Submission to the ACT Government Standing Committee on Climate Change, Environment and Water

Submission on the Inquiry into ACT Greenhouse Reduction Targets

From Peter Gerard Overton RAIA

Responding as a private individual

I am writing the comments below from the standpoint of a local architectural practitioner of twenty five years experience. I am a current committee member of the AIA ACT Chapter Sustainability Committee and long-term organizer of the ACT Annual Sustainable House Day, acting on behalf of the ACT Branch of the Australia New Zealand Solar Energy Society. I am a member of the Association of Building Sustainability Assessors and the ACTHERS User Group.

Our Practice, TT Architecture, has provided designs for three separate energy efficiency display projects since 1994 (two for ActewAGL in Nicholls and North Watson and one for HIA in Jerrabomberra) and also designed several research-oriented energy efficiency projects for the ACT Public Housing Authority in the early-mid nineties.

The following comments shall specifically address points 2(c) I, 2(c) iv and 2(c)v of the Standing Committee Reference document and shall also make additional points relating to building sustainability legislation and education.

(2) resolves that the Standing Committee on Climate Change, Environment and Water inquire into and report on:

(c) the following issues associated with achieving the greenhouse gas reduction target:
(i) the efficacy of existing programs within the current ACT Climate Change Strategy Weathering the Change, and the need for additional programs in the Strategy;
(iv) social equity and economic issues, costs and opportunities in achieving this target;
(v) the relationship between the ACT’s legislated target and policy and measures agreed to and implemented at a national level;
Existing programs within “Weathering the Change”

Under the Section Dealing with “Designing and planning our city to be more sustainable”, existing and planned changes to the ACT House Energy Rating Scheme are mentioned, along with proposals for introduction of a rating scheme for non-residential buildings. Having had a long involvement with use of the residential rating schemes in both NSW and ACT, it has seemed evident to me for some years that the critical link between the theoretical energy ratings produced and the actual energy used in the houses, post-occupancy, is generally very weak.

The reasons for this disconnection, I believe, fall into the following categories:

a) The initial (First Generation) rating software was only ever intended to be a stop-gap tool and was not completely suited to the purpose to which it was put (The CHEETAH and ZSTEP software on which the original tools had been based was developed for a specific application for the Gas and Fuel Corporation of Victoria). This led to significant inaccuracy in the predictions and omissions in simulations, especially relating to natural ventilation modeling, but also in numerous other areas (building geometry, thermal zoning and construction description).

b) Once a rating has been done, insufficient resources are made available to ensure that the building description contained in the rating is accurately transferred to the finished building in the field. With the introduction of the Energy Provisions into the BCA in 2006, this problem has been partially dealt with, but it is still an area requiring serious reconsideration. All responsibility for checking the incorporation of energy efficiency measures into the building envelope construction now rests with the Certifiers who, I would suggest, are themselves inadequately resourced and inconsistently trained to undertake the task.

c) Insufficient resources have been made available to ACTPLA to audit the use of the ACTHERS for both new house ratings and mandatory disclosure ratings for existing houses. Over time, this has led to a somewhat lax approach to the rating process and inconsistent outcomes in the field. These inconsistencies in the product damage the public faith in the scheme and ultimately retard improvement in housing sustainability.
d) No tools are available to the house occupant to assist with real-world evaluation of their total energy use. This is a crippling problem for building sustainability at all levels, both residential and non-residential. **It is noted that the ACT Government is exploring the widespread use of smart meters for ACT Households. Such a measure is vital to the overall success of any building energy rating scheme.** Without a real-world measure of the success of designed sustainability features, progress is doomed to be slow and erratic. The valuable work of the Home Energy Advice Team should be recognized and commended. The auditing service they provide is invaluable in lifting the sustainability performance of existing dwellings and any further funding in this direction would be well spent. Smart metering of gas use would also be of great value in the ACT where many houses rely on gas as the main fuel for space heating and water heating.

e) No dependable source of advice is presently available to home owners or designers on the actual energy use profiles of the existing ACT Housing Stock. It is noted that a pie-graph is included in the submission from the Conservation Council which shows a categorization of energy-use in the “average” ACT house, however I do not think that the information used to produce the analysis is current or accurate; after trying for some years, I have not been able to source any up-to-date information which includes both electricity and gas use and I am unaware of any procedures in place to monitor a statistically relevant number of households in order to produce this kind of information. The importance of this gap in knowledge cannot be overstated. At present, both designers and home owners are effectively flying blind in terms of their ability to understand the nature of household energy use and prioritize their efforts to reduce it.

