



On the edge

**Proceedings of the 44th Annual Conference
of the Australian and New Zealand
Architectural Science Association**

Cross-disciplinary & intra-disciplinary connections in architectural science

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On the edge: Cross-disciplinary & intra-disciplinary connections in architectural science

The 44th Annual Conference of the Australian and New Zealand Architectural Science Association seeks to bring together not only the edges of practice and theory, but also cross-disciplinary edges – recognising that forward progress in, for example, sustainability, climate control and digital technology in architectural science and design, relies on a multidisciplinary approach. In turn this flows through to education, providing a new generation of professionals and academics with a rich and encompassing perspective.

This conference, held at Unitec Institute of Technology in Auckland and jointly hosted by the Departments of Architecture and Landscape Architecture, brings strength to the theme **'on the edge'**. Auckland, the city within which this conference is held, is located on a narrow isthmus (approximately 1 km at its most restricted) between two magnificent harbours – the Manukau harbour to the south and the Waitemata harbour to the north. It is also bounded by the Waitakere ranges in the west and the Hunua ranges in the east, and peppered in its geography with as many as 60 volcanic cones. Sea, bush, island and volcano edges frame our city and determine our landscape and architectural endeavours.

The papers presented at the conference, the abstracts for which fill the following pages, are a metaphor for the multicultural city in which it is held. They are diverse, they embody the cross-disciplinary collaboration themes sought by this conference and embrace, through the applied research focus, the rhetoric versus reality divide.

Unitec Institute of Technology prides itself on an applied learning focus, and the established synergies between the two host departments is a unique and celebrated aspect of the vibrant teaching and research environments generated.

The editors have been impressed with the depth and breadth of papers offered, and wish to thank all authors for their contribution to the success of this conference.

Chris Murphy, Susan J. Wake, David Rhodes, David Turner,
Graeme McConchie.

Keynote Speaker: Dr Mark Bassett

Design tools for water management in external walls in New Zealand

Principal Scientist, Building Research Association of New Zealand (BRANZ)

It has been well established here in New Zealand that moisture problems in buildings have the potential to dent the economy, destroy personal dreams and generally erode the health of many New Zealanders. Surprisingly however to date, progress on the development of adequate verification methods and design aids supporting the current regulations for controlling moisture in buildings has been slow. Primarily this is because difficulties inherent in the science of moisture make it one of the last frontiers of physical science in this area yet to be translated into useful design advice.

Encouragingly, there is progress afoot towards design tools for moisture control that are tuned for New Zealand and are consistent with energy efficiency and sustainability goals. In this respect the leaking building problem has advanced the science of water management.

This paper will outline, through case studies, the issues facing researchers in the area of residential moisture control, including common indoor moisture problems in homes and the questions this generates about the role of ventilation and house airtightness. It will also discuss the development of an early prototype tool called WALLDRY, used to improve tolerance of walls to water leaks.

Keynote Speaker: David Shearer

Clean, green and clever: Future directions for New Zealand

Member of Parliament, Mt Albert

The speaker, David Shearer, is the local MP for Owairaka/Mt Albert, an electorate that includes Unitec Institute of Technology. He was elected to Parliament in 2009, and has been a strong supporter of Unitec. His background is in humanitarian advisory and coordination work with the United Nations in such locations as Rwanda, Albania, Jerusalem and Afghanistan. In 2007 he was appointed by the United Nations Secretary-General Ban Ki-moon as his deputy Special Representative (Humanitarian, Reconstruction and Development) for Iraq.

David's background in humanitarian and reconstruction work, and his current role as Member for Parliament positions him well to comment on the crucial decisions New Zealand must make to remain viable in this rapidly changing global world. His seminar will outline personal views relating to the future of technology in New Zealand, within a world increasingly vulnerable due to the ever increasing demand for energy.

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Abstracts

**On the edge:
Cross-disciplinary & intra-disciplinary
connections in architectural science**

Post-disaster housing reconstruction: Post-occupancy case studies from Sri Lanka

Iftekhar Ahmed and Darryn McEvoy

RMIT University, Melbourne, Australia

After the 2004 Indian Ocean Tsunami, major housing reconstruction programmes were implemented in the affected countries. Five years after, the houses that were built offer post-occupancy lessons. This paper is based on Sri Lanka, one of the countries most severely impacted by the tsunami. The experience of these large reconstruction programmes prompts a fundamental question: what design and planning features should be encouraged, and what should be avoided, in post-disaster housing reconstruction programmes? Based on primary information from interviews of community members and representatives of agencies involved in planning and implementing the programmes, three main aspects are discussed – design, construction and post-occupancy issues. From the micro-scale of design of spaces within the house to the urban scale of settlement layout, the achievements made in the context of a highly constrained post-disaster situation as well as issues that required more careful attention are discussed here. The paper underscores the importance of resilience and capacity for adaptation of the communities in these settlements, and highlights the necessity of involving local communities in all stages of housing reconstruction.

Performance of a building integrated solar combisystem

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Solar combisystems providing both water and space heating to buildings are becoming commonplace in European and North American locations. However, the use of these systems in Australia and New Zealand is still in its infancy. While significant work has been undertaken to characterise the performance of these systems in northern hemisphere locations, this does not necessarily reflect their performance in Australia or New Zealand. This work examines the performance of solar combisystems utilising TRNSYS and F-chart simulations of an integrated solar thermal combisystem installed in a single storey detached dwelling under typical Australian and New Zealand climatic conditions. In doing this, it shows that there is significant scope for increased use of solar combisystems in the cooler climate regions of Australia and New Zealand.

Enriching student experience and inter-professional learning of inclusive design with *Second Life*

Susan Ang, Stephen Segrave, Helen Larkin, Valerie Watchorn, Danielle Hitch, Hisham Elkadi, Merrin McCracken, Dale Holt

Deakin University, Geelong, Australia

This position paper reflects rapid advances in immersive 2D and 3D eLearning technologies and the expanding pool of ideas and applications in higher education across two professions. Inspiration has been drawn from examples in design learning, and various multidisciplinary collaborative projects through developmental research in Multi-User Virtual Environments (MUVes). Linden Lab's Second Life (SL) is the most mature and popular of the 'persistent' virtual worlds. The study described in the paper aims to enrich student learning through a range of SL simulated 'life experiences' relating to accessibility and mobility in the built environment.

Significantly, the successes of such initiatives lie in several elements: teaching champions with vision and courage; detailed scripting of precise role-play encounters for first-time users to provide supportive 'blended learning' contexts; careful and vigilant strategic management of facilities and resources, and a robust design program. The paper focuses on the crucial alignment of these elements to the specific challenges of designing and navigating conception and development processes, to enable the execution and delivery of a tightly defined script. This innovative pedagogical approach lacks time-tested outcomes, but is recognised equally as opportunity and challenge; risk and reward.

Creativity and design: An educational dilemma

Hedda Haugen Askland, Michael Ostwald and Anthony Williams

The University of Newcastle, Australia

This paper explores the issue of creativity in design and considers its educational implications and in particular as it relates to assessment. The paper forms part of an ongoing Australian Learning and Teaching Council (ALTC) research project entitled *Assessing Creativity: Strategies and Tools to Support Teaching and Learning in Architecture and Design*, which rose from the 2008 ALTC Discipline Based Initiative (DBI) study into the architectural discipline across Australasia (Ostwald and Williams 2008a; 2008b). In the DBI study, Ostwald and Williams found that there is widespread confusion and disagreement surrounding assessment practices for design, in particular as they relate to creativity. The current study addresses this ambiguity and aims to arrive at a model of creativity and a set of strategies for assessing creativity in design education that may bridge theoretical and practical approaches to design creativity. This paper forms part of this process and reports on data collected during a symposium with Australian design academics and practitioners who met to discuss their perceptions and experiences of creativity and assessment of design students' creative works.

Lighting conditions in sustainable buildings: Results of a survey of users' perceptions

George Baird, James Thompson and Guy Marriage

Victoria University of Wellington, New Zealand

For the last four years the authors have been investigating the performance in practice of a range of sustainable commercial and institutional buildings worldwide. These investigations involved the principal author in one or more visits to each of the buildings and the personal distribution and collection of a questionnaire survey seeking the users' perceptions (on a seven-point scale) of a range of factors: operational, environmental, personal control, and satisfaction.

For this paper the authors focus on the users' perceptions of the quality of lighting in their work areas. The users' overall perceptions of lighting conditions are presented and analyzed, first with an overview of the average scores for each question, followed by a look at the shapes of their distributions over the set of buildings, and then the results of some correlations between Lighting Overall and a number of other key performance factors such as Health, Productivity and Overall Comfort. It was found that Lighting Overall was one of the higher scoring factors of the Environmental category, and the average scores for the amount of natural and artificial lighting were close to the ideal. However, direct glare from the lights and from the sun and sky were noted as issues to be addressed.

Wasted opportunities: Developing resiliency in architecture through ecosystem biomimicry

Brad Balle, Graeme McConchie

Unitec Institute of Technology, Auckland, New Zealand

Surplus buildings are frequently demolished and replaced under the assumption that it is cheaper to replace than adapt. The demolished building becomes waste material, usually ending up in landfills. Yet in nature discarded waste does not exist – it instead becomes ‘food’ for other flora and fauna. So too can surplus artificial waste become ‘food’ for new construction, thereby prolonging the life-cycle of materials by seeking new opportunities for their reinvestment in a building.

