The issues of using recycled materials in architecture

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ABSTRACT: The use of materials in architecture has social, cultural, moral, and environmental implications. These implications, however, have largely been ignored. The issue of where materials come from or where they ultimately end up has had little impact on the practice of architecture as a whole. This paper is concerned with this issue. The main objective of the research presented in this paper is to examine the use of recycled materials in architecture practice by considering the reasons and benefits of using recycled materials, the problems with their use, the aesthetics of recycled materials, and the future potentially of their use. The research was conducted through literature review and interviews with a number of architects.

The paper concludes that one of the most problematic barriers is a lack of knowledge and understanding of the use of recycled and reused materials by architects. If architects had a greater understanding and knowledge of the issues involved they would be in a position to inform their clients. To overcome this problem there needs to be education and support of architects and an acknowledgement by the profession of the imperative of sustainable approaches to architecture and of the impact design choices have on the environment.

Conference theme: Architecture and the environment
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1. INTRODUCTION

Building materials are all around us. They create our homes, our workspace, our shops, roads and cities. They create our built environment. The use of materials in architecture has greater implications than just those to do with aesthetics and design. They have social, cultural, moral and environmental implications. These implications have largely been ignored with the focus being on building performance, pure aesthetics and the short-term economics of materials. Architecture and materials have only been considered within the terms of user experience, with little or no consideration to implications beyond the actual existence of the architecture itself. This has meant that the issue of where materials come from or where they ultimately end up has had little or no impact on the practice of architecture as a whole. This research paper is concerned with these issues and seeks to examine the place and use of recycled and reused materials in architecture.

The objectives of the research presented in this paper are:
1. to examine the use of recycled materials in building, including the role of recycled materials in architecture practice, and
2. to examine the issues affecting the use of recycled materials in architecture practice, including the reasons for using recycled materials, architects’ and clients’ commitments, constraints in the use of recycled materials, and the aesthetics of recycled materials.

It is expected that this paper will contribute to the understanding of the use of recycled building materials, their place in architecture, how they are currently used by some architects in architectural practice, and the potential for their use in the future.

1.1. Methodology

The methodology for research in this paper encompasses two approaches. The first was a literature review and the second a series of interviews of practising architects.

1. Literary Review – The literary review was undertaken to understand the scope and potentiality of recycled materials in architecture as well as the current availability of different recycled and reused materials and their place in architecture.

2. Recorded interviews with architects - Four architects in Adelaide, South Australia, who have engaged in the use of recycled or reused materials, were selected and interviewed to provide understanding and knowledge of the use of recycled materials within architectural practice. It was not, however, the intention of the research to generalise results of the interviews to represent the voice of all practising architects. Rather, the information provided by these architects were acknowledged as very important to learn the issues, as this information was based on the architects’ own experience.

1.2. Scope

The term recycled materials in this paper is meant to encompass all of the following; reused building materials and elements, building materials consisting of materials that are conventionally considered (and treated as) waste, and materials that are recycled. Whilst it is acknowledged that all of these products may not be equal in terms of their sustainable merits, it is not the goal of this paper to discuss the relative merits of various recycled or sustainable building materials. Instead, this paper wishes to discuss the use of recycled materials as a serious consideration within the larger issue of sustainable architecture in particular and sustainability in general.

The scope of the paper encompasses and is limited by the information gained from the interviews with architects, and from journal, book and web information on recycled materials. It will not cover all the information available on recycled materials and is not expected to be
a comprehensive guide to specifying recycled materials.

2. THE USE OF RECYCLED MATERIALS IN BUILDINGS

This section discusses the first objective of the research – to examine the use of recycled materials in buildings.

2.1. Recycled materials

To consider the role of recycled materials in architecture it may be useful to consider the life of a building in three phases: an initial phase, a middle phase and an end phase. The initial phase occurs prior to the building’s existence and concerns how the materials that will constitute the building are sourced and manufactured. The middle phase encompasses the building’s lifetime, and the end or final phase begins at the time of the building’s deconstruction or demolition and involves the journey of the constituent parts of the building to their end destination.

