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The Edge Debate "Energy in Buildings"

Beyond Politeness

Proposition

Worthy attempts to achieve energy efficiency in buildings have been undermined for at least the last 25 years by cavalier attitudes to policy formation, environmental ignorance, lack of the appropriate costing of externalities, supply side thinking, technological fixes, added complication, and too much cleverness with insufficient wisdom, meanwhile energy consumption in buildings simply hold steady against an ever rising datum.....Can we now get on with it?

The issue is not trivial. We need a radical reduction in energy consumption through a combination of demand side management; improved efficiency of energy generation & delivery; reduction in dependence on polluting forms of transport (people & goods) and improvements in manufacturing. Over 90% of building materials and building components are mechanically transformed.

Unless efforts are part of a strategic approach which begins with individual and political will and addresses building inception, refurbishment through feedback to demolition and recycling we will not get the increase in efficiency which we need.

The greatest threats to finding a lasting approach are dominant cultural attitudes about how we manage ourselves as a society. These are already leading to tokenist responses and misinformation with respect to environmental issues. We cannot continue to divide the responsibility, perpetuate the inertia, respond with cynicism or invent more problems to solve. We need a discerning and rewarding culture and socially just, intergenerational solutions.

This is a serious design problem. It is a problem of synthesis, a problem of process.

Nothing lasts for ever but successful evolution involves the ability to diversify quickly and decisively in response to changes in circumstance. There is an inclination to read Darwinism as survival of the fittest, the biggest, boldest and strongest. In reality it is clear that survival is for those most fitting, a quite different concept, and that involves the application of science, precaution and humility in the face of ecological limitations to which we must all ultimately defer. If we are to achieve sustainability then we need significantly more respect for that which we inadequately understand and we should learn to advance on the basis of sensible and strategic enquiry.

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Part I: In Search of Consensus

Efficiency

Energy efficiency operates anywhere that there are genuine constraints of resources or site. The initial isolated projects which are recorded appear to stem either from this fact or from an individual or community pursuit of conservation. The reasons for pursuing energy efficiency have changed during my lifetime. In the '60's disparate efforts were more clearly defined as a 'movement' concerned with perceived resource limitations, then security of supply in the '70's, then, in the 1980's, economic effectiveness. In the '90's we are increasingly coming around to the view that the problem is not one of energy but of toxicity, the inability of the environment to deal with the pollution generated. However high the chimney we build the problem will not simply blow away.

Energy consumption per household has remained relatively constant since 1970. Overall during this period energy consumption in the domestic sector has risen by approximately 20%, roughly in line with the increase in number of households. Energy consumption in the commercial sector has risen by 15% during the same period. There are no figures readily available for increase in personal energy use due to transport and embodied in goods and services.

The cultural presumption is against conservation because consumption is perceived as a measure of success. Yet it is blatantly evident that the ability to meet social goals with minimum use of resources and minimum pollution is the mark of a successful society. The quality of an experience is independent of the quantity of resources applied but rather how effectively needs, requirements and aspirations are met. Effectiveness is a concept which is rarely used in this context.

At one time it was plausible to identify the inertia in dealing with anthropogenic pollution in its many forms as a consequence of a perceived quasi-political bias. But what was once the fringe is now central in theory to government policy and now we need to address the practice.

Gratification - an aside

Browsing the corner shop my eye was caught by the words "You can now have your cake and eat it". A bun - manufactured using high grade technology; refrigerated, transported and probably with more embodied embodied toxicity than a brick wall - advertising itself as having no calorific value whatsoever.

Inertia

Global Warming

The 1995 IPCC Assessment states that:-

"The balance of evidence suggests a discernible human influence on climate".

The climate change now predicted is more rapid than any change experienced by the earth in the last 10,000 years. We are familiar with the global warming figures such as those expressed in the HMSO's "Review of the Potential Effects of Climate Change in the UK". They aren't very different from figures published in children's books in 1972.

Costs

BRE work in 1990 identified 25% of energy use in buildings could be saved cost effectively with available technologies and identified additional savings possible from near market technologies. More could be saved by improved passive design. DEGW research on life cycle costs of buildings highlighted the perils of first cost accounting and showed the real cost of buildings over a 60 year time span lies in the services and the space plan. Yet this information which should challenge us fundamentally as designers has made only a marginal difference to design and construction activity.