We can therefore rethink a building as a long-duration work-in-progress, constantly developing and changing incrementally under evolving contexts. This would require buildings to be regarded as readily susceptible, not resistant, to adaptation and growth. The energy-conservative re-use of an existing building and materials represents a positive response to the environmental sustainability imperative. Yet, whilst gently adding layers and texture over time through gradual, incremental growth, this re-use paradigm also ensures a continuing social familiarity with the urban landscape and the sustainability of associated memory.

This paper critically examines the re-use paradigm and appraises the application of re-use strategies, taking as its case study a post-graduate architectural research project based on the adaptive re-use of an electricity substation building and site in the city-fringe suburb of Kingsland in Auckland, New Zealand.

Prefabrication potential: On the edge between academia and industry

Pamela Bell

PrefabNZ Incorporated and
Victoria University of Wellington, New Zealand

A recent Master of Architecture thesis on prefabricated housing in New Zealand found that research and development (R&D) are key areas for future emphasis. R&D can potentially benefit from tertiary institutions working in collaboration with the design and construction industry. This edge between academia and industry is where prefab's potential lies.

This paper aims to identify, investigate and highlight attempts at collaborative relationships between tertiary institutions and the design and construction industry in New Zealand. It begins by looking at international precedents of design-and-build studios teaching through the medium of prefabrication, before it looks at New Zealand case studies of research: industry collaborations.

Case studies from New Zealand's three architecture schools at Auckland University, Unitec and Victoria University of Wellington are documented. Issues and opportunities around these collaborative relationships between tertiary and industry sectors are summarised. The role of communication is discussed, leading to the introduction of the industry organisation PrefabNZ and the national prefab exhibition. The paper concludes by encouraging an increase in collaboration between academia and industry.

Architectural science versus green buildings: Issues for New Zealand

Hugh Byrd

The University of Auckland, New Zealand

If the mission of 'green' rating tools is to accelerate the transformation of the global built environment towards sustainability then a high priority must be placed on the energy consumed by buildings since energy supplies from various sources are depleting.

From an architectural science point of view, the environmental performance of highly glazed buildings raises questions about their sustainability. As we move into an era of depleted fossil fuels and global warming, this building type is even more questionable. The paper will investigate the drivers behind the highly glazed buildings including those components of 'green' rating tools that favour this building type.

This paper examines the apparent anomaly that almost all the case studies of 'green' office developments in New Zealand have high proportions of unshaded glazing, achieve an average of only 50% of the score available for 'energy' and are sealed, lightweight, air-conditioned buildings that are dependent on an uninterrupted supply of electricity in order to remain habitable. These characteristics are not normally associated with sustainability.

It will be argued that the 'green' building rating system in New Zealand has some inherent anomalies that favour over-glazing and hence poor environmental performance. It will also be argued that energy criteria in the rating tool should have a higher weighting in order to address not only the forthcoming 'peak fossil fuels' internationally but also 'peak hydro' in New Zealand.

On the architectural structure of photographic space

Mike Christenson

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The ambiguous relationship between photography and architecture is one of constructed and re-constructed identity. As a specific exploration into this relationship, this paper considers the construct of *point-of-view/field-of-view maps* (or *POV/FOV maps*), that is, diagrams which register photographers' positions, fields of view, and directions of view corresponding to a set of photographs of an existing work of architecture. A POV/FOV map can be expected to differ according to whether the set of photographs under consideration is (a) sampled from a image-sharing site such as Flickr; (b) published in an academic monograph, or (c) published in the popular press.

This paper tests the extent and significance of these differences through a comparative study of Mies van der Rohe's Crown Hall and Rem Koolhaas's McCormick Tribune Campus Center, both at the Illinois Institute of Technology in Chicago, USA. In both cases, POV/FOV maps are used to compare sets of professional or academic photographs to sets of touristic and popular-press ones. The comparison reflects the tenuous nature of architectural identity as constructed through photography and both confirms and denies assumptions concerning differences between professional and amateur approaches.

The paper concludes with the speculation that tools like Google Street View are likely to further erode traditional distinctions between modes of identity-construction, in particular, those distinctions which a POV/MAP can register.

On-line plant selection databases

Penny Cliffin

Unitec Institute of Technology, Auckland, New Zealand

On the connecting edge between the landscape architectural profession and tertiary landscape architectural education is applied research into plant selection data.

Landscape architects have a prominent role in designing and specifying plantscapes across a wide range of project scales, from gardens to urban streetscapes and parks to large-scale conservation revegetation. Both scientific and design plant data is essential to facilitate appropriate and creative planting design. At present there is a gap in the availability of comprehensive and up-to-date plant selection data for landscape students and the landscape profession. Each year students research and compile plant selection information from a wide range of sources as part of their course requirements. Each year the research leaves with the students, and is not captured or expanded in its use.

This paper reports on a survey of online plant databases, seeking to answer the question “What does an ideal plant database look like for landscape purposes?”, and secondarily “Can the plant data collected by students be used to grow such a database?” Databases are an effective way of storing plant selection data in an easily retrievable format. The development of on-line resources allow for instant and convenient sharing of information. However databases tend to cater well for the scientific aspects of plant data, but less well for visual / design data. Design characteristics are also important to represent, along with the dynamic nature of plants as they grow. The survey seeks creative ways in which plant knowledge and data may be presented by students while they are studying, and then shared as a larger collaborative resource with the profession. A summary of best practice in this field is presented, with the aim of development of such a resource for Unitec students and practitioners in the future.

Zero-emissions housing: The great *impossible* Australian dream?

Robert H. Crawford

The University of Melbourne, Australia

There are a growing number of examples of housing developments around the world that claim to be *zero energy* or *zero emissions*. Some of these clearly indicate that this only refers to the ability to minimise energy requirements for heating and cooling. However, others simply fail to recognise the energy and emissions needed to produce the materials and other components required for housing construction and on-going maintenance and repair. For a house to be considered as truly net zero emissions, all of the emissions occurring across every stage of its life must be offset. This study calculates the life cycle emissions associated with a typical new house located in Melbourne, Australia. Based on the findings, an estimation is made of the capacity of a solar photovoltaic (PV) system needed to offset these emissions over the life of the house, including the emissions associated with the manufacture and maintenance of the PV system itself. It was found that a 14.9 kW system would be needed. The findings from this paper provide greater insight into the life cycle of global warming impacts associated with housing and the capacity for them to be offset through on-site solar energy production.

Deemed-to-comply wall requirements in the 2010 Building Code of Australia

Lyrian Daniel and Terence Williamson

The University of Adelaide, Australia

The recent 2010 update of the *Building Code of Australia* (BCA) increased the energy efficiency requirements for all new commercial and residential buildings. The revised Code sets more stringent requirements for all elements covered by the deemed-to-comply provisions, for example, thermal resistance requirements for roof/ceiling, wall and floor elements. The BCA 2010 specifies the required R-value for walls as a function of location in relation to climate but also allows for modification of this value for walls of higher thermal mass, however the reasons or logic for these 'thermal mass' allowances have never been documented by the Australian Building Codes Board (ABCB). The first part of this paper investigates the background and provides possible explanations for the allowances. The likely effectiveness of these wall provisions are then assessed using the AccuRate thermal performance computer software. Variations in construction are tested to ascertain the resulting effects on the proposed m-factor. The paper concludes with a summary of findings and suggests that the methodology could provide a basis for future editions of the BCA. Further research will include sensitivity testing the methodology and applying it to different construction configurations.

Islands in the sky: Urban biodiversity enhancement in NZ on indigenous living roof landscapes

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² Landcare Research, Auckland, New Zealand

This paper analyses the habitat opportunities provided by the new landscapes of living roofs in the New Zealand (NZ) context. The paper identifies vegetative design considerations for future potentials in urban biodiversity enhancement.

Lack of local information and experience has been a barrier to living roof development in NZ. In response, the first corporate extensive living roof using only New Zealand indigenous plant species was initiated and completed a-top the Waitakere City Council (WCC) building in winter 2006. Plant species suitable for living roofs need to be low-growing and adapted to the special environmental conditions. Sedums are the norm on overseas roofs. The aim for the Waitakere roof was to find native alternatives. A range of indigenous plant species have and continue to be trialed on the roof and results monitored.

Monitoring of this project since its completion has provided important data on the potential of indigenous flora within living roofs and has confirmed that NZ indigenous plants can survive on an extensive living roof but that some are more resilient to the conditions than others. The results have established a range of considerations for successful use of NZ indigenous plants on living roofs, both horticultural and aesthetic.

Insect abundance and diversity is also being quantified using methods suited to windy environments and low-stature vegetation (a first for NZ living roofs). Results show that a range of native and exotic insect species are making the living roof their home, with a surprisingly diverse fauna.

Indoor air quality and health in New Zealand's traditional homes

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² The University of Auckland, New Zealand

Sustainable design consists of principles and practices of architecture that protect environmental quality and human health, reducing environmental impacts resulting from construction activities. Considering that in New Zealand approximately 15% of the adult population and 20% of children under the age of 15 are affected by asthma, the ongoing attempt to introduce sustainable principles in New Zealand's architecture appears questionable, as Indoor Air Quality (IAQ) and the related aspect of health have been poorly considered so far.

Allergies in New Zealand have become a serious health problem with considerable social and economic impact. Especially the indoor environment of residential buildings plays a major role in the increasing numbers of allergies and airways infections. Many new and renovated homes have been designed and built with low quality insulation and heating systems, and a lack of adequate ventilation. Furthermore, the energy performance upgrade of the existing building stock, ongoing since 1978, has changed the buildings' physical behaviour, generating new and unexpected problems. Badly constructed houses are difficult and expensive to heat: the consequent inadequate thermal comfort in homes, associated with poor ventilation, leads to growth of moulds, with health consequences.