In the initial phase we are concerned with the energy and raw material consumption in sourcing, creating and delivering building materials to the point where they will be used to construct a building. This phase involves the energy used and the waste products produced during construction of the building. Considerable amounts of energy are used in sourcing, manufacturing and transporting building materials as well as in the construction of buildings. Studies conducted in Australia and overseas revealed

“the embodied energy within a building, that is the energy needed to extract and process raw materials into finished building components, as well as the energy used in the construction of the building, in the case of large commercial buildings, can be greater than the operational energy requirement.” (Lawson, 1996:11)

For conventional residential buildings the embodied energy can equal as much as 15 years of the operational energy requirement (Reardon 2001).

The most common and widely used form of energy, created through coal burning, produces CO2 emissions that are credited with climatic changes such as the depletion of the ozone layer and the greenhouse effect occurring in the earth’s atmosphere. The emissions are considerable;

“building’s in the western world - their construction and use - are responsible for 50% of the deleterious emissions which are causing the planet to overheat.” (Jones 1998:8).

Alternative energy sources such as hydraulic and nuclear energy have their own negative environmental effects and are not necessarily solutions to energy-use problem. As well as energy usage, the building and construction industry also consumes a significant amount of the world’s raw materials. It is reported that the “building and construction activities worldwide consume 23 billion tonnes of raw material each year or 40% of total global use.” (Roodman and Lenssen 1995:1) In many cases these materials may be non-renewable and their extraction, whilst using a great deal of energy, may also have detrimental environmental side effects such as pollution and the destruction of ecosystems. There are other negative environmental effects caused by the sourcing and manufacture of materials, such as those created through mining and forest timber harvesting, as well as the issue of the creation of waste during the manufacture of materials. This waste, in some cases, is very toxic, as it is in the case of the manufacture of aluminium.

The middle phase of the building regards the performance of the building during its existence. This mainly concerns the energy needed to operate a building (including maintenance and repair), and issues such as water consumption and waste production. The end phase involves the end of the building’s life, and in this phase the majority of the materials are demolished and “are disposed of in a landfill, where they are effectively unrecoverable and may have a variety of adverse environmental impacts.” (Lawson 1996:17) The environmental effects include the leaching of toxic substances such as metals into the ground and then possibly into the water table. Once in the landfill it would almost be impossible to salvage any of the materials to use them at a later date. Construction waste makes up a significant amount of all landfill waste. Estimates in Australia place the amount at up to 40 percent (Reardon 2001). Landfills effectively contaminate the land where they are sited for future generations.

The issue of the use of recycled materials and its relevance to architecture and sustainability relates directly to the initial and final phase of a building. The use of recycled materials in buildings positively affects both landfill waste created at the end of a building life and the waste produced in the initial creation of buildings as well as decreasing the use of raw materials and energy.

2.2. Examples of products that can be reused or recycled

According to the “Your Home Design for Lifestyle and the Future Technical Manual” (Reardon 2001), most materials can be recycled. It is possible to recycle 100 percent of steel and aluminium. Recycling reduces the embodied energy of steel by 72% and aluminium by 95% (Section 3.2.2). Steel and aluminium materials and elements can also be reused. This manual also states that plasterboard releases poisonous hydrogen sulphide when disposed in landfills, although it is able to be recycled and is currently being recycled by a major building material manufacturer.

Timber is one of the most popular reused materials but it can also be re-processed into horticultural mulch or recycled into particleboard. According to an article on salvaged timber entitled “New Life for Old Wood” (Kroloff 1996), architect Peter Bohlin notes that “prior to the advent of the salvaging movement” beautiful old timbers from old buildings, piers, warehouses and the like were “either thrown away or wasted as shoring on highway construction.” (Kroloff 1996:165) Old timbers are becoming more popular and this is reflected in their price. Salvaged timber can be expensive and cost twice as much or more than the newly harvested timber. Whilst this is true and the current cost of some reused timbers may be prohibitive to some, most would lament the past practice of throwing away these beautiful old timbers. In addition to this, Gordon Plume, president of GIP Plume, a specialist salvage timber company in Seattle, USA, believes that it is “difficult to compare ....the stability, strength and quality finishes ....of solid recycled timber” with the “laminated or composite materials more typically found on the market.” (Kroloff 1996:165)