Ozone Depletion

In 1974 two independent scientific papers suggested that CFC's were a threat to the ozone layer. It was restricted in the USA as a propellant in 1978 but sales returned to 1978 peak by 1980, 40% drop in stratospheric ozone measured over antarctica in 1984. In 1987 chlorine confirmed as culprit and Montreal Protocol signed. In 1988 Du Pont agree to phase out CFC production. In 1991 the existence of the Northern Hemisphere ozone hole was established.

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Toxicity

"In 1971 the state laboratory for the control and inspection of foodstuffs in Geneva was given a new state of the art building with all the latest in sophisticated technical installations. After occupation all the food tests started to register excessive toxicity levels. When control measures were made back in the previous building the toxicity levels were found to be 'back to normal'. Ultimately it was discovered that the high tech materials in the new building were the cause of the high toxicity levels in the foodstuffs, and that it was occurring after only a short time in the building.

Toxic emissions were found to be leaking from paints, plastic materials, varnishes, flooring and furniture and were poisoning both the air and the foodstuffs waiting to be tested. The scandal was soon forgotten. There was no change in the building regulations or the standards for approving building materials"

Hubert Palm Geneva 1974

Hartmann/Schneider - Gesundes Bauen Gesundes Wohnes (1974)

Precautionary Principle

"It is often necessary to take a decision on the basis of knowledge sufficient for action but insufficient to satisfy the intellect" I.Kant

The precautionary principle is not new. It was first proposed in a formal philosophical framework by Kant but undoubtedly precedes him in philosophy and folklore. The use of the precautionary principle is dependent on an attitude of mind which if it suspects a problem seeks to identify a solution rather than talk it down. It is often intuitive and is probably an instinctive survival technique which assists discrimination between sensible enquiry and foolish pursuit. The antithesis is the 'nuclear' mind set which relies on an assumption of limitless and timely human ingenuity when presented with a dead end. It is pioneering stuff made all the more exciting by the fact that accidents happen. The argument against the precautionary principle tends to be that preemptive action is expensive, stunts beneficial innovation and may be unnecessary. Basically that now is optimal.

Limits to Growth

"whilst there are limits to growth there are no limits to development"
Beyond the Limits - Meadows, Meadows & Randers

Infinite growth on a finite planet is also logically inconsistent. In global terms there are vectors of rapid exponential change including population growth. An animal relies upon a constant input of sustenance and as a result emits waste products to the environment. The constraint on the process is not the number of animals but the ability of a finite environment to supply adequate resources and to absorb waste. The throughputs. Ultimately sources decline or recede and inevitably require ever more resources to obtain, reducing net gains ultimately to less than zero. Sinks overflow as treatment and storage of waste become more difficult.

The modern analogy is not simply our rate of growth of population but the exponential rate of growth of our throughputs of industrial goods and the wastes that they generate and the time lag of our response to pollution. We need to utilise resources more efficiently as a matter of common sense and intergenerational responsibility.

Sustainable Development

It has become evident to those in positions of responsibility that it is no longer tenable to do other than identify sustainable development strategies given that the alternatives are unsustainable development or no development at all. Serious debate is focussed only on the pace, means and methods of achieving sustainability and agreement is sought regarding a common understanding of how it might be measured and targeted. Sustainable development implies the ability to meet the needs of the present without adversely affecting the ability of future generations to meet their needs. But we don't meet the needs of the present and we are producing waste at a rate faster than the environment can absorb it. This is child abuse on a massive scale. How much longer can we go on pretending that the environment is not a vital aspect of the economy, is not a vital aspect of health and enjoyment, is not the cornerstone of development?

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Part II - Construction Is a Responsibility

An Unfortunate Transgression

"the environment is everything which is not me" - A Einstein

Nowhere is the misguided nature of Einstein's attitude to the environment more evident than in the 20th Century approach to our buildings. Buildings have a crucial impact on the physical and economic health and well-being of the individuals, communities and organisations which they are intended to support. Buildings and their components are basic needs which should be socially responsible products able to contribute to our physical psychological, cultural and economic well being. Yet they frequently contribute to ill-health and alienation, undermine community and create significant financial liability.

