Natural materiality – the people's choice

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Abstract

Despite the variety of toolkits, life cycle analysis, models, and other forms of guidance on sustainable resource use in architecture, the amount of energy used and waste created in the industry is going up on a global basis. The conventional approach to promoting sustainable specification clearly isn't working.

This paper offers a new approach based on a recent qualitative case study of people's attitudes, associations and understanding of key construction materials in housing. The findings suggest that people have a deep tacit knowledge of materiality which draws on the ecological "affordances" offered by materials and are very clear about which materials they want, where, and why. These affordances, identified in Gibson's theory of ecological perception, transcend the usual subject/object divide and challenge designers to do likewise.

This tacit knowledge appears uniquely related to people's place of upbringing as well as their occupation. It supports the notion that a bioregional approach should be adopted for material and product specification which empowers users to take more responsibility for the materiality of the buildings they live and work in. The emotional "endearment" of materiality in architecture to the users is argued as a key factor in potentially reducing maintenance costs and subsequent resource impacts.

Currently, architecture is conceived primarily as the design of space using construction resources. Reframing architecture as the design of resource use in place, draws on users' local knowledge and an implaced, more natural materiality. Design and research are thus challenged to focus on a more limited palette of materials, based on the findings of the study, and work to the edge of technology in developing building elements related to these. This way of working can then be closely linked into the eco-systemic processes which underlie any sustainable design endeavour that aims to harmonise with nature.

Keywords: materiality, sustainable resource use, construction materials, ecology, tacit knowledge, place, architecture.

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1 Introduction

"Which material should I use for this element of my building?"

It's a common enough question that all architects ask themselves at some point in the design process. The answer depends on how much awareness and understanding there is of the various design parameters involved and the skill and knowledge available to select and integrate the chosen material within a coherent design proposition. A quick list of these parameters would include: functionality, aesthetics, symbolic value, availability and cost. Due to the current economic de-coupling of resource reserves from true environmental cost, a later addition to this list is the self-conscious concept of sustainability, with its triple bottom line of environmental, economic and social concerns.

Whatever our definition of sustainability is, it is often framed as a question of freedom .v. limits. Traditionally, buildings and the use of construction materials evolved slowly over time with subtle innovation that responded to needs and limits. Contemporary design is synonymous with relatively limitless innovation, often for its own sake, largely because capitalist economies need to both meet and create needs. Architects are wary of sustainability with its imperatives and apparent limitations, seeing this, still, only as a necessary appendage to their design process rather than an integrated part of it (Ryhaug [1]). Architecture as a discipline is therefore not leading the way on the reality of sustainable specification but has largely retreated into the spectacle of visual and spatial innovation with materials.

The evidence for the need to design more prudently with our existing physical resources has never been more compelling. Demand for oil is predicted to outstrip supply as early as 2008 according to some estimates. The loss of these supplies will potentially remove many oil-based construction materials in a relatively short space of time. It is also estimated that we will need to reduce physical resource use through efficiency gains by a factor of twenty if the construction lifecycle is to remain sustainable (Kasteren *et al*. [2]). Despite this, mainstream research to date has largely failed to adequately address the need for appropriate evaluation of sustainable construction, often producing inaccurate generic "tick-box" type information on sustainable specification (Stevenson *et al.* [3]). The use of a more people and place-centred approach is explored in this paper. This is a new approach to sustainable specification which may yet engage the designer and user alike.

2 Approaches to sustainable resource use

Despite the huge variety of cultural responses towards materials, construction science has developed a remarkably homogeneous and global approach towards sustainability (Guy and Shove [4]). The leading players in the field of generic specification are the USA and Europe, using mechanisms such as the ISO standards worldwide, and the Eurocodes in Europe which promote energy-intensive construction materials and products, whose added economic value is

ironically reflected in the number of transport miles they can clock up. They are supported by the deductive reasoning of Life Cycle Analysis, and Eco-labelling, whose testing regimes can marginalise local and relatively unprocessed materials (Morton and Little [5]).

By contrast, traditional cultural approaches to material specification are predicated on a sense of living with the earth, drawing on sustainable living traditions and practices which provide a vehicle for passing on local knowledge through deeply held beliefs and the teaching of skills (Ingold [6]). A number of ecological architects have picked up on this knowledge through working with relatively natural materials in their own locality. Biodiversity, environment-economy integration and participation are automatic considerations in this holistic approach to sustainable specification.

The question is; which of these approaches is delivering on key sustainable construction targets? Energy costs and material consumption in construction are still rising on a per capita basis, despite efforts to reduce these (Kibert *et al.* [7]). In fact, generic specification makes it harder to re-use materials and privileges energy-intensive recycling processes. Although various scientific tools and checklists for sustainable construction are produced worldwide, their impact on the industrial world is negligible and for the rest of the world non-existent (Kohler [8]). This suggests researchers should be looking at other ways of evaluating sustainable construction materials which are more inclusive.