According to Downton (2003), a company in the US is currently producing a particleboard alternative using Kentucky bluegrass. Particleboard is made from wood chips and formaldehyde, which has negative effects both on human health and the environment. Another alternative to particleboard in a material produced in Victoria, Australia, called Ecopanel, which was made from straw, an agricultural waste product. Due to its price, however, this product could not compete with the cheap particleboard that was being imported from
overseas and the company subsequently went out of business. Windows can be reused and when this is not possible glass window is able to be recycled. Recycled glass has a 20% reduction in embodied energy compared with virgin glass. Glass can also be used instead of virgin materials as aggregate for concrete, along with other products such as crushed bricks, tiles, and concrete (Reardon 2001). Industrial waste can be reused as a component of concrete, a partial substitute for cement. This industrial waste includes flyash – a by-product from coal-fired power stations, slag – a by-product from steel mill blast furnaces, and silica fume – a by-product from silicon metal production. This alternative concrete has been used in the Sydney Harbour Tunnel, Sydney Parallel Runway, the Melbourne Crown Casino, and the Sydney Olympics white water canoe course at Penrith (CSIRO 2003). About one million tones of flyash are currently used in cement replacement; this is of the approximately ten million tonnes that are generated in Australia each year (Kingsley 2003). An Australian company has also produced an alternative concrete block that is almost completely made out of flyash. Consequently it “uses one-sixth of the 15kg of virgin material of a conventional block.” (Kingsley 2003:3) This has the added advantage of being able to be crushed and remoulded into new blocks at the end of its life, which cannot be done with conventional concrete blocks. These are only some of the examples of alternative recycled and reuse building materials that can and have been (and have yet to be) used in buildings and other constructions.

2.3. Deconstruction – critical to the reuse and recycling of buildings

An important issue in the use of recycled materials is the way in which we dispose of buildings. For materials to be reused or recycled, first they have to be recovered from an existing building. Currently, most buildings are demolished with the materials ending up as unrecoverable waste in landfill. Neil Seidmann, director of the Waste Utilisation for the Institute of Self-Reliance asserted that “deconstruction” (read: demolition) is an area of vast social, economic and environmental potential benefit.” (Nadel 1999:22) He states that material reuse is 200 times more efficient than recycling, and as an example, a deconstruction project that Seidmann worked on recovered 40% of building materials (bricks, wood windows) and recycled an additional 10%

It appears that there could be definite economic advantages to the deconstruction of buildings compared with the conventional model of demolition. Ruth et al. (1994) showed that a cost saving of 16% could be achieved in dismantling and reusing or recycling materials compared with more conventional demolition and disposal, even though the former would take more time. (Lawson 1996:20). Whilst, as Seidmann points out, the use of reused materials is more environmentally efficient than recycling materials, reused materials are highly unlikely to be employed in large commercial buildings. Such is the nature of commercial buildings that they require large amounts of repetitive standard materials and elements. This is where alternative materials from post-construction, post-industrial or post-consumer waste become imperative. There are many examples of materials that are manufactured using waste and that are direct alternatives to widely used construction materials. Large manufacturers of building materials need to be encouraged to develop green alternative materials.

2.4. Examples of buildings that use reused and recycled materials

There are many examples of the successful use of reused and recycled materials in both public and residential buildings. A significant building, which utilises a large amount of reused materials, is the Sydney International Shooting Gallery, built for the 2000 Sydney Olympics. In this facility 90% of the timber used is reused timber, the remaining 10% is plantation timber. The Olympic Coordination Authority declares on its official Web site that it is committed to resource conservation in its buildings and that the use of recycled materials is one of the many ways it is attempting to achieve this (OCA 2000). Whilst this building is the only one mentioned that uses reused or recycled materials, its use of reused timber is significant.

Reused and recycled timber is also used in two large commercial/public buildings in South Australia. The first one is the National Wine Centre in Adelaide, designed by Grieve/Gillette. A large amount of reused timber is used for the floor of the function hall. In the Jacob’s Creek Winery Visitor Centre, which was awarded an RAIA State Award in 2003 in the category of environmental design, recycled timber is used for the posts and beams. The Christie Walk development in Adelaide, South Australia, utilises recycled timber for the structures of the cottage dwellings, pergolas and balustrades, as well as for the doors and window frames with some doors being reused doors (Downton 2003). Straw bale, a post-agricultural product, has been used for the external walls of the detached dwellings. A product called Ecopanel, a particleboard alternative, also made of straw, is used for all the joineries. Both these products provide very good sustainable performance for the building over its lifetime. Strawbale has a thermal performance higher than insulation products on the market. It also has a high fire rating; 2 hours compared with 90 minutes for a brick veneer. Flyash was also incorporated into the concrete slabs as a partial alternative to cement.

