RED IN ARCHITECTURE - AN ECOTROPIC APPROACH

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ABSTRACT

This paper explores the manner in which ideas of resource efficiency is taught to design students through the principles of iteration and generative design within a framework of eco-systemic thinking.

1. INTRODUCTION

The Department of Architecture at the University of Pretoria received an invite from the offices of the UIA to submit a poster on the teaching of sustainability in the Department, which was exhibited at the UIA World Congress of Architecture held in Turin, Italy during June-July 2008. This was one of twenty such invitations extended to identified institutions internationally and one of three to institutions on the African continent. The invitation caused us to reflect on what it was that we wished students to – in the parlance of the Department – 'think, feel and do'. (We have transliterated the cognitive, emotive and psycho-motorial domains which are the lingo of educators into this simpler language.) This essay expands on texts published in these posters, here quoted in italics.

2. THE TRADITION

The teaching of sustainability in the Department of Architecture is founded in the tradition of studies in energy, and particularly thermal performance, which have been conducted by members of staff in the Department since the 1970s. Persons involved in this include Holm[1], Kemp[2], Wegelin[3] and Irurah.[4]

Under the tuition of Prof Dieter Holm in the 1980s a curriculum was developed in the field of sustainability in the Fourth Year Building Technology course. Roger Fisher, appointed to the

staff in 1986, took over this course and developed it further during the 1990's. With the curriculum development of the restructured degree courses in 1999, a specific quarter was allocated to the teaching of appropriate and sustainable technologies at honours level. The expertise of Dr Jeremy Gibberd was called in from the CSIR to teach in this course. He presented the Sustainable Building Assessment Tool (SBAT) in his coursework. This also formed the basis of his Doctoral studies.[5]

The inclusion of the SBAT tool in the teaching of the course made it self-evident that sustainability is nothing more than good and appropriate design. Such a design should have good fit with its brief, strategize around the essence of the problem and respond in a resource efficient way. This has led to our use of the term 'Resource Efficient Design' or RED.

It is important to note that RED is not only presented to students of architecture but to students of three of the design disciplines in the built environment, namely architecture, interior architecture and landscape architecture.