3 The architectural discourse on materiality

One way of re-evaluating the sustainable specification of construction materials is to expand the parameters of consideration. Whereas construction science is strictly concerned with the physical properties of matter, materiality in its widest sense is the understanding of how meaning is attached to matter through our experience of it. There are few texts which deal specifically with the cultural interpretation of construction materials as they are used in buildings, and virtually none that examine sustainable materiality. One reason for this might be because the tacit nature of materiality is built on the repetition of successful design efforts and becomes a matter of habit (Leatherbarrow [9]). Examples include the unquestioned use of standard details and materials despite the excessive resource depletion involved, and their thoughtless transfer between differing climates and cultures.

Such texts on materiality that do exist, tend to debate the "truth" of materials, but any physical truths are continually subverted in architecture through aesthetics desires which are seen as superior, thus presenting a dichotomy between common sense and visual representation. Within architecture, formal gestures towards sustainable materiality often visually copy the ecological processes involved, without really understanding them, and thus undermine their intrinsic truthfulness. Even avowed environmentalists within architecture can be prone to supporting a misrepresentation: "What is important is the fact of a material's presence, not its readability. Wood may be painted to look like aluminium, but the deception is harmless" (Hagan [10]). It will be argued here,

that such architectural misrepresentation of physical truth to materials is not only harmful, but can be a matter of ecological survival in terms of evaluation. The continuing disjunction between how architects and researchers choose to evaluate materials and how these are actually functioning within situated environments undermines ordinary people's understanding of those environments and their respective eco-systems to the detriment of both.

4 Tacit knowledge and affordance: re-evaluating sustainable construction

A key aspect of evaluating materials is people's perception of them. Ecological psychologists have developed Gibson's theory of "affordance", which claims that the value and meaning of things in the environment can be directly apprehended through the body's interaction with the environment. It is the persisting surfaces of the environment which provide the framework of reality. If a surface is horizontal, it "affords" support and can therefore be stood upon. Equally, a material's affordances can be perceived in terms of strength, comfort or protection. Stone offers strength through resistance; wool offers comfort through warmth and softness. These affordances are neither purely objective nor subjective –they are both, and cut across the usual subject-object divide in evaluation. They do not change as the need of the observer changes –the affordances are always there, waiting to be perceived, in materials that are not value-free, but value-rich as ecological objects (Gibson [11]). We draw on this wide variety of inherent affordances according to our needs; the "warmth" of wood for the intimacy of a home interior can, for example, be contrasted with its relative "solidity" in a door for protection.

An essential part of Gibson's theory is that things must look like what they actually are to provide appropriate information for perception. Things which don't look like what they are provide environmental misinformation for the perceiver. This is because people do not simply perceive good form; what is seen are different opportunities to act, such walking, sitting, resting, climbing, moving, or using, according to Vihma [12]. When this is applied to the evaluation of construction materials, it is clear that they should express affordances unambiguously in order to ensure a good match between users' needs and their understanding of their construction environment.

While ecological psychology argues that the inherent meaning and value of materials are discovered or detected, constructivists suggest that individuals also impose value judgements on materials based on their personal beliefs, which are tested over time for validity. Critical theorists add to this brew, by pointing out that these value judgements are then socially prescribed by society which legitimates certain judgements and not others. Thus, even where certain materials may provide greater affordance for satisfying our needs, the construction industry will continue to be able legitimise unsustainable substitutes as more "normal" given the social requirements of capitalist reproduction. An example is the substitution of natural wooden panelling with laminated wooden panelling which pretends to be wooden but this is only as deep as the photographed image

of the wood on its surface. The glued laminate is also difficult to re-use, recycle and is non-biodegradable. This is now legitimised as normal "wood" type flooring.

It would seem then, that while materials offer certain natural meanings and values, we also select what meanings and values to ascribe to them as a result of our learning experiences and internalised normative processes. Some of these influences are more tacit and others more explicit. Tacit knowledge of construction materials is a personal appraisal based on an inarticulate set of pre-suppositions that have been assimilated subconsciously over a lifetime from various sources, including bodily experience, cultural normalisation and social experience, according to need. These form an immense and subtle understanding which we innately know how to draw on, comply with, and live by, without specifiably knowing its content (Polanyi [13]). Arguably, any understanding and accreditation of construction materiality, should therefore be coincident with the particular tacit rules shared by the community of any particular place. This notion was explored in a recent qualitative case study by Stevenson [14].