Figure 1: Straw bales are used for the external wall of the cottage dwelling (left) and recycled timber is used for balustrades and pergolas in the townhouse building (right) of the Christie Walk development. Both buildings also use recycled timber for window and door frames.

Pritchard’s first family home incorporates large reused windows and all the ceiling joists are made with pine off cuts (Pritchard 2003). This house was constructed at a fraction of the cost of a conventional home with Pritchard salvaging all the materials himself and building the house. A house designed by architect John Maitland, called Kawanda Muna, uses recycled timber for the roof
structures, and salvaged materials such as electrical fittings, wire, and plumbing, all of which were collected by the owner over the years (Smith in Reardon 2001). These two houses demonstrate how using recycled materials can make building a house a more affordable option is one is willing to spend the time salvaging for suitable materials.

3. ISSUES AFFECTING THE USE OF RECYCLED MATERIALS IN ARCHITECTURE PRACTICE

This section discusses the second objective of the research, which is to examine the issues affecting the use of recycled materials in architecture practice including the reasons for using recycled materials, architects’ and clients’ commitments, constraints in the use of recycled materials, and the aesthetics of recycled materials.

3.1. Reasons for using recycled materials

Three of the four architects interviewed for this paper cited both aesthetic and environmentally ethical reasons for using recycled materials. They refer to the issue of embodied energy as being an important factor or benefit in the use of recycled materials. For example reusing or recycling a material or element means that the energy used to produce the material is amortised over more than one building’s lifetime. Dowton (2003) makes the point that aluminium should never be thrown away because of the amount of energy it takes to manufacture. Aluminium’s continual reuse or recycling can be a way of justifying the energy used in its initial production. Another consideration mentioned by both Dowton and Maitland for their use of recycled materials is the gas emissions produced in the manufacture of some materials. For this reason Dowton specified the use of flyash, as a partial substitute for cement in the concrete slabs of the Christie Walk project. As Dowton asserts, the manufacture of cement contributes “something like 5 to 8% of global warming.” As mentioned above flyash is a waste product from the burning of coal to produce electricity. So whilst the burning of coal for electricity is not a sustainable activity, it is a reality. The use of this waste product, therefore, can only be considered a benefit.

Consideration of the environment and ethics of materials encompasses not just energy use but other far-reaching cultural, social and political issues. This is the case with one of the most popular construction materials, timber. The ethics of timber use is something Phillips and her office give serious consideration. They have a policy of endeavouring to use recycled materials first and then Australian timbers. If there was not a suitable product they would then “use North American timber or European timber that are at least from first or second world countries” (Phillips 2003). This, she says, is to avoid sourcing timber from countries because of forest mismanagement which may mean the destruction of indigenous people’s land. Phillips states her office also uses plantation pine but acknowledges that this material has other environmental problems attached to it “in terms of what (the plantations) do to the bio-diversity in the area that they are in.” The Wilderness Society (2003) argues in favour of using plantation timber over timber from Australia’s “last remaining native forests”. It argues that plantations grow “timber 10 to 40 times the rate of a native forest.” However, there are other environmental problems associated with use of plantations the issue of bio- diversity, for example the toxic chemicals needed to protect against termites. Such problems have to be weighed against the loss of rainforest, bio-diverse ecosystems, habitat and species, which are some of the side effects of native forest logging.

One of Phillips’ projects, the Monarto Zoo Visitors Centre, was built using recycled timber from old Adelaide wool sheds. The client was very keen to use recycled timber because of their strong ethical position. The Monarto centre is concerned with the preservation of endangered and threatened species, and as a result is worried about the loss of habitat through logging and other related activities. They therefore wished to produce a building, which did not contribute to the problem of habitat loss.