Modern planning, construction activity, building management and demolition processes are innately unclean and environmentally exploitative. It is necessary for everyone involved to recognise the role of buildings in the quality of our lives and the extent of client and professional responsibilities in creating a sustainable habitat. We need to identify the consequences of our actions and to process these to show how we might create a healthy built environment within the ecological limits to which we must all defer. Above all we must recognise that we are inseparable from the environment in which we live and that the environment is the source of all our future potential.

Life Cycle

The most important decisions affecting the impact of a building are taken at the earliest stages in building conception and design. The brief, location, selection of the design team, clarification of the client or user requirements, building management, future operational plans, design approach, local impact, orientation and form in relation to resources amenity, transport and microclimate all have a fundamental and crucial impact on the environmental impact. At present many of these are of limited vision and users, clients and managers suffer the consequences throughout the remainder of the building lifetime. Construction is a process not an act and given the rate of turnover of buildings it is not enough to rely on new build regulations. We need to deal with existing buildings and to ensure that we do not continue to perpetuate the problem of ongoing revenue demand.

Mechanical Systems

In the past buildings often made good use of orientation, sunshine, natural light and air, local materials and landscape features. Over a period of time there has been an increasing tendency to replace natural systems with energy consuming mechanical and electrical building services which create external local and global pollution. Architectural fashion drives design and selection of materials on the basis of remoteness, while mercantile philosophies invariably demand sites regardless of the wider impacts such as on transport. Designing within available limits is rarely perceived as a creative engineering challenge, generally it is not considered at all. Services are now an ever growing proportion of the capital expenditure of commercial and leisure buildings, especially the energy efficient ones! They take up valuable space and impose high dependency costs on occupants. As well as being frequently more prolific, less functional and less efficient than they need be. All too frequently design is driven by extremes leading to oversizing and they can be difficult to operate as well as inefficient under most conditions. Oversizing precludes use of some of the more benign options. They are also on a short term replacement cycle which makes them a substantial aspect of the life cycle cost and exploiting an economic climate dominated by capital cost considerations. We know that the first costs of buildings are only the tip of the iceberg in terms of overall costs but we also know that Nobody Cares Very Much. Mechanical systems can also contribute to poor air quality, from poorly maintained air ducts for example; requiring yet more technology to resolve and adding to the vicious cycle of degradation.

Simpler and more benign solutions are often possible with mechanical and electrical building services operating as efficient supplements to natural systems rather than as complete substitutes for them. The main requirements are not for increased complexity but for more care and forethought, more attention to the environmental impact of material and energy supplies and more focus on the genuine needs of organisations and users. So why do we use so much of them?

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The F Word - Fragmentation

The rapid growth in building services technology in the 1960's facilitated a design approach which encouraged the architectural vision to be context free. Because of the availability of fans and pumps and wires we now have a global architecture with little attention to the external climate or the availability of local resources, including human skills. Globalisation means identical opposing facades which are physically 13metres apart with climates which may differ by the equivalent of 2000 miles.

People have been defined as unadaptive units and managed by universal comfort rules. But expectation with respect to building temperature has continued to rise in ways which are clearly unrelated to physiology, bucking the laboratory manikins. This problem of over-simplistic thermal standardisation is only slowly being unravelled.

We have separated technology from people by removing personal control and yet we have found that technology choice has a potent human dimension. We are beginning to seek design solutions which rationalise building control and management to the available skills.

The design process traditionally stops at completion and encourages a fit & forget, 'maintenance-free' culture and ignores the downstream implications of design. The implications of maintenance free are rarely anticipated.

As a consequence of fragmenting the professions the building rarely lives up to the vision but instead reflects (a) the poor communication between the professions who, apart from trading insults, speak very different languages and have different priorities; (b) the fee structure of the mechanical/electrical engineer, which is still largely based on percentage of equipment installed; and in general gives little forethought to management or maintainability and less to the needs of the user. It is unrealistic to hold any one profession uniquely responsible and equally so to assume that adequate and timely solutions can be generated solely from within the industry as presently structured. Changing hearts and minds of clients is arguably the biggest challenge but a speculative market and short term thinking are hardly compatible with genuinely green buildings. Responsible clients are too few, and rarely responsible enough, to provide adequate response to the evident risks.