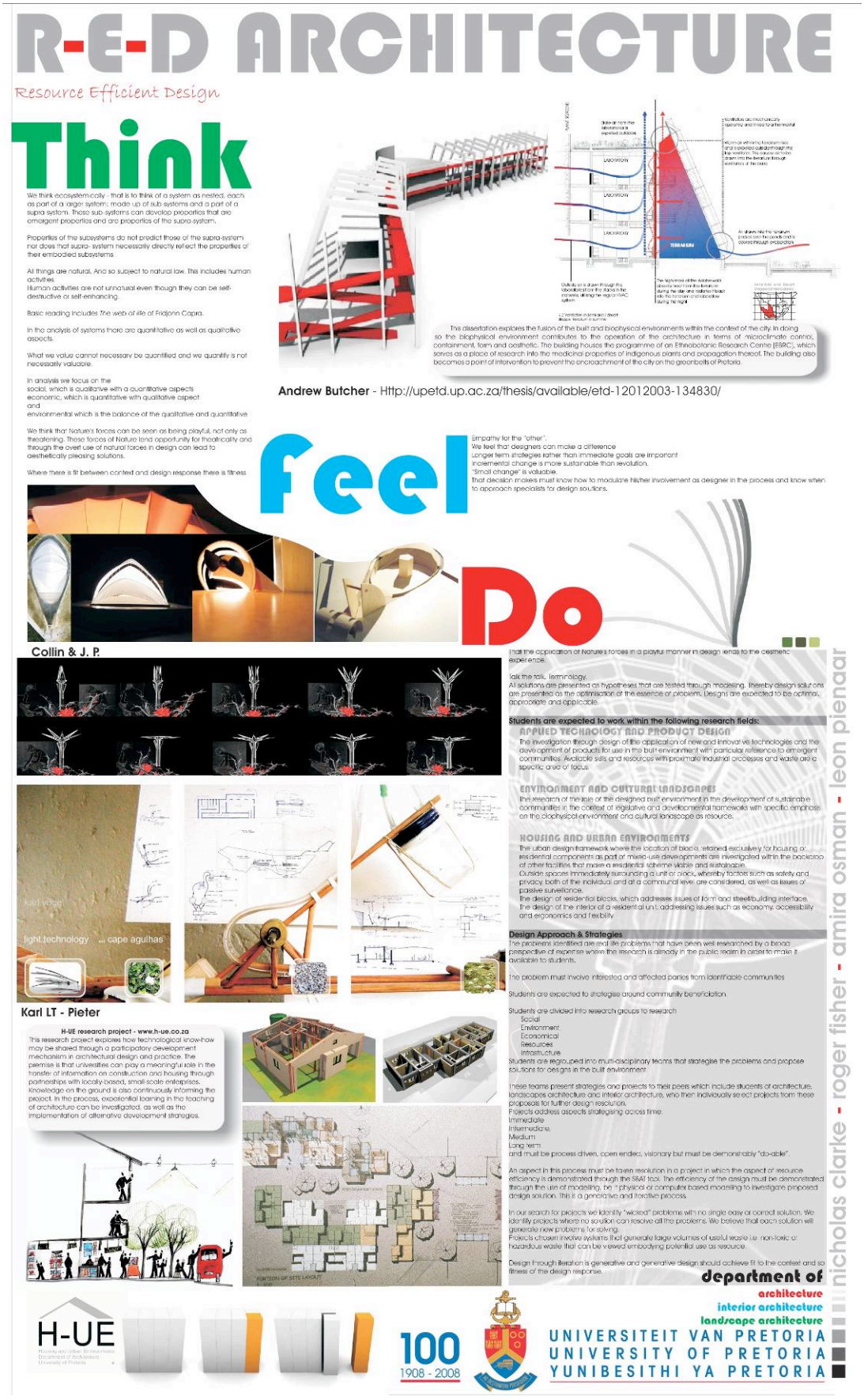

Fig1. The poster presented at the 2008 UIA Turin Conference. Authors: Fisher, R.C., Clarke, N.J., Osman, A. and Pienaar, L.

3. THINK

We think ecosystemically.

Ecosystemic thinking is an approach which has emerged from the field of psychology, particularly as it is reflected in the writings of Jordaan and Jordaan[6]. In South Africa it has a long tradition and probably can be traced back to Smuts' *Holism and Evolution* (1926)[7] and John Phillips' (1931) *The Biotic Community.*[8]

To think ecosytemically is to think of systems as nested, each as part of a larger system; made up of sub-systems and in turn as a part of a supra-system. These sub-systems can develop properties that are emergent and are uniquely properties of the supra-system and not found in the sub-systems. We can thus speak of the ecology of building materials as biologists would use the term, and understand the term and see each element as part of a larger whole which impacts on other sub- and supra-systems. We propose that design that has such fit be termed 'ecotropic' rather than 'green' or 'sustainable'.

Properties of the subsystems do not predict those of the supra-system nor does that supra-system necessarily directly reflect the properties of its embodied subsystems.

The idea of emergence in systems originates with the thinking and writing of Ilya Prigogine and Isabelle Stengers[9], popularised in their book *Order out of Chaos* (1984). Central to their thinking is that, while the universe may be an entropic system, embedded within it are events that display neg-entropy. Within these systems order emerges from chaos and hence displays emergence where the emergent properties are more than the sum of their parts. Hence they display acquired characteristics not predictable from those of the constituting subsystems.

Analogously atoms do not predict the behaviour of molecules, proteins do not predict the behaviour of DNA, and the properties of buildings will not predict the social behaviour of their users.

All things are natural and so subject to natural law. This includes human activities

Human activities are not unnatural even though they can be self-destructive or self-enhancing.

This proposition finds its source locally in the writings of the botanist John Phillips, particularly in his concept of 'biotic communities':

> *My inclusion of man* [in the biotic community] *will call for much criticism – so to anticipate such I would remind you that despite the ability of man to upset temporarily, to hold in check to some degree, and to accelerate to greater or lesser extent the response, the reactions, the co-actions and the development of a community, it is more than he can do to alter fundamentally the trend of these. To him certain – and not all – things are possible.*[10]

While superficially it may seem obvious that this is so, as an idea it does not resonate easily with human thought. We are used to, and perhaps even programmed from birth, to think in dualities, dialectics, oppositions. If we are of nature we do not have to become more natural; we should rather, perhaps, reflect on our own nature. Even when well embedded in theory the designer tends to revert to a thinking of a 'natural world' in opposition to that of the cultural. We have deliberately endeavoured to broach this dichotomy of thought by introducing the term 'bio-physical' for all where human activity is not dominant, as opposed to 'cultural' where human activity dominates. Both of these are embedded as subsystems in so-called 'nature' and are consequently considered to be natural. Any activities which undermine the persistence of any of these systems must therefore be considered 'natural' even when self-destructive. Industrial ecologies are considered as systems in the built environment, and so, when designed for, might contribute to the larger ecology through the emergence of unpredictable properties at the urban scale.