This paper examines the indoor air pollution in relation to construction details, insulation level, ventilation and humidity. It also addresses moisture damages caused by damp housing. The specific influence of poor IAQ on health in general and possible risks of developing allergies in particular is identified. The lack of information about IAQ in New Zealand's buildings is addressed by discussing preventative actions, advice on how problems can be proactively avoided and practical recommendations for the refurbishment of specific building typologies. As in New Zealand practice there are currently no methods available to simulate the process of moisture transport within building components in relation to the indoor climate, a calculative assessment of thermal and hygric processes in the external wall assembly is introduced by using the simplified Glaser Method and the computer programme WUFI (Wärme und Feuchte instationär). This produces realistic calculations of the transient heat and moisture transmission in building components under natural conditions.

The meaning of the meaning of houses: An interdisciplinary study

Nicolo Del Castillo and Aurora Corpuz-Mendoza

University of the Philippines-Diliman, Quezon City, Philippines

This study uses an interdisciplinary framework from Architecture and Psychology to investigate the meanings Filipinos ascribe to houses. The “meaning” of house is deemed important to understanding how people behave in their built environments. Using convenience sampling, 124 city residents from randomly selected informal communities, housing projects and gated subdivisions were interviewed, while 16 respondents participated in focus group discussions. Content analysis of descriptions and preferences in relation to houses yielded 38 dimensions that indicated the meaning of house is organized into 6 main themes: Inside the house, house as Building, Lot as part of the house, house in a Community, Location of the house, and house as Self. The first five themes suggest a schema of house that begins with internal spaces, expanding outwards to more external spaces such as the lot, neighbourhood, and eventually to the physical links of the house to schools, markets, churches and places of recreation and employment. The Self theme represents value dimensions that reflect relationships between self and house. The Self theme is not only central to the meaning of “house”, but links together all other dimensions. Data also suggests differences in the meaning of houses across types of participants.

“I’m a designer, get me out of tech class!”: Closing the gap between design and technology education

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This paper explores the use of collaborative pedagogical approaches to advance foundational architectural design education, by linking design process to sustainable technology principles. After a brief discussion on architectural design education, the collaborative approach is described. This approach facilitates students’ exchange of knowledge between two courses, despite no explicit/assessable requirement to do so. The result for the students is deeper learning and a design process that is enriched through collaboration with sustainable technology. The success of this approach has been measured through questionnaires, evaluation surveys, and a comparative assessment of students common to both courses. The paper focuses on the challenges and innovations in connecting architectural design and technology education, where students are encouraged to implement lessons learnt, thereby closing the gap that these courses have traditionally represented.

Upgrading slum settlements in Turkey: Sustainable housing strategies in low-income communities

Tuba Dogu

The University of Sydney, Australia

Being a developing country, the mindset in Turkey regarding slum upgrading plans is limited to an understanding of housing supply only in response to population growth, while the larger frame involving human resources is underestimated. However, creating a sustainable environment and improving life involves more than just providing housing. According to UN-HABITAT, Turkey has a slum population 23% of the total urban population. In response to policy initiatives, the country reduced its proportion of slum households from 17.9% in 2000 to 12.4% in 2010. But this fact raises a question: how did it impact on the built environment?

In response, this paper considers the squatters of the settlements of low-income communities in Turkey. Revealing the existing social, environmental and design issues of those settlements, the potential role of sustainable housing strategies is researched within the frame of social justice and environmental development. In highlighting the problems that have accompanied slum-upgrading projects in Turkey, the paper will also propose social and design strategies for better and sustainable outcomes to meet the environmental and social needs of slum communities.

Digitising the complex form

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The demands of Landscape Architects and Architects use of organic and complex forms at various scales heavily fuel this project. In a typical project a designer is often faced with three challenges: how to create a digital model; how to enhance their design; and how to visualise the final product. However due to the limitations of typical CAD programs used in the industry as a stand-alone solution for digital representation the designer may end up representing complex form by illustrating either by photographic means or hand-rendering. While these two methods have their place as representational tools it limits the techniques available to the designer to manipulate and interrogate these forms as they would with a typical CAD model. The difficulty in producing digital models of complex forms limits the methods to visualise the design and often mutes the detail presented. This paper investigates techniques for digitising and manipulating the complex form in various ways.

Design for dementia: Sustainability and human wellbeing

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The key internationally utilised building environmental rating tools, such as Green Star (Australia), BREEAM (UK), LEED (US) and CASBEE (Japan), are scientific in their epistemological underpinnings. Buildings are rated on the basis of their anticipated energy consumption and consequent carbon emissions, water consumption, indoor environmental quality and so on. Generally, these are based on theoretical, modelled estimates, compliance with standards or use of best practice in the case of tools used at the design stage or in some cases, actual performance data for buildings having at least a year of operational use.

Given that these building rating tools have been developed to address the scientific evidence that human activity, including the construction but especially the operation of buildings, contributes significantly to global warming, resource depletion and pollution, it is understandable, therefore, that the tools have focused primarily on energy, pollution and water reduction. Applied research has been the focus of industry and academic research that supported the development of these rating tools.

There are certain building types, those for which human wellbeing is central, for which the scientifically based rating tools appear inadequate. Perhaps the assumption is that designers take human wellbeing as a given though in many cases the evidence for this is not clear. This paper, argues through an examination of buildings designed for the care of people with dementia, that the lessons learned from the design of these buildings and the rating tools developed to assist in their design are transferable to all buildings occupied by sentient beings. Current research indicates that quantitative and qualitative indicators that go beyond the current building rating tools are relevant to the design of buildings for wellbeing.

Experiments on common grounds: Four Auckland houses by Richard Hobin (1949-1953)

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In Auckland in the 1950s a group of architecture students and young graduates were exploring innovative techniques of small scale construction. While these explorations can be seen in the context of a broader, global post-war interest in rational construction, they did appear to have a particularly New Zealand flavour; working as they were with a local light timber frame and its supporting concrete technologies. Collectively known as Structural Developments, this group was concentrated around the structural and material interests of Richard Hobin.

This paper examines four houses designed and built by Hobin in Auckland between 1949 and 1953; the now demolished Strewé house in Glen Eden, the Taylor house in Devonport, the Bryant house in Forrest Hill and the J.M. Hobin house in Point Chevalier. The examination reveals the beginnings of a life long interest in structural and material innovation, unfortunately lost to this country when Hobin left for London in 1954, where he remained for the rest of his career.

Beyond 'green' streets: the role of urban street trees in addressing climate change

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Streets are the single largest public domain resource of our cities, comprising between approximately 25% to 35% of the total area. Recent debate has focused on transforming streets to address climate change. A new terminology of 'green' or 'sustainable' streets has evolved in city planning and design. Despite the rhetoric, there is a lack of effective tools to quantify greenhouse gas emissions for the layout structure and components of an existing street, making it difficult to ascertain just how effective these 'green' strategies are.

This paper is a component of a wider study that assesses greenhouse gas emissions associated with the structure, layout and components of street environments. It provides an overview of the contribution of urban street trees to this broader research topic. A literature review focuses on two key areas: (1) the role of urban street trees in carbon storage and sequestration; and (2) the impact of urban street trees on reducing energy consumption for adjacent buildings through shading. A methodology is presented for calculating greenhouse gas emissions reductions associated with urban street trees. Using new technology based on data derived from the local context, it allows design professionals and government authorities to calculate and test configurations for urban street trees to optimize reductions in GHG emissions. The methodology will be tested at a later date in a field study in an existing suburb in north-western Sydney.

Whilst this study focuses on Sydney, the methodology described can be applied to other cities. It will assist users to cut through the rhetoric of "green" streets and harness new opportunities in addressing climate change on urban streets.

Autoclave Aerated Concrete as a suitable alternative to conventional concrete in a seismically active location

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The use of AAC within the construction industry is greatly limited in terms of structural applications. But in non-structural applications the properties of this material work well in terms of seismic performance and sustainability – the two aspects focused on in this paper. A theoretical approach is taken to the study of seismic performance – information and values pertaining to performance derive from literature reviews of various sources, including manufacturer’s specifications and independent research studies.

There is little direct correlation between the two aspects of seismic performance and the sustainability of ACC. However, in New Zealand, both need consideration in the construction of buildings. Theory suggests that AAC will perform very well under seismic action due to its lightweight nature, closed regular structure, and standardised connections of each element. And in regard to sustainability, compared with conventional concrete there is less embodied energy and embodied carbon dioxide emissions; although the annual operational energy is greater for both heating and cooling loads.

A review of ecology in landscape architecture publications

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In landscape architecture publications, landscape designs that incorporate ecology vary in the degree of ecological functioning that is included. Sustainability is often not specifically differentiated from ecology and the term ecology is used very loosely to support, not just rich and complex ecological design, but designs that include any environmentally-friendly aspects. This can lead to some confusion in clearly representing the degree to which ecological functioning is occurring or intended to occur in the designed or managed environment. This paper is based on a review of article content relating to ecology in *Landscape Architecture*, which identified topics relating to ecology over the period from 1996 to 2010. Results show that while there is an acknowledgement that landscape architectural designs published in *Landscape Architecture* contribute toward a 'greener' environment, there is room for more ecological complexity to be acknowledged in the profession and for a distinction between complex and singular ecological functioning.

Web 2.0 VDS: Social networking as a facilitator of design education

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In 2009, Deakin University and the Chinese University of Hong Kong trailed the use of Web 2.0 technologies to enhance learning outcomes in a third year architectural design studio that was modelled on the Virtual Design Studios (VDS) of past decades. The studio developed the VDS further by integrating a social learning environment into the blended learning experience.

