same building designed to meet the 2006 Building Regulations. On the face of it this seems like a good concept with a 44% improvement being required to meet the challenging, but modestly labelled Code level 4. The wise designer will, however, have reduced the surface area to volume ratio of the dwelling, optimised orientation and perhaps opted for a terrace or semi-detached format for even greater energy, materials and cost savings. This makes the base case inherently efficient, which is a good thing, but it also means that it is harder to achieve the required percentage reduction in energy use by passive measures, such as insulation, rather than expensive add-ons.

Conversely a large building with lots of external wall area due to a complex shape will be able to achieve a good percentage improvement if the insulation is increased and the windows are improved. However, it will still use significantly more energy than the lower rated eco-minimal design. In a recent report, the energy consultant, Peter Warm, showed how he had altered a wall to reduce heat loss and gain living space but the design dropped from Code 4 to 3. He then switched to electric space heating and regained Code 4[12]: alarm bells should be ringing.

This article is not a detailed critique of the CSH, but I want to make the point that in the UK, not only will the eco-minimalist designer have to let go of many technology grants and subsidies, but they will actually be penalised by the de-facto environmental standard for buildings.

Does an eco-minimalist approach prohibit bolt-on solutions?

PV and wind turbines are visible and get people thinking! And that is the problem. They are the magic pill that is claimed to cure another social ill without us having to face the deep complexities of the real problems. The simple

approach is harder work. I'm lazy and would welcome a magic pill, but only if it actually works. Undoubtedly, some eco-minimalist will choose to add PV to make their efficient home zero carbon. It's a tempting thing to do when your consumption is low enough for this to be an affordable option. However, if we are serious about tackling climate change we could have much more effect by investing the same money in large-scale renewables or even low energy appliances for friends and family. From a society's point of view, rather than forcing every home to have its own power station it would be better to levy a tax on new dwellings and then invest in large scale renewables that would provide perhaps ten times the yield and free householders from the burden of ongoing maintenance.

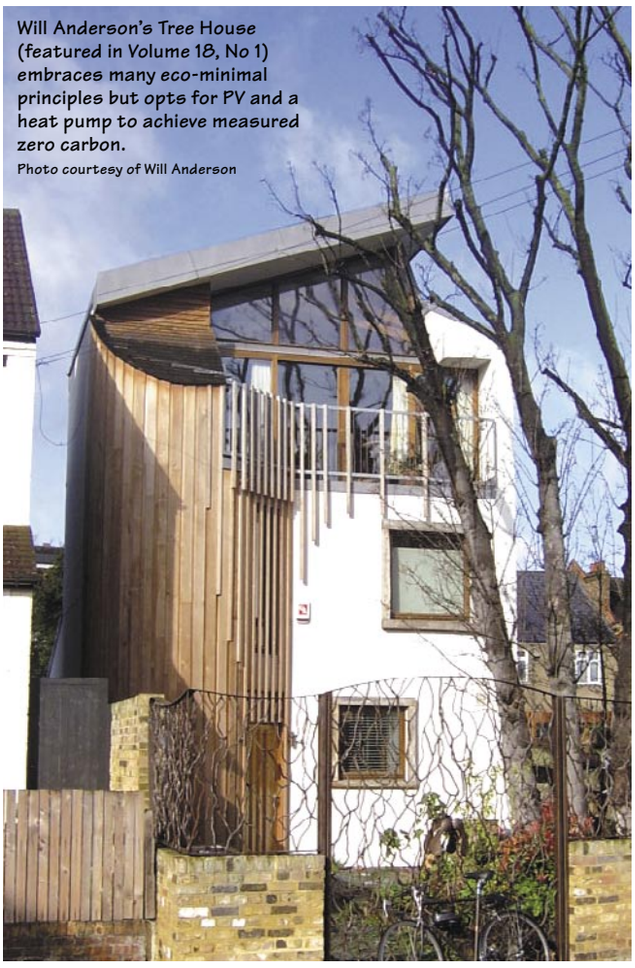
"The most dangerous problems are the ones that you think you have solved. Anything that makes you think you have solved a problem that in fact you haven't is therefore to be avoided, at almost all costs" says Robert Lowe.

What if climate change and resource depletion were solved?

Technical fixes such as carbon sequestration may have a vital role in tackling climate change. However, the danger is that such measures merely allow us to think we can carry on as we are. These technologies are like expensive credit that has to be continually extended. Unless we tackle the problem at source, ever more technical fixes will be required. But what if the overwhelming scientific consensus on climate change, natural resources and biodiversity is wrong? In that situation I would still be an eco-minimalist although a less militant one. I would still get pleasure from making something that had maximum function for minimum effort or from turning waste into something useful[13]. There is something graceful - even elegant - in striving for ecominimal simplicity.

Henry David Thoreau[14] described his experiments in eco-minimal living and the rationale behind his search for simplicity at the height of the coal boom after 1854. Emerson said of Thoreau *"He chose to be rich by making his wants few"*. Although previously unnamed as such, eco-minimalism is probably as old as human culture, indeed as old as the tendency to make things more complicated than they need to be. In the recent past it was a matter of taste, but now it could be a matter of survival.

Nick Grant



Will Anderson's Tree House (featured in Volume 18, No 1) embraces many eco-minimal principles but opts for PV and a heat pump to achieve measured zero carbon.
Photo courtesy of Will Anderson

Refs:

1. Original article Scottish Environmental Design Association newsletter, Summer 2002 www.seda2.org/articles/Ecominimalism.html. Final version; Liddell H., and Grant G., Eco-minimalism; getting the priorities right, Building for a Future; Winter 2002 , Green Building Press. WWW.GREENBUILDINGPRESS.CO.UK
2. BENNETTS R., and BORDASS W., Keep It Simple And Do It Well, Sustainability supplement to Building magazine, 28 September 2007, Digging beneath the greenwash, pps 8-11.
3. We could consider a development boundary, town, bioregion, country or planet – all will lead to different optimum solutions.
4. This can be calculated on a case-by-case basis and is more significant than most designers imagine.
5. Robert Lowe, email 4/12/07.
6. 1984 prices!
7. PassivhausPlanning Package 2007, a transparent Excel spreadsheet available from WWW.CARBONLITE.ORG.UK
8. Email communication 3/12/2007.
9. Most passivhaus buildings would not meet level 1 because of anomalies in the water section of the Code.
10. The analysis was deliberately optimistic (in favour of micro wind) and assumed 315kWh/y yield, £25/y maintenance costs and £1,500 installed cost. Warwick Urban Wind Trial project showed electricity generation 'of the order of 3-10kWh/month'. WWW.WARWICKWINDTRIALS.ORG.UK
11. AIC is a water Industry standard measure but the calculations are site specific.
12. Report for Good Homes Alliance by Peter Warm working for NBT Consult, WWW.GOODHOMES.ORG.UK
13. I might, however, fly more!
14. Walden; A life in the Woods. Henry David Thoreau.

Banner photos. Riches Hawley Mikhail Architects' new affordable housing scheme (see next page).

Nick Grant has been working as a consultant in all aspects of water management since 1996. He is a Certified Passivhaus Consultant and works in association with other energy consultants and architects committed to the Passivhaus approach. He is co-author of the AECB Water Standards with Dr Judith Thornton. As well as running his consultancy Elemental Solutions, Nick is a director of NatSol and the AECB and is an associate of NBT Consult.

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