Basic reading includes the writings of Fridjof Capra.

Fridjof Capra's *The web of life* (1996)[11] introduces the student to many concepts which are useful when thinking about sustainability. They are concepts that come from the natural order. Examples of such concepts are: autopoesis, homeostasis, iteration, emergence and generative processes.

In the analysis of systems there are quantitative as well as qualitative aspects.

What we value cannot necessary be quantified and that which is quantifiable is not necessarily valuable.

The last forty years has seen an exponential growth in our ability to predict or model complex problem sets through the aid of computing. Students are exposed to these contemporary tools and expected to understand their use in iterative processes – a process of feedback, evaluation and adaptation. Computing is not the only way of quantification and more 'primitive' but intuitive tools are also presented and used to ensure scholars develop a core personal understanding of issues such as solar shading and the forces of air movement. Computation, while being extremely useful, also has the potential for fascinating the mind, thereby dominating the design process and steering the final design towards a purely technocratic solution, an aspect that needs guarding.

It is considered important for students to realise that that which can be numerically represented, analysed and modelled, is only an aspect of sustainability. Here a clear simile is the contemporary 'value' ascribed to brand names.

While there is a certain intellectual satisfaction in being able to represent reality through mathematical or other modelling, the fact that something can be modelled and expressed at an order of magnitude does not necessarily mean that it is important, it is not necessarily a dominant concern and it does not necessarily represent value.

The obverse, that that which is not measurable is not necessarily valuable, is a much more difficult aspect to teach since it is dependent on developing an empathetic understanding of need. Such an understanding of necessity requires life experience, something that cannot be taught in a class. Here it is important to expose students to real problems with real people who have real needs. Exposure to this is sometimes disturbing to students, for example the discovery of eight year old prostitutes servicing truck drivers in a shanty town near Ngodwana, Mpumalanga – "they say eight…don't they mean eighteen?" – or that the burial ground is the perimeter fence of this township for lack of space and lack of land-rights, the community being mainly foreigners.

In analysis we focus on the social, which is qualitative with quantitative aspects – the economic, which is quantitative with qualitative aspects and the environmental which is the balance of the qualitative and quantitative.

Students are encouraged to engage with the biophysical as resource and inspiration in design resolutions. This engagement with the larger 'site' includes aspects ranging from the tangibles of cultural palimpsest to intangibles such as time. Projects aim at creating an awareness of the biophysical, not only in the possibilities this might hold for the designer but also in the impact that the biophysical will have on buildings. Steward Brand's *How Buildings Learn* (1994)[12] as reader forms an integral part of this process.

Where there is fit between context and design response there is fitness.

The idea of 'fitness' is again a biological concept as for example in the notion of 'survival of the fittest' (which Darwin never wrote). The idea of design as something that has 'fit' requires a deep understanding of the context in which the designer is working, for only through a full understanding can the determining aspects which characterise the design solution be identified.

4. FEEL

Empathy for the "other".

Ethos:

Sustainability is the attempt to harness our understanding of the natural order and natural laws so as to be able to spend more time as a species on planet Earth.

The attempt to extend the sojourn of the species on the planet involves personal sacrifice, and personal sacrifice is a moral issue. A new mindset requires a change in the ethical standards by which we have come to judge our successes.

Essential to our thinking is empathy. Many students, by virtue of their backgrounds, are unaccustomed to engaging with the divergent aspects of the culturally and economically diverse realities of a Third World, contact is important. Empathy can only be engendered through engagement. It is only through empathy that appropriate design responses that 'fit' can be found.

We feel that designers can make a difference.

Through finding 'fit', built environment professionals allow not only for current 'fitness' but also for future growth. This fit should be "loose" enough to allow for this growth and have an embodied energy high enough to make it valuable and low enough to allow for change.

Longer term strategies rather than immediate goals are important.
Incremental change is more sustainable than revolution.