In summary:

- There is an urgent need to provide real-world validation of ratings which are done at the design stage or sale of a dwelling. Smart metering for electricity, gas and water is an essential element of a successful sustainability assessment scheme. Post occupancy performance rating schemes, such as NABERS, should be adopted as a mandatory component of both new dwelling and sale-of-premises ratings. By correlating the pre and post occupancy assessments, a valid measure of success for emissions reduction strategies could be established.
• While occupied display houses, as are opened to the public each year for the National Sustainable House Days, are extremely valuable in raising awareness of better design and construction options by enabling the public to experience alternatives, there is a further need to provide dependable empirical data which can allow the residential building industry to quickly improve its standards. Dedicated test facilities should be quickly established in all the major population centres (starting with state capitals, and broadening to include regional centres) of Australia to allow objective environmental performance testing of building design and construction methods. A description of how such a facility could be structured is included in Appendix A. I see a role for the various state and federal governments in the development of these facilities to ensure independence and accuracy of data. They could also perform an invaluable, on-going public education roll.

• The feed-in tariff legislation for distributed PV power generation has been one area of outstanding leadership for which the ACT Government should feel rightly proud. It is, without doubt, the best such scheme to be devised so far in Australia and will hopefully influence the Federal Government in development of a uniform national FIT scheme. Similarly, initiatives outlined in “Weathering the Change” regarding solar hot water rebates, mandatory performance disclosure and energy rating for non-residential buildings, participation in the Sustainable Schools Initiative, the Mandatory Renewable Energy Targets and Greenhouse Gas Abatement Scheme are all well-targeted and should produce measurable reductions in ACT emissions in the short to medium term. There are two additional areas of legislative action which have so far been neglected by governments in Australia and which could produce massive, and rapid, positive results for emissions reductions.

1. Energy Budgets

Use of universal energy budgeting for both residential and non-residential buildings is an effective way of making the connection between a theoretical, pre-occupancy, energy-use goal and the real energy-use pattern of the occupied building. A suitable method could work as follows:

Existing rating software and schemes, (NATHERS and NABERS for residential, and ABGR-NABERS for non-residential) would be used to produce the target budget based on the agreed performance levels specified under the BCA and state government ordinances. Once the building was occupied for an agreed time period (2-3 years), the energy-use (water use could be included as part of an overall sustainability index) would be audited by making use of organizations such as HEAT, the newly-formed federal government Green
Loans assessors, and most-importantly, by the energy utilities themselves through survey of existing billing records. Any energy use over and above the predetermined level would be required to be provided on an emissions-neutral basis by purchase of accredited 100% Green Power or installation of equivalent zero-emissions power generation system. (PV, wind power, micro-hydro, geothermal etc.)

Bearing in mind that existing building envelope energy efficiency rating tools do not address appliance energy, differentiation between primary energy use (related to building space heating and cooling) and secondary energy use (all other demands, appliances, water heating etc.) would be necessary in order to establish the overall energy budget for the building. While real-world monitoring would be desirable to establish up-to-date appliance energy profiles, estimates drawn from existing data collected from the BASIX program, DEWHA, DRET and supply authorities would be a good starting point to calibrate average appliance energy demand correlated to house size. Floor area brackets could be defined to categorize both primary and secondary energy budgets with respect to house (or other building) size. NATHERS ratings for residential buildings already use a sliding scale to increase stringency with increasing area beyond 200sq.m.

Secondary energy use budgets in residential buildings, for in instance, could be bracketed by area, increasing in 50 sq.m. increments up to a capped level for, say, 200 sq.m. houses. Beyond this size, the budget would remain static.

While such a scheme would be ambitious, all the necessary information is largely available from existing data-bases. Once a budget is established (this would be done at Certification point for new buildings, and through the S.O.P. auditing for existing buildings – presuming mandatory disclosure is extended to non-residential buildings) the essential task becomes a simple (on-going) correlation between the theoretical budget and the actual use. The budget limits would be continually adjusted in line with increases in stringency of mandatory energy efficiency targets.