3.2. Architect’s and client’s commitment

There are many problems associated with using recycled materials discussed later in the paper, which are credited with deterring architects from using them. It is widely accepted that architects are at their core problems solvers, so why do these difficulties prevent architects from engaging with them? One could argue that for architects the imperative of sustainability is not a very urgent one. Wittmann’s study, entitled “Architects’ perceptions regarding barriers to sustainable architecture” (Wittman 1998), seemed to confirm this. She found that the majority of architects surveyed were not committed to lower the adverse impacts their designs can have on the environment. Wittmann found that this is not an attitude isolated to architects and concluded that “the main barrier to sustainable architecture is of societal significance rather than a problem confined to architects alone”. Architects perceived five main barriers preventing them from engaging in sustainable design. Amongst these are a lack of information, lack of interest by clients, developers, and the profession itself, as well as a lack of focus on the issues by influential bodies such as the Royal Australian Institute of Architects and other government bodies. This at least partially, seems to be supported by the architects interviewed for this paper. It appeared that the use of recycled materials strongly depended on the goals of the clients and in many cases the clients’ strong commitment to the use of recycled materials. That is to say that they were willing to either spend time sourcing the materials themselves, or were prepared to wear a significant cost increase on their building. Dowton (2003), who explains that architects are ‘end-users’ in the conventional developer model, also supports the survey findings. He says that in this model architects are not the drivers of the projects, nor are they considered the fount of all wisdom by developers.

Phillips (2003) believes that architects are in a strong position to educate the public. It is a pity then that Wittmann’s study found that most of the architects surveyed did not “possess much knowledge in the field of sustainable architecture.” Along with this Wittmann found that two of the five main barriers, that architects perceived, as preventing them from engaging in sustainable design were ‘inaccessibility of relevant information combined with uncertainties regarding the riskiness of energy efficient technologies’ as well as ‘the issue of costs associated with sustainable architecture’. Despite these barriers some architects, such as the ones interviewed in this research, chose to engage in the use of recycled or reused materials.

3.3. Constraints in using recycled materials

There are a number of issues that may constrain the use of recycled materials. These include cost, liability,
availability, suitability, and the effects on the design process.

a. Cost

One of the major disadvantages of using recycled materials is cost. This can be either in terms of the cost of the material itself or the cost of time spent salvaging and/or working with the material. Maitland (2003) and Phillips (2003) attest to the fact that reused timber is far more expensive than new timbers. Phillips believes the cost penalty for using reused timber can be up to 30% of the total cost of the project. Recycled materials or materials made with waste can also be more expensive than their conventional counterpart. This is also the case with the material called Ecopanel as discussed earlier. Downton (2003) stated that often the most commonly used building materials are the worst for the environment and human health but are also the cheapest.

Pritchard (2003) believes that the use of reused materials is most suited to the owner builder who cannot only salvage the materials but is also willing to spend the time working with them. He salvaged most of the materials for his first home and built it at the fraction of the cost of a conventional house. He has used reused windows in a restaurant where the client found the salvaged elements. Pritchard currently has a client who is salvaging her own hardwood decking timber because she wishes to avoid using recently felled rainforest or old growth forest timber. Apart from these projects Pritchard does not use recycled materials and it seems that this is primarily because it is not a focus of his clients. Alternatively Maitland (2003) regularly uses recycled materials in his projects as his clients often willing to salvage these materials themselves. Downton makes the point that many people do not have time to source their own materials because they work full time and have children or other commitments.

Increased costs are not only due to the material themselves and salvaging time but according to Phillips (2003) can also be in the form of a premium paid to the builder for the risk of dealing with these materials. Old timbers can often contain nails or bolts, as was the case with timbers salvaged from the old Adelaide Wool Stores. These timbers, Phillips explains, were supposed to be nail and bolt free but in fact were not. Time is spent locating and avoiding or removing these unwanted inclusions and there is a risk to machinery if any go undetected. In the case of Monarto Visitors Centre the hardwood seasoned timber was very hard and caused much greater wear on the machinery than would unseasoned or softwood timbers. All these conditions add to the overall cost of a building.

Downton agrees that it is very labour intensive to deal with recycled materials. On the Christie Walk project timber was purchased directly from a demolition site, meaning that it had to be de-nailed and prepared on the site. This added significantly to labour costs. In a later stage of the project, therefore, recycled timber that had been prepared for reuse was obtained, and even though the material’s unit cost per metre was more expensive, it was found to be more cost effective for the project.