The Web 2.0 VDS utilised the social networking sites *Ning.com*, *YouTube* and *Skype*; various 3D modelling and video- and/or image-processing software; plus chat-software. These were used in combination to deliver lectures, communicate learning goals, disseminate learning resources, submit work, and provide feedback and comments on various design works in assessing students' outcomes. This paper centres on issues of learning and teaching associated with the development of a Social Network VDS (SNVDS).

Designing with change at hand

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Exploring methods to embrace a temporal factor in design, to both augment and challenge the dominant discourse of spatial design, has been a concern of the environmental design disciplines for some time. Nowhere has this argument been more compelling than in the field of landscape architecture. Gardens in particular are subject to environmental forces, plant growth and horticultural practices, and become something new all the time, well beyond the anticipated projections of the designer. The garden has no final form, “no unchanging inert core”.

Something of a disjunction can occur between designer and the ‘caretakers’ of a design, the gardeners. Generally the gardeners take over at the point of the ‘completed’ design, exercising horticultural skills in the care of a garden, but not usually design intent. In an attempt to find common ground between design and the future evolution of a garden, this paper explores the parameters for design and ‘re-making’ of a type of garden most ostensibly fixed, sculptural and of a static quality: the Japanese karesansui, dry raked garden.

A life cycle energy comparison of textile and glass materials for building envelopes

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An increase in building energy efficiency, including reductions in their embodied energy, is essential in order to mitigate the impacts of climate change. Material selection is a key element of any attempt to reduce the life cycle energy requirements of buildings. The building envelope itself plays an important role in determining the operational and embodied energy consumption of a building and therefore the materials used in the building envelope must be carefully considered.

This study considers the use of textiles as a building envelope material and analyses the life cycle energy requirements associated with a roof construction recently erected in Melbourne, Australia using ETFE cushions, and an alternative design for the same roof using a traditional glass structure. It was found that the ETFE cushions resulted in a 42 per cent reduction in life cycle energy requirements. The paper demonstrates the benefits and challenges associated with the application of textile materials in buildings. It also provides builders, architects and planners with knowledge to support the design decision-making process as well as further ways of achieving additional reductions in the environmental impacts resulting from the building sector.

Using the psychrometric chart in building measurements

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This paper centres around the presentation of multiple measured results on a psychrometric chart. The psychrometric chart was programmed in Microsoft Office Excel to accommodate measured results. It was written because existing programs appear not to cater for the researcher wishing to enter results electronically onto the chart. Furthermore, many existing charts are complex and cluttered displaying up to ten attributes, being intended for engineering design, whereas presenting the behaviour of living and working environments is focused on wet and dry bulb temperature and relative humidity. As well as results, users would also like to specify and adjust the 'comfort zone' (a shaded area on the chart) for different 'adaptive' or 'seasonal' conditions. The comfort zone is bounded by lines of constant heat loss from the skin, relative humidity and wet-bulb temperature.

The paper presents various applications of the psychrometric chart for the analysis and reporting of research and discusses the programming of Microsoft Office Excel to generate the chart and display user data.

The theoretical/empirical divide and practice and policy led research: Cross disciplinary approaches and the market place

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Practice and policy led research should be accorded higher recognition in academic institutions, alongside the dominant scientifically- orientated research culture. Three reasons are adduced for this. A broad-church approach to planning and policy-making involves baptising and using a variety of disciplines and perspectives for planning and policy purposes. Practice and policy led thinking, judging and doing cannot be reduced to, and transcend the theoretical /empirical divide. The social location of practice and policy led research on the border between academia and the planning, policy and political market-place requires the development of assessment criteria reflecting the overlap and the tensions between the norms of these different institutions. The challenge for the future is to explore these issues as part of a continuing conversation between academic and political institutions. The goal is to change the world rather than simply interpret it.

A typological approach to daylighting analysis

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A typological approach to daylighting has been an unconscious feature of past daylighting research with the production of daylight performance diagrams and graphs in a manner similar to traditional typological exercises, such as Ruskin's categorical analysis of architectural elements. The main objective of this paper is to highlight this latent connection between daylight design study and typological analysis and provide a validation method. The paper builds on recent work by Baker and Steemer and proposes that daylighting rules of thumb can be effectively studied by means of a typological approach. As a result, some of the inconsistencies in current daylighting rules found in architectural literature can be explained, promoting improved application in design.

Black-boxing design education

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There is a long-standing dispute in landscape architecture over whether professional education should aim to improve graduates' skills in office and production-related practices, or enhance graduates' grasp and application of theory and research in design. While the design community seeks to cultivate emerging design talent, design practice can often be viewed in very different ways. A recent shift in practice toward a hybrid model of research through design experimentation suggests a need to re-think the traditional dichotomy between knowledge creation and practice. The increasingly cross-disciplinary nature of design practice makes this hybrid model particularly relevant for landscape architecture, which has tended, historically, to graft professional knowledge from related fields. Hybrid practice may, in fact, exemplify an evolving mode of spatial practice in landscape architecture. Further, this hybrid mode of practice understands education as an active, experimental practice, as students engage in serious critiques of their own investigative methods and integrate different forms of knowledge.

This paper explores the emerging language of hybrid practice, showing that improvisation, openness, and self-critical processes are successful developments in an archetypal 'black box' design methodology currently entering the field of production through education.

Rating existing homes in Malaysia against the Code for Sustainable Homes (UK)

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The Code for Sustainable Homes (UK) is the replacement to Building Research Establishment's (BRE) EcoHomes rating tool that is designed to measure the sustainability of homes against a broad set of design categories. Conceptually, the nine categories of the Code are universal in nature and could be utilised to rate the sustainability of homes anywhere around the world. Furthermore, the same categories could be used as basis for creating new sustainable home rating tools for other countries, especially developing countries where locally developed schemes are unavailable or under development. In doing so, it is important to test the applicability and validity of each issue against each country's unique contexts, which are inherently different from the climatic, environmental, regulatory, and social-economic conditions of United Kingdom. Hence, this paper reports the findings of a test that was done by rating, against all issues in the Code, three existing 'green' homes in Malaysia – namely CETDEM's Demonstration, Cool and Energy Efficient House in Petaling Jaya; a private bungalow in Semenyih; and a private corner-lot terrace house in Ulu Klang. All reported findings are based on the difficulties and hurdles caused by incompatibilities between certain issues and the Malaysian context and other regulatory discrepancies.

Simulating pedestrian flow dynamics for evaluating the design of urban and architectural space

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This paper proposes a new method for pedestrian behaviour analysis in simulated urban environments. Our proposed software system analyses pedestrian behaviour with a combined focus on movement trajectories, walking speed and the angle between the movement vector and gaze vector of individuals in large groups of simulated pedestrians. The system learns a statistical model characterising normal behaviour, based on sample observations of regular pedestrian movements without the impact of significant visual attractions in the environment. Sudden changes of the pedestrians' behavioural characteristics, caused by the visual detection of 'attractive' objects, are considered as abnormal behaviour. The simulated environment, which is at the core of the research, can be automatically generated using scanned line drawings of two-dimensional street maps or public spaces. In the simulation model a variety of scenarios can be defined and modified by altering different parameters. Using the example of Wheeler Place in Newcastle (Australia), our pilot experiments demonstrate how pedestrian behaviour characteristics can depend on selected abstract features in urban space. The purpose of the system is to support architects and urban designers to better assess the impact of pedestrian behaviour on planned urban spaces and streetscapes.

Solar thermal walls: Field trial in three New Zealand schools

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The main objective of this research was to determine whether an uncommon space heating system that has been used successfully overseas could be replicated in New Zealand, using accessible off-the-shelf materials. The system being trialed is called the solar thermal wall. It makes use of the naturally (solar) heated air within the cavity space of northern-facing metal wall cladding systems. Field trials were conducted on secondary school buildings in three climate zones – Auckland, Hamilton and Invercargill – representing the climatic spectrum of New Zealand. A working partnership was established with the Enviroschools Foundation, a whole-school sustainable educative process, to assist and coordinate the project. The results from the three schools in terms of the solar efficiency, peak power and costings are overviewed.

This research builds on the field trials that were conducted by BRANZ on a residential building in 2006 and 2007.

Evaluating the integration of digital design and prototyping tools in a problem-based learning tertiary level course

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This paper presents an example for tertiary level education institutions to establish and develop a digital design and prototyping course in a problem-based learning environment. The paper reports on a developed framework that was used as a basis for a computational design course involving a mixed cohort of architecture and industrial design students. Using a practical design brief, students went through a design process with an object (either physical or virtual) as an assessment submission, including providing an appropriate solution to an identified problem. This design scenario, involving the investigation of a range of possible outcomes, evaluates specific realisation tools that are currently bound in the academic domain and yet to be utilised effectively by industry. Outcomes of the course included a range of perception-challenging forms and a thorough evaluation of the course from the students' experience of using both familiar and unfamiliar design tools. A quantitative analysis of the students' self-reflection enabled the course leaders to refine the course structure, design brief, teaching methods, project context and outcomes that will improve the learning of successive years of students.

Using a basic understanding of architectural science as an integral part of the design process

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It has been suggested that if a designer wishes to minimise energy-based services to maintain acceptable indoor thermal conditions, four tasks need to be carried out to establish design parameters. These four tasks are to examine the existing outdoor conditions, to establish acceptable indoor thermal conditions, to design in order to manage the outdoor conditions as far as practicable and to provide energy based services only for the residual needs.

This paper considers how a user-centred theory of design can integrate these four tasks into the design process in order to enable a transition towards more energy efficient housing. The application of this integrated user-centred theory in the design of a new suburban house in Perth, Western Australia is used as a case study.