Benefits of establishing such a scheme would be many-fold.

a) Intrinsic equity in energy pricing. Both energy use and house size tend to increase with increasing income. Budgets mean the choice to use more always remains with the user, however, a pronounced cost incentive would exist to remain within the allocated budget. Those choosing to use more would do so in the knowledge that their over-budget energy would be charged at 100% Green Power rates and would be incurring a commensurately higher tariff.

b) A massive stimulus to the low carbon/renewable energy industry sector to provide the necessary Greenpower resources required by the supply authorities.
c) Visible connection between the energy rating assigned to buildings and the actual emissions produced post-occupancy.

d) Rapid validation and development of rating software and predictive energy assessment methodology and greater acceptance of performance simulation by the building industry and general public.

e) Rapid reduction in emissions from stationary power.

f) Creation of a mechanism for ongoing improvements in energy-use standards applicable to all classes of buildings. (From incremental adjustment to the minimum acceptable performance levels via the BCA.)

g) By focusing on co-ordination of pre-existing systems (NATHERS, NABERS, Green Loans) set-up costs would be relatively low. Budgets could also be complementary to other more direct subsidy and infrastructure projects.

h) An incentive would be provided for long-term building industry investment in low-emissions design and technology.

i) Energy budgeting would assist in educating the general public on effective abatement strategies for their own homes and work places.

2. Rights to Sunlight

With all the emphasis in the past twenty years on improving passive solar heating performance of houses in the cool temperate zones of Australia, one critical aspect which enables this design principle to work effectively has been largely overlooked. No-one can enforce rights to sunlight. While almost every planning document in use at present includes some measures to reduce overshadowing on the north by other buildings, (setbacks, building envelopes, window placement guidelines etc.) none that I know of have extended this principle to include vegetation, which is often a far more influential factor in limiting solar access. Inappropriate planting in urban areas has unlimited capacity to ruin potential for utilization of solar energy for both active and passive uses. While natural heritage and streetscape issues obviously need appropriate consideration, stronger rights to solar access should be included in the Territory Plan design and siting provisions. More considered choices for new planting should be enforced at the Development Approval Stage, and, for this reason, Action 23 of Weathering the Change Action Plan 1 should include an objective to take solar access into account in urban landscape design.
The Roll of the BCA and Local Government Development Codes

Since the introduction of mandatory energy efficiency provisions in the Building Code of Australia in 2006, a sudden change in emphasis has occurred in how and when sustainable building design issues are taken into consideration. The introduction of the national Building Code in 1990 led to two distinct phases being present in the approvals process in Australia – the Development Approval phase, addressing basic design and siting issues with reference to state and local government ordinances, and the Building Approval phase which ensured compliance with the uniform national Building Code and its many cross-referred standards governing materials and workmanship.

Until the introduction of BCA2006, energy efficiency guidelines had been contained within the local government ordinances as part of design and siting. While this approach was limited in many respects, it did ensure that basic building envelope and siting decisions (early stages of design) included energy efficiency parameters as part of the design consideration. Residential Development Approval in the ACT, for instance, required houses to be energy-rated as a part of the process. In NSW, this is still the case because of its adherence to the BASIX Sustainability Index as part of Development Approval.

Since adoption of the BCA energy efficiency provisions, the ACT, and all other states except NSW, have effectively removed energy efficiency as a parameter in design and siting assessment. This has led to a fundamental flaw in the overall approval process. While the BCA is the correct tool to use for assessment of more detailed compliance issues – relating specifically to construction method, services, appliances and installation codes of practice – this stage of compliance checks is too late in the process to ensure that energy efficiency has been incorporated into the early design considerations which influence the configuration of the building envelope. It is these early considerations which have the greatest capacity to influence the design and ensure a successful outcome. Sustainability cannot be added into building design as an afterthought.

Persisting with this approach invites a recurrent circumstance where band-aid measures are hurriedly applied to a fundamentally inefficient building design in order to ensure that “Deemed-to-Comply” measures in the BCA are satisfied. One must remember that Building Codes are not aspiratory documents, but are designed to ensure compliance with minimum acceptable levels of construction. Reliance on BCA compliance to assess fundamental building fabric design issues will not be successful and shows a failure to understand the intention of the document.