One important point that the authors wish to make is that whilst environmental materials are usually more expensive than the conventional ones, if we were to consider the real costs of conventional materials to society in terms of future adverse effects on health and the environment, it is highly likely that the cost of conventional materials would far exceed the costs of environmental materials.

b. Liability

The use of reused building materials can also lead to increased liabilities and insurance costs for the architect and the builder. Phillips (2003) points out that if a reused aluminium window leaked there could be two possible reasons, because of the quality of the reused product or because the builder installed it incorrectly. She says this kind of situation can introduce ‘grey areas which introduces liability, which increases the architect’s exposure to claims. Any claims you have, have an impact on the cost of professional indemnity.’

This situation implies that there needs to be a willingness to use recycled materials on the part of the client. Phillips agrees and feels that “at the end of the day, is an education issue. The architect or our profession is in a good position to contribute to that education. We can be an agent for change but I think it is hard to expect the architects to take on all that liability in a very hostile insurance market.” (Phillips 2003)

c. Availability

One of the difficulties associated with using reused or salvaged materials as opposed to recycled materials (or materials manufactured from waste) is availability. The problem is finding suitable materials at the right time. Maitland (2003) makes the point that there is not a stock standard supply of available reused materials, unlike conventional materials where if a product is not available today it will be available tomorrow. Downton (2003) wishes to use many more salvaged materials in the Christie Walk development and feels that the only way to deal with the amount of materials needed would be to start their own salvage operation, which was not done as it required a complex management task. The salvaged materials for this project also caused storage problem as they were sourced prior to the commencement of the project. He points out that established suppliers will take care of the storage issue prior to contract. And the storage costs are included in the cost of materials. This again means that the materials are more expensive than the conventional option.

d. Suitability

The issue of availability is also linked to the issue of standard specifications. There can be difficulty in obtaining reused materials that meet the required safety and other appropriate standard specifications. Downton (2003) salvages steel for balustrades on the Christie Walk development but found it did not have the sufficient thickness. There are similar issues in using reused windows if there is a need to have double glazing or fire-rated glass. The cost of replacing the glass will overshadow the cost advantage of using such windows. This is also the case with reused steel elements, which would usually have to be redrilled, punched and cut to fit the exact specifications of the new building.

e. Effects of recycled materials on the design process

The availability of reused or recycled materials also impact significantly on the design process. Maitland (2003) points out that you cannot design without knowing the availability of specific recycled materials, but equally, without an initial design in mind you do not know what materials to look for. This means that the design process becomes more complex and iterative. In his office, for example, standard, commercially available materials, such as pinus radiata, are specified for framing, but then the client may go out looking for recycled materials and return to the office with information about what is available. These materials would then be incorporated into the original design idea.

Phillips (2003) mentioned that in some of their projects, the reused timber was resourced first and the timber span then determined the building’s structural grid. She makes the point that this way of designing is not completely back to front as there are standard
economical sizes for many materials. The difference though is that the standard material sizes are known prior to the inception of the design process. In another project, reused stone was used for a landscape wall. The amount of stone that was available determined the length and height of the wall.

The above experiences show that it is not simple to incorporate recycled materials in a design of a new building. As Maitland asserts, the designer needs to know the condition as well as sizes of the materials in order to proceed with the design, but at the same time the initial design is also needed in order to find out what recycled materials to look for. This complicated process may also be the reason why many architects avoid using recycled materials.

1. Role of the architect versus role of the developer

Another issue is how much role the architect has in a project in specifying the materials. The Christie Walk development is a community-based project with the clients forming a non-profit development group to develop the project. Downton is the project architect, a client, as well as for a builder for one part of the development. This unusual arrangement has blurred the conventional lines of demarcation that would normally exist between the different stakeholders of a development. A clear distinction usually exists between the developer, client, architect and builder. This unusual development model where the relationship was “not purely contractual and economic” has meant it was easier to incorporate non-standard materials. In a usual development the developer is building for economic return, so it is likely that materials such as flyash would not be specified. Flyash requires a longer drying time compared to normal cement in a slab and therefore holds up the construction of levels in a multi-storey development. In the next stages of the Christie Walk development, the stakeholders are looking at using more “conventional development structures” whilst still employing non-standard materials. This will be a test to see how well non-standard materials can be incorporated within a normal development structure. In this scenario Downton says his role as a specifier will become more crucial to ensure the use of these materials (2003). This is opposed to the usual developer model where the role of the architect as a specifier is reduced in place of economic rationalism. As Downton explains if a developer is not getting the answers they wish for, they can always find another architect. In this model the architect is the “end user” of the project and not the driver. This conventional model depletes the architect’s potential role as an instigator of change through environmental design and specification.