A reflection: Transformative aspects of teaching building science to architecture students

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Building science is not generally the favourite area of interest to undergraduates studying architecture. However it is an essential ingredient in assisting future architects to produce low energy buildings. Successful teaching and learning involves the engagement of students in their own learning and transformation. This paper discusses the links between transmissive learning, a standard approach in the teaching of building science, and a transformative approach which can have a fundamental impact on the approach of architecture students to building science.

One way of encouraging the engagement of students in their transformation is to provide experiential learning through such activities as site visits and hands-on assignments and experiments that demonstrate the impact of building science on design. This paper focuses on a number of aspects of one building science unit that teaches the basics of heat transfer in buildings. It examines how the learning experience is related to transmissive and transformative teaching approaches. The paper concludes that there are some missing threads in the learning experience which results in transmitted knowledge not leading to higher levels of understanding.

Evaluation of ultraviolet radiation protection of a membrane structure using a UV shade chart

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This paper reports a study which calculated shade effect against UV radiation using a UV Shade Chart. Ultraviolet radiation damages the skin. The use of sun-shading is an effective means of blocking this radiation. Membrane structures are sometimes used as sun-shades – however, it is difficult for a membrane structure to be evaluated for a shade effect against ultraviolet radiation because of its free shape. The UV Shade Chart which has been developed expresses sky erythema radiance as point density. The Chart has been used to evaluate several kinds of shades by calculating the architectural sun protection factor (ASPF).

Student, educator and industry: Reconciling digital technologies

Steve Kelly

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Within the realm of digital technologies, the student, the educator and the design industry all seemingly want different things. The industry desires fast and accurate documenters, the educator persuades the student to explore the potentials of massing and modeling, and the student wants to present their work with photographic realism. Digital technologies can be a distraction to design discourse by making it “about the image” rather than the ideas or the creative process. Two groups, design academics and those who resist technological change, also commonly hold this view.

Can education of digital communications reconcile all these needs? Are BIM (Building Information Modeling) and parametric systems the panacea, the next generation of CAD software combining drafting, modeling and presentation in one user-friendly program? Or are they simply another marketing approach by software developers and resellers?

This paper will explore the individual requirements of each of the stakeholders, identify the causal relationships, both fundamental and contributory, between them and relate their experience to the Australian context. The discussion will also focus on the question of digital training: Should it be the sole function of the University to educate students in the digital technologies, or should the design industry share the load by taking a greater responsibility for in-house digital training of staff?

Ten years of environmental university building

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The authors have been involved in over ten years of environmental consulting and research on university buildings. Numerous simulations and measurement studies have occurred over this period of time. The intentions have always been to improve and optimise the environmental performing aspects of a building. This paper is a reporting of the implemented strategies, their pre-building research investigation as well as their operational outcomes. Their successes and failures are discussed here. This research is intended as a feedback loop to future design specification, commissioning and maintenance improvements.

In hindsight many of the environmental concepts, when executed as planned, were successful. However, often those requiring extensive control, such as lighting, ventilation and mechanical air-conditioning were a failure. The observations between simulation and actual performance are also noted. The paper includes discussion about some of the obstacles in building procurement which can hinder the result of a good environmental performing building.

South East Queensland's projected population and its environmental footprint.

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South East Queensland's current population of 2.8 million is projected to reach 4.4 million by 2031. At the global scale, unchecked population growth and rampant consumption is clearly damaging the ecosystems of the planet. The current dilemma in South-East Queensland is whether we should continue to share the amenity and resources of this region through continuing population inflow, and whether resource consumption has or will exceed the sustainable capacity of the region.

This study applies Global Footprint Network methodology, using Australian data to assess likely regional impacts relative to sustainable bio-capacity. Key dimensions of Australian consumption are assessed relative to the international database, and benchmarked to countries with a high Human Development Index. The study confirms clearly that current consumption patterns are excessive, but concludes that the proposed 2031 population may be able to be sustained within the SEQ Region, provided significant changes to our current lifestyle and patterns of land use are adopted.

The paper recognises that the issue of sustainable population growth is a scientific question, but one that requires a political response. To that end, the paper seeks to communicate its findings through contextualised graphs that relate the magnitude of the issues directly to its local impacts.

Building the FirstLight house: Applied research in sustainability

Guy Marriage

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Sitting on the junction between theory and practice, the design and construction of sustainable buildings has become one of the major growth areas of architecture over the past decade. The growth of 'green' (ESD) buildings is also providing impetus and direction for the growing field of sustainability in building science.

The aim of this paper is to chart the progress to date of the FirstLight House, an entry in the United States Department of Energy Solar Decathlon 2011 competition. This entry was initiated by a student-led design competition, which realised theory through the actual construction of a full sized experimental dwelling, to be constructed and deconstructed as a working laboratory.

As the project is ongoing, the paper addresses issues that have been resolved, and future issues to be faced in the coming months. The project bridges the gap between the theory and practicalities of architecture. Outcomes are being used to inform both teaching and practice within the School of Architecture at Victoria University, New Zealand.

Connected: Linking postgraduate design students and industry through online mentoring

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This case study explores the efficacy of online social network sites in linking design students with industry through an e-mentoring scheme, to enhance employment prospects and promote professional networking. Over one semester eighteen students engaged with their peers and a group of industry professionals through an interactive online forum within the host site *Facebook*. *Facebook* was chosen ahead of alternate sites for several reasons including its immense popularity, intuitive interface, and its successful integration in other design courses within an Australian school of architecture. Each week students were required to submit work-in-progress online, after which industry representatives would provide feedback and critiques, with the expectation that meaningful discussions would ensue, allowing students to generate embryonic professional connections with industry. The evaluation process involved pre and post semester questionnaires for the students, weekly analysis of the online group, and interviews with the industry representatives involved in the project. Students responded positively to the experience, citing professional networking and peer feedback as key outcomes. The project will expand in the future to include international peers and mentors.

The cost effectiveness of housing thermal performance improvements in saving CO₂-e

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To reduce the CO₂ emissions associated with the energy needed to heat and/or cool houses, the *Building Code of Australia* (BCA) requires that new houses meet a minimum level of thermal performance. A star rating system is used to indicate the level of thermal performance a house achieves. Ratings range from 0-10 stars. Currently all states and territories in Australia require a minimum 5 or 6 star performance, however this is likely to be increased incrementally in the next decade.

Generally, increasing the thermal performance of a house will increase the embodied CO₂ emissions of the building envelope. While it is widely claimed that improving the thermal performance of houses is a low cost way to reduce CO₂ emissions, the increase in embodied CO₂ emissions is rarely considered when assessing the cost effectiveness of thermal performance measures. This paper examines the cost effectiveness of incremental thermal performance improvements, taking into account their embodied emissions. Improvements are described and ranked in order of their cost effectiveness. The results show that the cost effectiveness of achieving a certain level of thermal performance varies significantly depending on the methods and materials used.

Radiance as a tool for investigating solar penetration in complex buildings

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There are a number of tools currently used by architects for the investigation of solar penetration in buildings. However, complex building forms present unique analysis difficulties. Current 3D computer aided design software can display sun patches and shadow on the exterior of buildings, however, it is difficult to obtain accurate and timely information about the sun patches internal to the building. This paper details a methodology to enhance the capability of commonly used CAD software to show indoor sun patches in complex buildings. The paper demonstrates how multiple software packages, including the Radiance Lighting Simulation Suite, can be used as part of a tool chain to display solar penetration in complex buildings in a timely manner.

Value-change and self-reflective practice in ecologically sustainable design

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Ecologically sustainable design is a transformative design paradigm based on the theory of interdependence. This theory requires that the transformative agenda of design is holistic in practice. In effect, the requirement is for value-change on the part of the designer along with transformation of the built environment.

This paper, based on recently completed research into design practice, argues that value-change rests on certainties that are drawn on intuitively while designing, and that this intuitive process is characteristic of design as *praxis*. It is further argued that design, as *praxis*, requires a phenomenological approach for inculcating value-change.

A phenomenological approach relies on self-reflective practices exemplified by meditation and yoga that can focus on the designer's ethical know-how. A model for this approach to value-change, the biopsychosocial approach, already exists within clinical medicine.

This paper presents findings from interviews with key architects practising self-reflection and/or ecologically sustainable design. These highlight the premium placed by these architects on both certainty and empathy, and how these values influence design as *praxis*. Formalising techniques for closer scrutiny of these values will highlight design as *praxis*. Doing so will critically strengthen ecologically sustainable design as holistic, transformative practice.

Wind-driven natural ventilation study for multi-storey residential building using CFD

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Computational Fluid Dynamics (CFD) has become an attractive alternative application tool to investigate outdoor and indoor airflows for buildings in comparison to other airflow prediction models. However, CFD comes with two main setbacks: it requires a large amount of computation and its results are often difficult to assess and require a validation process. In the case of a multi-storey residential building, it is always a limitation faced by researchers to simultaneously simulate both outdoor and indoor airflows of the building, due to its large scale and high complexity.

This is a preliminary study in which various CFD setups are investigated prior to subsequent investigation of wind-driven ventilation performance in a multi-storey residential building. The objectives of this study are: a. to simultaneously predict outdoor and indoor airflows using CFD; b. to investigate various CFD setups as an optimization process and; c. to analyse the accuracy of the CFD results against existing wind tunnel data and empirical models as a validation process. This study found that CFD can provide reasonably accurate results for prediction of coupled outdoor and indoor airflows for a multi-storey building, but it comes with some limitations.

Cost effective quality: Next generation building controls?