While the BCA is undeniably useful and appropriate to ensure that correct construction method and materials are applied to an energy efficient building design, (insulation is installed correctly,
building elements have acceptable thermal resistivity, light fittings and appliances meet acceptable minimum energy efficiency etc.) it is not the correct type of document to assess the success or failure of sustainability aspects of the basic building design. No consideration is given in the BCA to how the building relates to its site, how it is zoned internally, what proportions are used in the overall building envelope, how different construction types are used in relation to each other – in short, any factor dealing with the dynamics of the design. Only performance simulation can be used for this, and it is this option which is effectively being relegated to the margins under the current system.

It is my sincere hope that the decision to remove performance simulation from the Development Approval assessment process in the ACT (and other states) is reversed as quickly as possible.

Peter Overton RAIA
Appendix A

From a submission originally made to Canberra Investments Corporation following TT Architecture’s involvement with the North Watson Energy Efficiency Display Project, 2005-2006.
PROPOSAL FOR DESIGN OF A THERMAL PERFORMANCE MONITORING TEST MODULE

SUBMITTED TO

CANBERRA INVESTMENT CORPORATION

3RD APRIL 2007
PETER OVERTON
For
TT ARCHITECTURE
Thermal Performance Test Module

Background

Further to a debrief session with Mr Lindsay Hunter regarding the Majura Rise Eco-Living Display (22nd March), this proposal will attempt to outline an alternative approach to building awareness about sustainable residential design and construction.

It was encouraging to learn that the project was very well attended during its operational term and, no doubt, succeeded in exposing many visitors to unfamiliar design ideas and options in an easily accessible and relaxed context.

This conclusion is consistent with the results shown in other earlier Eco-Design display projects with which TT Architecture has been involved (Actew Nicholls Display and HIA Jerrabomberra Display). It seems evident that broad awareness benefits flow on from these types of projects, however, displays inevitably suffer from the effects of multiple competing objectives. A traditional Display House must serve many purposes, ranging from information dissemination to both the public and building industry professionals, promotion of the development in which it is situated, and also of the sponsors’ products which are displayed, setting of constructional and aesthetic standards which can serve as a model for the remainder of the development, and finally, adhering to a predetermined cost structure which enables some degree of return on the capital investment.

With so many diverse objectives, it is obvious that not all will be served to the same extent or effect. It is our view that there is a pressing need for information on performance evaluation to be made available from public display projects at this point in time, and it is this purpose which is most heavily compromised by the traditional format of displays.

The Problem

The building industry is presently at the cusp of a new era. Designers, developers and builders are struggling to adapt to a working environment which is increasingly affected by legislation aimed at improving environmental outcomes. The legislative response is a legitimate step in addressing what must be seen as a market failure by the industry to provide more resource efficient products to the buying public. There are a myriad of reasons for this (beyond the scope of the immediate discussion) however many of the reasons relate to the speculative nature of much residential development and a disjunction between costs and benefits influencing the providers and users of development projects.

For anyone interested in making rapid improvements in the sustainability of our new developments, it is difficult to escape the conclusion that both the buying public and industry professionals need better quality information on the effectiveness of the design/building/planning methods currently in use, and also on appropriate directions in which to pursue change to those methods.

A common problem with research oriented projects to date has been the lack of resources directed toward data collection and analysis, even when these tasks have been initially briefed into the project description (due in large part to the competing objectives raised above). While this problem persists, a critical part of the potential benefits obtainable from such projects will continue to be lost.
We now have a design context which is increasingly influenced by the feedback from computer-generated resource analysis tools (such as Basix in NSW) and NATHERS-integrated thermal modelling tools (Accurate, BERS, First Rate). The evolution of the thermal analysis sections of the BCA and these related modelling tools is becoming an extremely rapid process in itself, but it is a process which is not being conducted with the benefit of complementary real-world validation (at least in any structured fashion – refer to following description of Newcastle, Perth and Launceston research projects).

Those few projects which have commenced have been relatively narrow in scope, aiming to explore specific constructional issues, or using buildings which need to eventually be sold for normal habitation purposes. In the following submission, we will outline a conceptual scheme aimed specifically at addressing the gap in performance evaluation. It is a project format which we believe will solve the problems inherent in the multiple objectives of the traditional display, which will be able to provide long-term benefits to the buying public and industry professionals, and also a valuable marketing presence to those involved in its inception and execution.