Students are required to strategise around the problematics of a specific location. Thereafter they are set the task of generating development strategies that react as nested systems with loose enough fit to adapt over time as new eventualities emerge, but with enough rigour to energise them for long term impact. The designer may not always be present at the realisation of the design intent. Hence it is imperative that the residue of this realisation is seen to be acting as catalyst and stimulus for the actualisation of the intended change.

Small change' is valuable.

Building on the thinking and work of Nabeel Hamdi, we believe that small interventions that impact on systems by gradual evolution and do not upset social hierarchies are more likely to succeed and catalyse change. As evident in Namdi's *Small Change*[13] it is the act of enabling that produces results, not the act of providing results which can never make allowance for growth. As Schumacher states in *Small is Beautiful*: "In practice all prediction is simply extrapolation, modified by known 'plans' … As a matter of fact there are no rules; it is just a matter of feel or judgement … what can you predict?" [14]

Students are led to realise that no single solution exists to the multi-faceted problems designers are confronted with in the real world. Engagement means allowing for emergence. No intervention is too small, but it can easily be too large. The critical intervention requires the necessary minimum even though this may seem simple. Buildings that are tightly bound by the requirements of programme are more likely to fail or become quickly redundant than those that

are loose-fit. Programmatic design leads to rapid obsolescence. Form does not follow function, but rather fitness follows fit.

Decision makers must know how to modulate their involvement as designers in the process and know when to approach specialists for design solutions.

The complexity of the biophysical environment as understood from a holistic perspective requires an input from the full range of diverse talents available in society and cannot be resolved through the limited responses of any one person. The implication is that the designer as 'master' is superseded by the designer as catalyst and facilitator. Design is not merely a product but a moderator of the environment.

5. DO

The embracing of the forces of nature in design lends to the aesthetic experience.

Design responses are seen as part of built environment ecologies that are emergent, which are not only delivering product but is plugging into and optimising processes. In the feed-through cycles of resources design should optimise the retention and delay and minimise the production of waste. Cradle to cradle[15] rather than cradle to grave.

Talk the talk. Terminology.

All solutions are presented as hypotheses that are tested through modelling. Thereby design solutions are presented as the optimisation of the essence of the problem. Designs are expected to be optimal, appropriate and applicable.

When designing, the programme of a brief must be seen as facilitating the design response. But if 'buildings learn' it is also important to take long term strategies into account as resources in the design response. The designer has the obligation to enrich the brief, seeking out opportunities for 'double-functioning' elements and the 24/7 cycling for uses. Interventions should be "long life, low energy, loose fit", a term coined as title to a RIBA probe into the long term use of buildings as announced by the then RIBA president Alex Gordon, in 1972.[16]

Waste must be seen to offer opportunity.

Design is currently often form-driven, with the intrigue of how the computer can generate complex form and feed-through to fabrication. Our feeling is resonant with that of Papanek[17] when he says: “modern technology is beginning to give mankind a chance to return to the interactive … [to become] relevant to a society of generalist; in other words designer planners.”[18]

Design should rather be generative where the responses to each of the diverse problems that inform the design thinking are investigated independently so as to optimise its resolution. Through iteration and convergence the design process achieves an optimal resolution to the problem. It must be borne in mind that the inherent qualities of each facet is but a subsystem of the emergent design which needs to be tested as a whole. A simple example addressing aspects of the SBAT tool: a sphere has the lowest surface area to volume but in terms of efficiency of planning and adaptability of use is the most inefficient, particularly as the complexity of use increases. It may be an ideal form as a hut but probably not as a hospital.

6. ITERATION[19]

RED is an acquired discipline which can be learnt but not schooled. It is an attitude underpinned by skills and not a skill in itself. It does not obviate the need for a designer or suggest that design can be left to computers. However it does highlight the use of computers and computation as aids to informed decision making as well as the need for other inputs by those skilled in their particular areas of expertise. Design should not be an end in itself but the privilege and obligation society offers those so talented.

Footnote: The authors would like to acknowledge the contribution of Dr. Amira Osman to the course as well as that of Mr Leon Pienaar to the generation of the original poster.

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[16] Editorial. Design. 01/07/1972, p 26.

[17] Papanek, Victor. 1974. *Design for the real world: human ecology and social change*. London: Granada.

[18] Ibid, p234, 5

[19] The authors realise that the writing and publication of this article does not conform to the credence of RED. Our only excuse for committing so many words to paper is its containing embodied carbon.