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In 2004 the New Zealand Government reviewed the *New Zealand Building Act*. The review was prompted by increasing concern at the lack of weather tightness evident in buildings constructed since the initial performance based Building Act was passed in 1991. Now, in 2010, some six years after the 2004 review and against a continued backdrop of non-performing leaking buildings, the Government is preparing to review the Building Act again.

This paper will provide a brief history of the controversy surrounding building under-performance in New Zealand since the initial Act was passed. It will summarize the changes brought about by the 2004 Building Act, and discuss the reasons for the Government's desire to yet again initiate amendments, particularly in areas related to the exemption of minor works, low risk dwellings and the rationalization of building consent processes. The paper reinforces the view that changes lessening the degree of oversight by Building Consent Authorities (BCAs) to building work should proceed cautiously, and then only after the appropriate back-up legislative and educational systems have had time to coalesce and prove their effectiveness.

Metaphor as a conceptual tool in design

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Metaphor is not merely word play or ornaments for daily speech. It allows abstract concepts to be understood by comparing them with familiar ideas and objects. While metaphor usage continues to be relevant in architecture, a review of its developments in cognitive linguistics could provide an alternative interpretation of metaphoric processes in design. In particular, this investigation aims to explore the possible application of cross-domain mapping based on Lakoff's Conceptual Metaphor Theory in design. By integrating Antoniadou's metaphor theory in architecture with cross-domain mapping, a hybrid approach of comparative cross-domain mapping was devised. The final evaluation of comparative cross-domain mapping based on analyses and experiments suggest that cognitive clarity of the proposed hybrid approach holds opportunities as a conceptual tool in analysing abstract concepts and in the generation of parametric designs.

Sustainable timber potential for Northland, New Zealand

Neil Newman and Kerry Francis

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This paper explores the feasibility and potential use of locally grown timber alternatives to chemically treated *Pinus radiata* for domestic construction in the Northland region. Current and potential locally grown alternative timber resources are initially identified through direct contact with local forest managers, sawmill operators, and timber suppliers. This is followed by an investigation and description of the characteristics specific to each of the available timbers. Finally, the paper discusses the implications of using the timbers within domestic construction, and examines what methods are available for architects to use these timbers within the current framework of the *New Zealand Building Code*.

Prototyping spinifex grass as thermal insulation in arid regions of Australia

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The vegetation of arid and semi-arid regions of Australia is characterised by spinifex-dominated ecosystems. Spinifex grasses belong to the genus *Triodia*, of which there are at least 67 species, and are broadly classified into hard and soft, resiniferous types. This paper draws on a multi-disciplinary research project that examines the potential uses of two species of spinifex as a material component of a range of sustainable building products. Novel findings on the botany, ecology, chemistry and bioengineering of *Triodia* spp. continue to inform the architectural stream of this research, which is in the third year of a five-year project.

This paper describes preliminary investigations into the use of two species of spinifex as potential materials for the thermal insulation of buildings. Recent data on the morphology and mechanical properties of *Triodia pungens* and *T. longiceps* are compared with plant-derived fibres, such as flax and hemp, which are used to make thermal insulation for buildings. A range of prototypical building products have been developed which investigate different processing techniques, binders and compositions. The paper discusses these results in the context of the wider research project and the potential applications for spinifex grasses, which are limited by inchoate knowledge of sustainable harvesting practices.

Investigating the architecture of architecture education in Uganda: Student perspectives

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For all the discourse on the state of architecture education today, little is written about the student experience in architecture schools. With increasing emphasis on Service Quality, Learning Outcomes, and Completion Rates, understanding student motives, and perspectives of professional education is particularly significant. This paper reports on the findings of a research study that gathered views of key stakeholders in architecture education, and is part of a broader study examining architecture education in the context of East Africa and Uganda in particular. The paper presents the findings of Focus Group Discussions held with students at Part I and Part II levels of the architecture programme in Uganda. Of interest, were the perceptions of students in relation to their chosen careers, as well as their experience in the programmes, stemming from anecdotal evidence indicating that a hidden curriculum in programmes presented a significant challenge for students, at times having a negative impact on their learning. While not conclusive at this stage, the initial findings suggest that a lot can be learned from what students reveal about how they relate to their programme of study, and may be valuable in defining a revised approach to architecture education in East Africa.

Towards energy efficient buildings in Amman, Jordan: Defining thermal requirements by mean of thermal simulations

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In order to identify the optimum U-values for the construction elements, we have simulated the thermal behavior of an apartment which is the most commonly constructed building type with the highest energy use in Amman, Jordan. It was shown that it is possible to achieve good indoor thermal comfort by applying a climate-conscious design without the excessive use of energy in mechanical heating and cooling systems. The optimization process carried out for the climate of Amman found the requirements on thermal transmittance (U-value) for both roofs and walls to be between about 0.5 and 0.7 W/m²K. The optimum window to floor ratio (WFR) for a south oriented main façade was found to be between 12% and 20%. These requirements would allow a total saving in energy for cooling and heating of up to 70% for a typical apartment in Amman.

Evaluating networked technologies for facilitating collective intelligence in design

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With the emergence of a digitised and technological supporting infrastructure, mass communication via the global internet has given rise to more investigative interest in collective intelligence. Nevertheless, it has highlighted a lack of supporting technologies that can readily facilitate collective intelligence, specifically in design. This paper uses a classification of three categories that constitute the practice of design in a more collective and inclusive manner. They are the professional designers, the design academy or semi-professional designers, and the end users or non-professionals; each with their own introverted and isolated methods of design and collaboration. The paper investigates various networked technologies in facilitating collective design intelligence in terms of different levels of interactions within and across design professionals and non-professionals.

Generative urban design with Cellular Automata and Agent Based Modelling

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This paper reports on initial findings of a bigger research project that set out to explore the potential of generative algorithms in landscape architecture, urban design and architecture. The paper focuses on how urban morphologies of unplanned settlements can be modelled as emergent phenomena using parallel computing. Theoretically the research stems from Hillier's discourse about space syntax, summarised in Section 2. The paper outlines the concepts behind generative design and illustrates the principles of Cellular Automata and Agent Based Modelling using some simple examples. The models are described in detail and their potential usefulness in design education is demonstrated. The potential of using such models in design practice is also evaluated.

Recycling of materials to reduce embodied energy consumption in the redevelopment of urban areas

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Whilst the size of many cities around the world is increasing, there is also an imperative for urban areas to minimise their environmental impact. One way to reconcile these opposing trends is by the densification of cities. Urban areas can be redeveloped into more compact configurations which accommodate a greater population and use existing infrastructure. New compact dwelling forms will also be more energy efficient thereby lowering energy consumption and greenhouse gas emissions. However, the redevelopment process uses additional energy by virtue of construction activities and the energy embodied in new building materials.

This paper describes future projections for the redevelopment of an existing suburb of Adelaide, Australia and models energy consumption including embodied energy. It shows that with certain demolition and redevelopment rates, embodied energy is significant and may negate energy savings made in new energy efficient dwellings. However, there is some potential for reducing this embodied energy by a much greater use of recycled materials from demolished buildings.

A modelling appraisal of design standards in retrofitting a high-rise office building in Brisbane

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This paper reports the testing of appropriate design standards to optimize energy performance in the pursuit of building retrofits. The impact of whole-building “best” and “normal” practice standards are predicted and evaluated using as a case study a forty-year-old heavy core-dependent deep-plan twenty-three storey office building in Brisbane. Predictive modelling used DesignBuilder simulation software. A Forward Simulation Model (FSM) and Data-Driven Simulation Models (DDSM) contributed to the evaluation of “normal” and “best” practice standards. With higher thermal resistance in the built fabric the PassivHaus Model (PHM) – a “best” practice standard – demonstrated a maximum energy saving of 9.5%. Findings suggest that retrofitting for energy saving in internal-load dominated office buildings requires strategies to control internal loads. The whole-building energy standards with efficient operational profiles promoted 46% of energy savings, showing systematic appraisal and prediction to derive case-specific design solutions in satisfying the regulatory measures for future commercial buildings in Australia.

Developing a framework of interventions for retrofitting high-rise office buildings in warm climates

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There is a complex interplay of issues associated with retrofitting high-rise office buildings in warm climates. This paper explores non-technological and technological interventions for retrofitting and the potential environmental benefits associated with them. An approach is developed in the context of bioclimatic renovation design for existing high-rise office buildings in warm climates in Australia that offers opportunities for promoting energy-efficient practices through the exploitation of occupant behaviour, building design and powered systems in the commercial building sector.

Conceptual shift from green homes to sustainable homes: Case studies from Malaysia

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As part of the climate change mitigation strategy, the creation of green homes has created awareness of the plight of the environment and the need to alter our lifestyles. Although this is a great step in the right direction, green homes are often conceptually inadequate in addressing the overarching principles of sustainability. In order to achieve sustainability, houses should be made to perform a role along the lines of Cole's 'Sustainable Building Criteria'. This set of considerations is the backdrop to the four case studies from Malaysia – namely CETDEM's Demonstration Cool and Energy Efficient House in Petaling Jaya that represents retrofitting existing houses; a private bungalow in Semenyih that was built using the Smart and Cool Home technology; a private bungalow in Melaka that uses the Cooltek system; and the traditional Malay house that typifies the cultural response to living in the hot and humid climate and the unique Malay society. Each case study is reviewed against Cole's 'Sustainable Building Criteria' and the findings are reported in this paper. The findings are used to judge whether the case studies are indeed green buildings that can support sustainable ways of life, or whether Cole's 'Sustainable Building Criteria' should be more pragmatic according to the context.