The Solution

Scheme outline

The basic idea for this scheme has its origins with the study module set up at Newcastle University by the Clay Brick and Paver Institute to assess the relative influence of increased levels of thermal mass on three very simple, dimensionally similar garage–sized buildings, each one constructed to a different formula. Surprisingly, this seems to have been the first time in Australia that a dedicated physical research installation has been used to provide empirical feedback on thermal performance of building materials in a full-size, real world environment. (Refer to Appendix)

In terms of its major aims, the project has been successful in providing extremely valuable information about how thermal mass affects overall building performance, and it continues to function to this day. It is altered from time to time, but being constructed by traditional means, it simply relies on demolition and reconstruction for changes to the structure to be implemented.

Our proposal suggests the construction of a skeletal structure which would provide the bones of an easily changeable modular building fabric system – a building “clothes horse”. This will be referred to henceforth as the Test Module. It would be changeable in every major respect which has an impact on the thermal performance of a building. Even the orientation of the structure would be changeable by using one of several methods (outlined below). In line with the five groups of variables which are assessed under the current energy rating software, the Test Module would be constructed to allow for on-going modification to:

a) Floors
b) External walls
c) Internal walls
d) Ceilings
e) Roofs

Before looking in detail at each of these variables, we will describe the proposed structural skeleton and base support mechanism.
**Skeleton**

It is proposed that a structural steel column frame be constructed from hot rolled sections, laid out on a grid of 2.4 metres on both directions, and implying a building orientation by using a typical rectangular form of either 3 modules by 2 modules or 5 modules by 3 modules. (7.2 x 4.8 or 12 x 7.2). The grid, or part of the grid, would be extendable to two storeys and would allow for fixing of cross members at predetermined spaces vertically. The base structure would be used to model a standard uninsulated concrete floor, with potential existing to add suspended framed floors above the base, or pre-cast concrete planks over insulation to simulate insulated concrete floors.

In order to allow for simulation of different orientations, two basic approaches could be taken. The first simpler approach would be to lay out additional grid points (refer diagram in Appendices) to allow for the inferred orientation to be changed from east-west to north-south, or, as an increased level of sophistication, 45 deg. Grids to allow for four additional orientations. In this approach, footing blocks and steel spigots would be set out for each orientation, thus allowing the easy replacement of the prefabricated steel structural frame in a new position. While being a relatively straightforward procedure, the time and materials handling factors involved in this type of disassembly operation would still be significant.

A much more sophisticated approach to the problem would make use of an industrial carparking turntable system (refer to ATC information in Appendix) to act as the base structure. These are available in sizes ranging from standard 4.5m diameter carpark units up to 30m. diameter industrial turntables with a carrying capacity of 100 tons. Given the logistics advantage offered by being able to retain primary structural members in one position, and the speed of changing orientation, this option would be the preferred approach. Cost information is currently being sourced from ATC. Initial inquiries suggest that limiting the size of the Test Module to under 10 metres in length would be more practical in terms of capital cost for a turntable. ($150,000 would be the rough order of cost for this size and load capacity)

With respect to the roof skeleton, most thermal influences derived from roof spaces can be simulated with either a flat (minimal roof cavity) or substantial pitched construction (large roof cavity) using standard lightweight gangnail trusses. All other relevant determinants can be adjusted through changes to insulation levels, cladding material and ventilation level within the cavity, and such changes can be made without adjusting the structure itself.

**Floors**

The performance of floors and sub-floor spaces are one of the most complex variables influencing a building’s internal climate. While the alternatives for basic structure are few in number – concrete or light weight framed – there are many variables which can be studied relating to insulation levels and placement, the degree of subfloor ventilation and the degree of earth coupling affecting the behaviour of monolithic slab-on-ground construction. The base 600mm of the wall structure in the Test Module could be used to simulate a subfloor space. Varying degrees of subfloor enclosure could be achieved by leaving out parts of the cladding in this zone.

Because of the weight of concrete floor systems, manipulation of this element would always be a difficult materials handling problem. This problem could be mitigated by using different floor systems in several different parts of the Module and comparing the performance of the floor materials with other variables held constant. For this option, zones above the different floors would have to be thermally isolated from each other.
External walls

External wall elements would be simulated by mounting purpose-made panels on structural girts capable of spanning the 2.4 m. length between columns. The girts themselves would have mid-span connection points allowing 1200mm-width cladding panels, or windows, to be mounted on the frame. Girt spacing would generally be at 900mm c/c over a 2700mm height above the subfloor level. The upper level façade would maintain a similar horizontal and vertical structural pattern.