5 The case study: a people-centred approach to sustainable materiality

The study considered two culturally distinct groups of people to see what role place had in their understanding of materiality. The participants consisted of twenty local residents who had grown up in a culturally and physically homogenous region of NE Scotland, and a control group of twenty new residents who had grown up in a range of other countries. They were interviewed in depth using a technique called The Repertory Grid [15] which revealed their various beliefs, or "constructs", concerning various construction materials. Construing, as opposed to conceptualising, is essentially a dynamic search for personal understanding evolved through recognising similarities and differences in our experiences, which are then stored as assumptions. A combination of Content Analysis and Principle Component Analysis was then used to analyse the results and identify the key themes. Nine common construction materials were examined using deliberate mix of traditional and new as well as reflecting different degrees of processing from raw resources: wood, stone, concrete, steel, glass, clay brick, plastic, gypsum plaster and mud.

The key findings of the study were that each group differed significantly in the way that they construed construction materials, suggesting that geographic location plays a key role in determining people's attitudes to materials. Stone was generally the material of choice for the Scottish group, reflecting its prevalence in their locality, but this was not the case for the control group. Emotional feelings were used as the primary means of evaluation overall, followed by construction function and purpose and whether a material was more or less processed. Interestingly, the Scottish group appeared more concerned with construction function and purpose, including durability, compared to the control group.

There were also significant gender differences, with women appearing more concerned than men with the social aspects of materials, including the homeliness, warmth and comfort offered. Additionally, men related more to the qualities of strength in a material, whereas women focussed on its "naturalness" related to the degree of processing and sourcing from relatively natural environments. There was an overwhelming preference in both groups for wood, stone and glass, and a distinct antipathy towards concrete, plaster, mud and plastic. Women, rather than men, related to glass as a "social" material, because of its ability to provide visual connection. Individuals also demonstrated a surprisingly sophisticated approach to evaluating materials using a wide range of criteria and showing significant discrimination. Their occupation also influenced the way in which they appraised materials, with those involved in craft and design occupations, rather than administrative ones, tending to relate to the materials in terms of what they could physically do with them.

For both groups, the appraisal of materials was primarily in terms of subsistence, protection, identity and understanding their function. Virtually no mention was made of energy efficiency or waste minimisation which suggests that there is a poor connection between people's ways of evaluating construction materials and the way that the literature on sustainable construction conventionally evaluates these materials. This does not necessarily mean that people are unaware of these issues, given that they are at the forefront of government publicity campaigns, but that they relate to materials more tacitly and holistically on both a physical and metaphysical level. This finding presents a fundamental challenge: how can the technical discourse on sustainable construction resource use and materials meaningfully re-engage with issues of locality and culture?

6 Materials with a sense of place means materials with meaning

When individuals were asked about how their personal evaluations of construction materials might best be promoted, several clear themes emerged. These suggest a new way forward for the discourse on sustainable construction resource use drawing on the relationship between people, materials and place. Firstly, although 70% of all participants grew up in cities, there was a consistent reference to the more natural environment of the region in which they had lived, and the importance of understanding this in relation to the materials that "belonged" there. Through their childhood upbringing, they had a special bond with the relatively unprocessed materials associated with the more natural environment of the region and a deep understanding of how these should be used in relation to both climate and associated cultural traditions. There was also an understanding that the local knowledge which embeds the use of materials in their place of origin, through a deep understanding of local climate and topology, must be handed on from person to person over time rather than reproduced in abstract books. This tacit knowledge is arguably activated and developed through people's changing needs over time interacting with natural affordances.

The desire for a sense of identity and understanding in relation to construction materials was again related to a sense of place, often with clear references to the particular way in which materials were used in a given place through local construction techniques and local crafts. Place therefore provides a profound sense of orientation through repetition, familiarity, experience and attachment and the materials found in place are a part of this. This bioregional approach to materiality, which includes local cultural, social and economic as well as physical and geographic dimensions is seen by Cooper [16] and others as perhaps the most complete way of approaching genuinely sustainable construction. It is a fundamentally empowering process for the users and developers of local buildings, because it creates a virtuous circle of local economic development through the use of local resources in local environments, thus keeping people orientated and in touch with an understandable local identity.

7 The emotional design of resource use in place

A second theme relates to the emotional attachment that people in the study expressed towards certain construction materials. Gibson's theory of affordance suggests that our ability to survive is directly related to our evolutionary perception of what an environment physically offers to us. In terms of construction materials, we appear to relate to them in terms of how they can meet our personal needs, rather than thinking of them in remote or generic industrialised terms.