The role of building physics in the New Zealand architecture curriculum

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The process of designing fit for purpose building structures is a complex task, which includes a requirement to comprehensively conceive their physical performance. While in the architecture programmes of many overseas universities building physics is anchored as a mandatory subject (usually taught over two semesters), in New Zealand building physics is solely offered at University of Otago as part of an Energy Management degree. Architecture students in New Zealand remain however, largely ignorant of the applied science of building physics. It therefore seems that architecture educators in New Zealand, in contrast to many of their overseas peers, consider building physics to be dispensable.

This paper questions the justification for this. It elaborates on the importance of proficiency in building physics for meeting contemporary architectural challenges like affordability, peak oil and climate change. It argues that New Zealand is at the cross roads. It needs to either cement building physics firmly in the architecture curriculum or, alternatively, limit the responsibility of architects to aesthetics and spatial layout. It is believed the former direction will equip students with a better understanding of the built environment and enable them to respond to assignments more appropriately.

Quantifying the ‘human factor’ in office building energy efficiency: A mixed-method approach

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Greenhouse gas emissions from occupied Australian commercial office buildings can be reduced substantially. Accessible and cost-effective technologies and knowledge (know-how) are being widely adopted in the construction of new buildings and there is evidence that, on average, office buildings constructed since 2005 are performing with lower energy intensity than older buildings.

However, to achieve the sector’s potential for deeper and more sustained reductions in greenhouse gas emissions, research into the interaction between technology and the people that operate the buildings is required. This is especially the case for older buildings where accessible and cost-effective technologies and know-how that can abate greenhouse gas emissions have not, as yet, been widely adopted.

There is an urgent need to understand the role that human competency, values and interests play in determining the success of investments in technology and know-how and, indeed, the likelihood of investments being made at all. We need to ground this analysis in ‘real world’ operational data, rather than speculative models.

The paper proposes a mixed-method approach for defining and quantifying the extent to which operations staff and other key decision makers influence the energy efficiency of occupied Australian commercial office buildings, and presents preliminary findings.

A preliminary evaluation of two strategies for raising indoor air temperature setpoints in office buildings

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The thermal comfort of office building occupants can be enhanced by adjusting the operation of heating, ventilation and air-conditioning (HVAC) systems to account for seasonal variations in ambient climatic conditions and the occupants' clothing insulation, behaviour patterns and expectations.

This paper presents findings from a study of the potential to reduce HVAC energy use and enhance thermal comfort by raising internal air temperature setpoints in Australian commercial office buildings. Setpoints at 33 large mechanically ventilated office buildings were adjusted throughout the period 1 November, 2009 to 31 March, 2010 using either:

- a *static* control strategy (i.e. raising temperatures 1°C higher than normal over summer), or
- a *dynamic* approach (i.e. adjusting temperatures in direct response to variations in ambient conditions).

It was found that occupant comfort, quantified by frequency of 'complaints' registered with a tenant helpdesk, was adversely affected in both trials. The 1°C static setpoint increase was associated with a 6% reduction in daily HVAC energy use, compared to a 1.4% reduction for the buildings where the dynamic approach was adopted.

These preliminary findings have significant implications for the implementation of adaptive comfort control strategies in large centrally air-conditioned commercial office buildings.

Housing for low-income in the urban fringe of Surabaya

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Surabaya is the second largest city in Indonesia. With the ever increasing development in the city, the price of land is becoming very high. Inexpensive land for housing is almost impossible to find. Cheap land for low-income housing is now only found on the periphery of the city. This is therefore the location where the government's subsidised housing programmes for the low-income tend are built. The intent of the research is to investigate the effectiveness of the One Million Housing Programme, in particular the degree to which the low-income houses accommodate the dwellers' needs.

The discussion in this paper covers the government programme to build these houses. It examines the condition of houses and the inhabitants, the manner in which the houses were improved by the dwellers and the impact the housing development has had on the environment. The low-income houses included in the survey were houses built with government subsidies, houses built by the people themselves, and houses in the slum areas. The research methods used included surveying the government housing officials, in depth interviews with the residents using prepared questionnaires, and an environmental impact assessment of the area.

Talking to practitioners about their graduate hiring practices: How highly are technical skills valued?

Susan J. Shannon

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This paper reports on a study, which engages with important questions around whether the current educational focus within architecture schools is leading to a productive interface with industry.

More than 20 architectural practices around Australia, private and public, large, medium and small, who hired architectural graduates, were asked what they prioritised in the evaluation of graduates for employment. The study used the Commonwealth of Australia's employability skills list as a starting point, and a simplified summary of the published Graduate Attributes derived from the seventeen Schools of Architecture in Australia. A set of questions was compiled designed to elicit standard responses from potential employers of graduates during semi-structured interviews.

The study is nested within larger studies, such as that funded by the ALTC, who examined the transition of Built Environment and Design graduates from University to the Workplace from the perspective of graduates, employers and academics. This study has narrowed its scope and conclusions to elicit a clearer understanding of how highly architecture graduates' employers rate (from completely unimportant to critically important) various skills in hiring graduates. The paper reports on just one aspect of that research – the degree to which employers value graduates' technical skills.

Employing graduate attribute mapping to bridge the divide from education to industry

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Worldwide there are many motivating factors that underpin a sustained interest in graduate attribute mapping. These factors have driven an increased level of institutional accountability to stakeholders, particularly funding groups, and industry. When the graduate attributes of professionally orientated and accredited courses are mapped, industry could expect that their requirements overlap those of graduates attributes. But how would industry prospectively know what attributes graduates possessed? This question drove a collaboration between the University of Adelaide and Prismatic Architectural Research - to develop a prototype system for eliciting and mapping the graduate attributes of courses which aggregate into a degree Program or Course. This study proceeded through distilling the Graduate Attributes of the relevant accreditation bodies for professional architects, landscape architects and planners, and developing a template for industry accredited bodies and academic-derived graduate attributes. Course coordinators were then asked to “vote” with a pre-set number of tokens against these aggregated attributes, for the extent to which they were contained within the course. The results were mapped onto a data base developed to display the course’s attributes as bar graphs, donut charts, or, in an ambitious development, as an undulating landscape of the attributes from responses, for the information of stakeholders.

Gaps when mapping technical skills in courses and assessments: Can we explain the gaps?

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In order to map the graduate attributes of courses (or subjects, papers or units) Prismatic Architectural Research developed the APMMap prototype tool which mapped the graduate attributes of courses which aggregate into a degree Program (or Course). In a further development, the research was extended to encompass mapping of assessments of any type against courses. Gaps were revealed between the extent to which Course Coordinators believed they were assessing any given attribute in their evaluation of the constituent parts of the course, when considering the course at course level, and at assessment level. This paper explores that assessment vs coursework difference in the dimension of technical skills acquisition and demonstration. Shannon (2010) has shown that employers of M Arch (formerly B Arch) graduates highly value the demonstration of technical skills at graduation. APMMap may assist in stakeholders (employers) understanding where students acquire and demonstrate the acquisition of these skills, and as an aid to reflection for academic staff and University management.

A heat and mass transfer analysis of the subfloor cavity of a residential building

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As roof and wall insulation have become a standard inclusion in a residential building's design, the conditions in the subfloor cavity have gained relative importance to the building's thermal performance. However, the modelling of heat and mass transfer between a building and the ground is considered a weak point in many building simulation programs. As very little measured data on Australian subfloor conditions exists, this research seeks to investigate the subfloor conditions experimentally. This paper examines measured subfloor climate data and compares it to acceptable limits and prior field studies. Heat and mass transfer relationships connecting subfloor ventilation, ground evaporation and the subfloor and outdoor climate conditions are developed theoretically and investigated using measured data. Ground evaporation is found to have a significant effect on the energy balance in the subfloor. Thus a recommendation is made to include an evaporation model in Australia's AccuRate building thermal performance simulation program.

Effectiveness of methods to calculate the greenhouse gas emission reduction of residential refurbishments

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The building stock of 2020 largely exists today! The enormous task of the next decade is to retrofit and refurbish these buildings to reduce Greenhouse Gas (GhG) emissions. These retrofitting strategies are of particular relevance for the future of the current inefficient model of the Australian suburb. This paper considers the methods that are used to calculate residential refurbishment savings in GhG emissions e.g. using actual calculations in case studies, and using thermal modelling software, and provides examples. It also includes a residential performance upgrade case study, which used thermal modelling research to select the most practical and cost-effective strategies. This research is currently being applied to the case study, and logged and modelled temperatures are compared. The comparison of methods provides guidance for a research methodology for practical and cost-effective strategies to lower GhG emissions of residential buildings in Australia. The paper incorporates cross-disciplinary approaches in practice and academia, and considers the integration of architecture, engineering, building and science.

Depth of Shadow: Research and design

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Changes in technology and the Australasian Masters in Architecture Professional degree structures have changed the way design is taught in our architecture schools. There is increasing emphasis on research that goes with the territory of a higher degree and is evident in recent course structures and design teaching practices. There is a lack of clear demarcation of what differentiates design and research by design outcomes that can create an academic void where design and research may be confused and conflated. This paper teases out implications of emphasis on research by design for the teaching of design.

The Depth of Shadow project is considered as a case study demonstrating research through the medium of design in action. Characteristics, strengths and problems associated with research undertaken through design as methodology are identified and considered. Advantages and limitations of design understood as research medium are identified and documented. Clear definition of how design may be applied as research method occurs. Criteria for assessment of design as research method are identified as being required to avoid confusing operative design research and findings from procedural design processes and outcomes. A design research matrix is proposed as an academic tool to aid assessment of research through the medium of design and the quality of design research outcomes.