For the concept to be successful, the structural grid would need to be suited to the most common materials sheet sizes in order for panels of the test materials to be prefabricated and quickly fixed to the structure. In the medium term, there may well be sufficient incentive for cladding manufacturer’s to use the Test Module to validate their own testing and predictions for thermal behaviour. This could ultimately provide an ongoing income stream from the installation.

For cladding options using small unit construction (brick veneer being the most obvious example) the exterior skin could be laid in place. While, at one level, thermal behaviour will only be marginally affected by structure lying outside the main insulation layer, it would be prudent to allow sufficient flexibility in the structure to accommodate cladding systems in their true “as-built” configurations so that complete accuracy and transparency in the testing procedures could be guaranteed.

For systems making use of unit masonry on the inside, an approximation could be made by pre-fabricating panels from concrete (or core-filled block) with closely matching density characteristics.(adjustable via the aggregate choice)

Internal walls

The same installation rationale would be followed as for the exterior walls. Any framed construction could easily be pre-fabricated to the appropriate module dimensions and jointed using gaskets. Systems normally using unit masonry could be closely approximated by creating panels from pre-cast concrete or core filled block as described above. All partition walls at upper levels would be fixed in position over the beam matrix formed by the intersections of grid lines. (refer to diagram in appendix). For the purposes of the Test Module, all walls would only need to be finished to the extent necessary to produce their particular thermal characteristics. Normal trim and finishing trades would, of course, not apply. All junctions could be handled using pre-formed dry gaskets.

While not of the same critical level of importance as the external fabric of a building, the partition walls do play an important thermodynamic role in providing one of the main sources thermal inertia, and acting to disrupt air flow throughout the interior, which, in turn, affects natural ventilation. They tend to subdivide the overall space into fairly uniform, discrete thermal zones.

The effects of internal walls are accurately modelled in second generation simulation software.

Ceilings

Ceilings for the system could be constructed in a totally conventional way, and would be unlikely to require much alteration over the course of normal use. Exceptions to this rule would be pre-fabricated sandwich
panel systems (such as Ritek) where the ceiling is simply formed by the underside of the panel itself, or heavy weight precast concrete slab systems. Adapting even for these structural permutations would still only involve removal of the pre-fab trusses and ceiling panels. Column and footing structure would need to be engineered to account for heavy loads at roof level if necessary.

For cavity roofs, ceiling lining would best be constructed from tile systems to allow easy access to alter insulation, sarking details etc.

**Roof**

Roof construction would largely be standard, as stated with respect to ceilings above. Roof spaces, like underfloor spaces, have very complex thermal behaviour and extremely useful data could be generated by the Test Module to help validate the current computer simulation algorithms. Provided the column and floor structures were appropriately engineered, all types of roofing systems, including concrete plank built-up roofs and sandwich panels, could be easily accommodated. Basic geometrical permutations could be covered by prefab trusses configured for near-flat and medium-pitched profiles.

Fixed shading devices could be supported by cantilever frames attached to the walls at the column tops, and detailed to vary in width. A range of adjustable horizontal and vertical shading devices could also be supported by the same structural additions.

**Ancillary facilities**

Given the nature of the Test Module and the importance of maintaining controlled conditions for data collection, the function of a public assembly place, access point and information office would be best handled in a separate (conventional but energy efficient) building adjacent to the site for the Test Module. The exact requirements for this would need to be explored with reference to its expected functions, however, allowance for temporary materials storage space (storing alternative cladding panels, trusses etc.) and an “education room” for instructing groups of visitors, schools etc., and monitoring results from the data collection operations, would be essential elements. This structure would function as the public relations and promotional hub for the facility, as well as its service centre and store.

**Monitoring**

It is proposed that continuous data logging of the Test module be undertaken with reference to a planned data collection schedule and with well resolved testing objectives giving a structure to the plan. It is this component of the scheme which would be of most value in attracting funding from industry and government interests and which would be the practical basis for undertaking the project. No properly-controlled, empirical thermal performance data set has yet been collected to aid design in the Australian Building Industry. We believe the time is right to commence such an enterprise and the scheme outlined represents an effective method which could be repeated for all the major climate zones and population centres of our country.
Appendix 1