This attachment to materials and their use within a building has consequences for sustainable construction. As Kasteren [17] points out, "A beloved building probably requires less maintenance, because the people who work there (or live in the vicinity) become attached to the building and thus treat it with more respect". Architects can therefore potentially reduce contracted maintenance costs by drawing on the free care provided by people who will look after, and take pride in, local materials used in the building. This emotional endearment of construction materials is a new factor to take into consideration when trying to evaluate them in terms of their inherent sustainability. It is a relational way of considering construction materials that is unfamiliar territory for building scientists but not for architects. What is new for many architects is the idea of harnessing the emotional meaning of materials to sustainable resource use.

It is arguable that sustainable construction is ensured by referring to the users themselves, the needs that they have and the specific and local manner in which they believe these are satisfied. In effect, this means re-framing of architecture as *the emotional design of resource use in place* rather than the design of space using construction resources, which is how it is predominantly conceived. This consideration of place and user in relation to resource use is now considered in relation to developing work in the fields of ecology and anthropology, which have further consequences for the sustainable specification of construction materials.

8 Cultural eco-systems and construction materials

The combination of systems theory and ecology has, over the years, provided a firm platform for the scientific development of sustainable construction resource use which has led to the emerging field of construction ecology. More recent developments in eco-system theory include work by Kay [18] and others on the ability of ecological organisms to develop through emerging properties in a system that attempts to re-establish equilibrium in the face of change. This has been termed SOHO (self organising hierarchical open) systems. Importantly, it suggests that within eco-systems, new knowledge emerges from the bottom up, rather than being imposed from the top down, even though it is then ordered by higher systems.

At the same time Ingold's [19] anthropological investigation into different human cultures and their interaction with their local environment draws on Gibsonian ecological psychology to suggest that the division between ecology and culture is an artificial divide. He argues that: "those specific ways of acting, perceiving and knowing that we…call cultural, are enfolded in the course of ontogenetic development, into the constitution of the human organism" and claims that cultural differences are not *added on* to a substrate of biological universals; rather they *are* themselves biological.

When we combine Kay's notion of SOHO systems with Ingold's definition of human cultures as an integral part of these eco-systems, a very powerful proposition emerges in relation to the findings of the case study considered here. We can effectively re-frame the user's local tacit knowledge of place, processes, culture and materials as essential and integrated ecological feedback for the design and specification of construction resources. Furthermore, this feedback and the new knowledge it provides, emerges from specific "bottom up" local situations, rather than from "top down" generic guidance that attempts to eradicate cultural differences towards materials. At present, bioregional guidance on construction resource specification, offers the most compatible approach through its fundamental recognition of the indivisibility of cultural difference and ecology.

9 Natural materiality: taking technology to the limit

A final theme to emerge from the findings concerns the nature of the materials themselves. The more natural and relatively unprocessed materials, which participants were familiar with and attached to, carried a higher emotional endearment value than more processed and composite materials such as concrete, steel and plastic which were difficult for them to place. In their overall preference for stone and wood, as raw and local materials with relatively low embodied energy, it would appear that participants tacitly recognised that the more processing a raw material undergoes, the greater it's potential for toxicity (Genoni and Montague [20]). At the same time the findings suggest that people will "trade off" different materials for different purposes, so that the more

processed materials are recognised for the contributions they can make in terms of their specific properties.

Given the importance of emotional endearment in sustainable construction resource use, a challenge for the industry is to try and utilise raw materials with the minimum of processing while maximising their potential. This will help "close the loop" between user and specifier and contribute towards buildings that are more self-sustaining. As Norman [21] points out, the imposition of constraints can actually improve the efficiency of design. Thus, rather than continually expanding the variety of construction materials available with ever increasing overall energy costs, designers and manufacturers should concentrate on utilising the properties of raw materials as close to their original elemental state and geographical origin as possible. This implies focusing on a more limited palette of materials but working to the edge of technology in developing building elements related to these.

10 Conclusion

By re-framing the debate on sustainable construction resources in terms of people's relationships with construction materials, the findings of the case study presented here suggest a number of new themes in the discourse which deserve further investigation. These themes draw on affordance, tacit knowing and attachment as important means of evaluating the wider sustainability of construction resources beyond the current physical criteria used in tools such as LCA and ecolabelling. This can arguably best be achieved by architects and researchers considering cultural difference as an integral part of eco-systems, and removing the present dichotomy between cultural investigations of materiality in architecture and physical investigations in building science.

The importance and particularity of place, as an ecological/cultural context for evaluating materials is re-asserted here through the findings and a bioregional approach to materiality is suggested as offering the best way forward at present, because it addresses this joint context. True sustainability is thus based on a deeply situated knowledge of materiality, rather than a simple physical efficiency of resource use, which stays as close to the origins of materials as possible.

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