3.4. Aesthetic qualities of recycled materials

Whilst these environmental considerations are important motivational factors for the use of recycled materials, the physical qualities of the materials and their use within the overall aesthetic aims of the architecture is an important (or in fact pivotal) factor, for them being employed. In two projects which Phillips sites, the use of recycled timber for structural framing, exposed roof joists, joinery and flooring was aesthetically important to the spaces they were trying to create. Both centres are in rural locations and the use of these materials created an atmosphere and a “patina of age” that made the buildings “appropriate to a particular place” (Phillips 2003).

For Downton (2003), the use of recycled materials helps create new buildings “to not feel sharp or empty” but instead feel “established” in a way that one is unsure about exactly when they were built. He states that it can give a building a “sense of patterning that you get with age and occupation.” In the Christie Walk Development this effect is achieved through the use of salvaged old tiles, straw bale walls, and recycled timber. Similarly Maitland (2003) attests to his clients referring to an aspect of his design that they feel connected with. This aspect, Maitland fees, is his use of materials such as rammed earth or recycled timber. Maitland talks about recycled timber in loving terms referring to their beauty and texture and to a communication that occur between the user and the material on an energetic level.

For these architects recycled materials are not only an environmental issue but they also hold fantastic design opportunities.

4. CONCLUSION AND SUGGESTIONS

Building needs to be considered in terms of their entire life, from sourcing of the raw materials through to the re-employment or disposal of the building and its parts. If we consider buildings in this way we will see the effects of a building far beyond those that occur during its physical existence. Recycled building materials have the potential to close the circle in the cycle of a building’s life.

This paper has discussed the use of recycled materials in building and the issues affecting the use of recycled materials in architecture practice. It discusses that there are many ways recycled and reuse materials can be employed in architecture. These materials hold many aesthetic and design opportunities, which are unique and cannot be obtained with the use of conventional products. Old reused materials are able to connect an architect to the past, to a history, a story; something that new products by their nature cannot do.

There are several examples of innovative ways to reuse and recycle materials for use in buildings. There are also many examples of the successful employment of recycled materials in both public and residential buildings. These examples demonstrate the possibilities of recycled materials.

Of the many issues that surround the use of recycled materials in architecture, most relate to cost whether it is the cost of the materials themselves or the cost of labour or time in relation to their use. For architects and builders there can also be an issue of liability and risk. Particularly in the case of reused materials there is also the issue of the availability and suitability of materials. The design process may also have to be considered and approached in a different way. This, however, could be viewed as a design opportunity and not as a constraint.

One of the major barriers to the use of recycled materials is the lack of knowledge architects possess of the issues and practicalities of recycled material use in particular and sustainable building in general. Whilst this is true of architects, it is also true of clients and society. It seemed evident from the interviews conducted that recycled materials are more likely to be employed when the clients themselves have an investment or interest in their use. Another barrier to the use of recycled materials is the lack of desire by society and the government to take an active role in encouraging sustainable architecture. For recycled materials to play a more significant role in architecture, architects, clients and developers must be encouraged to embrace building products that reduce waste, pollution, energy consumption and other environmental effect such as habitat and species loss. Unsustainable building products could be subject to an environmental tax, which reflects their true cost to society and can be used to help reverse their negative impact on the environment. Environmental building products could
also receive tax breaks, as could developers who produce environmental responsible buildings.
In conclusion, the authors believe that the use of recycled building materials in architecture should be viewed not as a fringe practice conducted by a handful of architects, but as a practice with which all players in the building profession should engage. More use of recycled materials and more sharing of the practical knowledge about their use will decrease the barriers that now still exist.

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