Thermal Performance of Masonry
Research Program

University of Newcastle

Research - Thermal Performance of Masonry

Industry (CPBI) and ARC funded
1. Development of lab scale GHB apparatus
2. Purpose built test modules for thermal performance
3. Zonal and CFD energy models, neural networks model, embodied energy and Life Cycle Analysis
Appendix 2

Validation of AccuRate Software

Associate Professor Behdad Nooghradani
Discipline of Chemical Engineering, School of Engineering, Faculty of Engineering & Built Environment

Project Objectives:

The main aim of the work reported in this document was to validate the AccuRate software (the Second Generation NathERS tools) against experimental data obtained from a series of masonry test house modules at the University of Newcastle.
Appendix 3

Chris Lafferty

Assessing the energy consumption of a design

The NatHERS software assesses factors such as insulation levels, window orientation and area, wall type and ventilation to provide an estimate of the heating and cooling energy required over a twelve-month period to maintain comfortable temperatures. Alternatively, it can estimate temperatures in a house without the use of heating and cooling.

A star rating, from zero to five, will indicate the efficiency of the design for heating and cooling energy. A low rating will result in either high energy bills or a relatively uncomfortable house. A four or five-star design is a sign of a thermally comfortable house that will minimise the need for heating and cooling.

This will be attractive to the home owner and can provide a marketing edge for developers.

Appendix 4

Monitored Thermal Performance of Passive Solar Designed Display Homes in Perth, Western Australia

G.M. James, M. Anda and K. Mathew
Environmental Technology Centre
Murdoch University
Murdoch WA 6150
AUSTRALIA
E-mail: g.james@murdoch.edu.au

Abstract

A number of sustainable demonstration homes have been built in Perth over the last 3 years. This paper will report on data gathered at two of them, provide a comparative assessment and present lessons learnt. A fundamental inclusion in a sustainable house is Passive Solar (PS) design. PS design is a simple methodology for the design of energy efficient buildings that can reduce the need for mechanical heating and cooling, therefore reducing the need for energy to operate active systems. PS design is a regionally specific design methodology whereby the general climate of a house site needs to be analyzed to best ascertain what design features will be needed. In Australia, due to the extremes of conditions, house designs will vary greatly by state, which is also due to the established building industry. The uptake of this design rationale has been very slow, with houses mainly relying on air-conditioning. The design of a PS building follows several basic principles: Orientation, Glazing and Protection, Thermal Mass, Insulation, Ventilation and Zoning. A PS house uses a system of windows, walls and insulation to control the flow of energy to maintain temperatures at comfortable levels for occupation. Separate components are not monitored, just the capacity for the building to have stable internal air temperatures, which is what inhabitants will detect.

The range of temperatures for Thermal Comfort (TC) is 18 to 26°Celsius. The Subiaco Sustainable Demonstration Home (SSDH) is a collaborative effort between the local council and the building industry to create a house that uses fewer resources than normal built homes during its construction, use, and eventual demolition. Harvest Lakes, the first Housing Industry Association (HIA) GreenSmart estate in Western Australia, showcases 'The Elements' Sustainable Demonstration Home (ESDH) as an example of a possible sustainable future of residential construction and living. With a PS design based on a standard plan, the ESDH could easily be replicated in various other locations around Australia. Each house has been monitored for at least the last year using stand-alone temperature data- loggers to record the air temperatures in different rooms to give an indication of the effectiveness of the PS design in terms of maintaining temperatures within established TC thresholds. Results collected to date indicate that a PS building can be thermally comfortable, but it does require occupants to 'drive' them to maximise the benefits of the design.

1. INTRODUCTION

Sustainable display homes have been built or retrofitted in five suburbs of Perth Western Australia in recent years. An integral part of a sustainable building is its capacity to maintain internal temperatures at comfortable levels for the occupants without the use of active systems.

This report looks at the monitored thermal performance of two of these houses, the Subiaco Sustainable Demonstration Home and 'The Elements' Sustainable Demonstration Home. Despite being designed using Passive Solar principles, both houses have very different features.

Thermal monitoring projects were undertaken whereby air temperature and humidity monitoring dataloggers were placed in several rooms of each house and set to record data at 5 or 10 minute intervals. The data has been collated and analysed with the results shown in graph and table form.
Appendix 5

Web sites for:
   o Australian Turntable Company
   o Hollow Core Concrete Floor Panels

www.turntables.com.au

www.hollowcore.com.au
Drawings:

STRUCTURAL SCHEME FOR THERMAL TEST MODULE