The C Word - Complication

At the extreme we fantasise about the four mile high building with photovoltaics on top; design the respite green house; and add lipstick to the face of the city gorilla by way of a solar scoop or bureaucratise with an environmental management system. The latter sees off both the cowboys and the little guy who can and wants to genuinely innovate, and justifies paralysis by analysis! It can after all be made to seem so, so difficult. As a consequence of complication computer controls are opaque. Advertising is equally so: -justified on the basis of any convenient element such as durability or energy efficiency without justification or credibility. After all with all that complexity, what is truth?

The M Word - Expediency

There is no expediency like Millennial expediency. The over-riding question for the Millennium Commission is "what kind of environment can we expect subsequent generations to provide in our dotage when we have left them so little of lasting quality and value?"

The Way Forward

True to the F-Word sectors of the industry respond to the present situation differently. They include the need for Guidance, Adequate energy costing, After sales service, Legislation, Appropriate Fee Structures, Feedback. None is a panacea, some are opportunities, some are simply shirking of responsibilities but they are all the basis of a discussion from which we can move forward. Can we?

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Part III: Foresight, Insight, Hindsight

Culture

The culture of construction is profligate with respect to energy and material resources and largely indifferent to the environmental, economic and social implications of short term strategies. Changes over the last 25 years have been largely as a result of personal, often intuitive, commitment to the high ideal of a functional, healthy, efficient, joyous and biodiverse built environment. The achievement is enormous - the limitations evident. However environmental design is increasingly perceived as a fundamental means of achieving client and user aspirations for a comfortable, maintainable, flexible, affordable and healthy indoor environment with minimum local and global degradation.

What do we need to do?

We need a huge improvement in resource efficiency, not 2 or 20% but 50-90%. We do not need to look at autonomy or covering buildings or the world in photovoltaics, rather at techniques and approaches which deliver a proper return on investment. That requires a strategic approach based on demand side management which includes no cost measures first, low cost measures next and then an appropriate balance of revenue and capital. Building regulations which only deal with new build will not achieve it. We have to set standards for refurbishment and we can do much more by improving the quality of the existing stock by a factor of 5 or 10 then by even 60% improvements in energy predictions for new buildings. We must begin to enhance the environment if we are to fulfill our commitment to future generations. We cannot simply design increasingly sophisticated BEMS systems to manage our energy budget, at least not on recent evidence. We have to design rational systems which respond to available skills.

How we get there?

We will not get there without a proper moral debate and an energy policy which includes the cost of maintenance and externalities. Blaming fee structures is not enough. The economic case for a longer term approach is becoming increasingly apparent as the true costs of maintenance repair, demolition and replacement become evident compared to proper investment. The viability of UK industry in the international market compared to less sustainable economies needs to be addressed at an international level. At some time we have to take the responsible, sane, answerable decision. The market and the industry as presently construed will not deliver energy efficiency.

Innovation

Focusing on the need for innovation and technology foresight is motherhood and apple pie without an understanding of why we have so much unimplemented innovation. There are positive examples of innovation, but the reward structure mitigates against the concern, ingenuity and resourcefulness which exists. There is little nurturing or support for primary innovation. Jewels are stolen as soon as they have a hint of credibility and exploitation is always by non innovators. It is a conviction game, risk game (read eccentric) and everyone in the UK knows it. If we want innovation we could start by asking who takes the risks and who the secondary and tertiary beneficiaries are.

Culture Shift

We do have to look at our culture and how we apply judgment. In general we appear to subscribe to policy avoidance, quantitative measures, consumption, short termism, linear, incremental and growth thinking. A culture shift is fundamental to the pursuit of sustainability and the direction of this shift is increasingly evident. We need policy implementation, quality, conservation, long term, cyclic, holistic and development based thinking. We have to develop a permanent culture with an ethos of continual improvement. The buildings and technologies which are most fitting to a sustainable economy are functional, efficient, manageable and healthy and increase in value over time rather than decrease. It is appropriate that this culture shift is accompanied by hindsight which can allow us to benefit from past experience, increased effectiveness and calmness to provide the environment in which to develop our insight; and foresight to develop a vision for the future built environment which is compatible with sustainable development. It signifies a move from the scientific, reductionist world view of isolation, competition, prescription and order to a holistic world view which began with Fourier and Owen and was developed into an applied human ecology of systems, patterns, co-operation and process by Geddes. It remains the path not taken.