Understanding membrane roof performance for water collection in New Zealand

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While there are an increasing number of outlets for information on building materials and methods, particularly web-based ones, little published information is available on the suitability of membrane materials for water collection. The microbiological aspects of roof materials and systems for rainwater collection are well documented, thanks to ongoing study of those at the Wellington Massey Roof Water Research Centre. Issues such as chemical leeching from materials however are far less comprehensively studied. This paper examines existing information on the performance of membrane roofs for water collection, identifies areas where such information is lacking, and suggests methods to improve the quality and breadth of information available.

Ageing and streetscape: Linking indicators of healthy ageing with the design of residential urban space

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Over the next twenty years, the number of Australians over the age of 65 is expected to double. Current policy initiatives emphasise ‘ageing in place’ whereby older people are encouraged to remain in the community, rather than move into institutional care. It is argued that ageing in place benefits individual health, social cohesion and increasingly, links are being made to the form and sustainability of our urban environment. This cross-disciplinary paper is a result of collaboration between researchers in architecture, construction management and population health. The outcomes of a study, undertaken by the authors, that combined subjective and objective measures of two residential suburbs within Newcastle (NSW, Australia) are discussed in relation to the links between the health of the ageing population and urban form; a significant national and international issue that is now only beginning to be adequately addressed through research. The outcomes of the study show that there is a relationship between the visual character and urban form of a locality, and the quality of life of its residents. This relationship also exists at the scale of individual streets, and this is discussed from the perspective of the potential scenarios for the design of residential urban space for ‘ageing in place’.

Compacting suburbia: A case for moving buildings

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Processes of intensification lead to some unforeseen consequences. One such unplanned consequence is the rearrangement of existing buildings in new or revised spatial patterns. In pursuit of higher densities, large lot suburban development inherited from previous generations – the quarter-acre section – is “intensified” by cross-leasing rear gardens. The site frequently has greater commercial value than the existing buildings. Where the existing house is below the standard required by market expectations of value a house mover can be contracted to saw the building into sections, and truck it away to another, lower value site. In larger developments several houses may be shifted off a site to clear space for higher density new housing.

Houses subjected to this process of rearrangement are known as “relocatables”. They are displayed in “relocatables yards”, from which they can be purchased for re-use elsewhere. The practice is known in other countries where timber frame construction is a standard house-building method, but is thought to be a more popular habit in New Zealand; where up to 10% of the annual housing supply is affected by moving buildings. There are casualties in this process including historical reliability of the urban landscape; but there is also an argument in favour, since analysis shows that the practice of re-cycling has merit as a sustainable supply methodology. This paper explores the increasingly temporary nature of the built environment in New Zealand’s cities: the temporary reality of suburbia as a phenomenon of, on one hand, a socio-cultural disinterest in permanence of place, and on the other, a building culture of light-weight construction that can readily relocate its products.

Towards a new paradigm for the assessment of sustainable housing: An environmental Quality of Life (QoL_e) approach

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The basic concept of sustainability is about supporting human needs within ecological boundaries. Human needs are diverse hence a measure called Quality of Life (QoL) is commonly used to ensure human well-being. Yet these metrics do not currently involve environmental factors, although QoL and sustainable development share common components. Hence by including environmental factors, the QoL approach has been adopted to measure the social needs and sustainability at local level. This paper argues that environmental Quality of Life (QoL_e) can be used for the assessment of sustainable housing. QoL_e refers to the perceived and experienced QoL in the broader social, physical and economic environment in the geographic space within which people live.

The paper explores methods to assess sustainable housing development using this approach. QoL_e is assessed through subjective and objective measures. A subjective measure involves two questionnaires, a) environmental attitudes survey, and, b) residential environmental satisfaction survey. The objective measure involves analysis of environmental, social and economic issues. In this way, it is possible to understand resident's' values and attitudes to the environment, particularly, their level of people-environment congruity. Secondly, their satisfaction with the physical aspects of built environment, environment and community. Thirdly, the level of sustainable attributes on housing development. The underlying hypothesis suggests that high QoL_e aligns with strong person environment congruity, high levels of residential environmental satisfaction and a high sustainability rating of housing development.

Timely changes: Connecting traditional systems for building with contemporary sustainable architectural education for children

Susan J. Wake

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This paper first makes a case for the importance of democratic sustainable architecture education for children, due to their capability and right to have a say in the design of their environments, as well as their role as future stewards of the environment. It then uses findings from the Eco-classroom Project in a New Zealand primary school, to explain how the project managed aspects of inevitability, that could easily have been seen as negative, in a positive way that led to greater involvement of students and a wider sphere of influence within the community. Through quotes obtained from interviewing the project architect, this is linked to traditional or cultural ways-of-working, now largely defunct in the Western world. These necessitated on-going community and family input and connections as knowledge and skills were handed on through generations in huge urban projects such as cathedrals. This led to greater meaning of these buildings within families and the community, perhaps comparable to the value changes observed in students involved in the eco-classroom project.

Consideration is made of whether the model used for the eco-classroom project has similarities to historical systems of building, and what place this may have as a model for sustainable architectural education in school co-design projects. Finally, a contrast is made to the recent Building Schools for the Future (BSF) Programme in the United Kingdom.

Uncertain politics: Agencies and ethics in a-disciplinary ecologies of practice

Charles Walker

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This paper introduces work-in-progress on a longitudinal, ethno-methodological case study of the process of establishing a new inter-disciplinary Bachelor of Creative Technologies (BCT) at Auckland University of Technology in 2008.

The project-organised BCT curriculum draws together elements of art, interaction design, computing, engineering, mathematics, philosophy of technology, entrepreneurship and industry internships. The program is conceived as a “post-graduate program for undergraduates” or a “liberal education for the 21st century” which recognises that pervasive technologies lie at the heart of any modern cultural enterprise. Learning objectives are framed as research projects from Year 1, and intellectual independence is cultivated through active identification of contemporary issues leading to the formulation of new research hypotheses, methodologies and outcomes. The BCT has been recognised as ambitious or timely in challenging normative disciplinary boundaries and pedagogical practices, yet has also attracted initial scepticism. In discussing the contested evolution of the program, this paper will draw on interviews with situated individuals to highlight frequently overlooked institutional investments in the micro-politics of disciplinarity, and how these influence the wider academic, socio-professional and industrial ecologies of practice within which we operate.

The paper argues that in these new, information-rich, a-disciplinary ecologies, ontological tensions will tend to manifest themselves inter-subjectively, reflecting aesthetic, social and/or ethical dispositions as well as disciplinary ones. This situation is compounded by the observation that the agencies of ‘professor’, ‘tutor’, ‘learner’ or ‘peer’ are frequently contingent, inverted or fluid enough to confound increasingly fragile institutional structures of authority and their expectations for predictable learning outcomes.

Enhancing practical pedagogy for construction students with e-learning technologies

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E-learning has increasingly come to the fore as a means to enhance students' learning in design education. This is despite academic research warning against putting too much onus on these technologies as the answer in improved learning experiences for students. This paper explores whether e-learning technologies have a significant role in linking students' knowledge, learnt from their practical placement experiences, to the theory learnt in the building and construction education curricula. This paper reviews a recently awarded Australian Learning and Teaching Council (ALTC) research grant, which compares work-based learning within the building and construction discipline, with nursing – a discipline where practical skills and experiences also play an important role. Overall, the research project aims to explore if new e-learning technologies can engage students by better connecting and integrating work-based learning and academic studies.

This paper concentrates on the Construction Management (CM) portion of the project. Derived from the outcomes of our preliminary research, the paper presents a robust framework that could facilitate and encourage reflective learning during work-based activities through using e-learning technologies, predominantly electronic (e)-portfolios. Through the development process of the framework, various challenges in evaluating work-based learning in construction management are discussed. These range from competency definitions, to strategies and criteria for assessing practical experience within e-portfolio platforms.

Use of lifts and refuge floors for fire evacuation in high rise apartment buildings

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If current population and accommodation trends continue, Australian cities will, in the future, have noticeable numbers of apartment buildings over 60 storeys high. With an aging population it follows that a significant proportion of those occupying these buildings will be senior citizens, many of whom will have some form of disability. For these occupants a fire emergency in a high rise building presents a serious problem. Currently lifts cannot be used for evacuation and going down 60 storeys in a fire isolated staircase would be physically impossible for many. Therefore, for many, the temptation to remain in one's unit will be very strong. With an awareness of this behaviour trend in older residents, many researchers have, in recent years, explored the possible wider use of lifts in a fire emergency. So far the use of lifts for evacuation has been approved for a small number of buildings but wide acceptance of this solution is still to be achieved. This paper concludes that even in high-rise apartment buildings where lifts are approved for evacuation, architects should design the building with alternative evacuation routes and provide suitable safe refuge areas for those who cannot use the stairs when the lifts are unavailable.

Colophon

On the edge: Cross-disciplinary and intra disciplinary connections in architectural science

The Proceedings of the 44th Annual Conference of the Australian and New Zealand Architectural Science Association.

Published in Auckland New Zealand by the Departments of Architecture and Landscape Architecture, Unitec Institute of Technology.

The Technical Committee of ANZAScA 2010 received 151 abstracts for this conference, from which 76 papers were accepted for presentation at the conference and inclusion in these proceedings.

Each paper has been double blind refereed by members of the ANZAScA 2010 International Review Committee. This Committee was selected by the Technical Committee. All papers accepted for the proceedings were reviewed by two referees. Where there was a difference of opinion regarding acceptance the paper was reviewed by a third referee, whose decision was final.

Papers were matched, where possible, with reviewers in the same specialist field and with similar academic interests to the author.

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