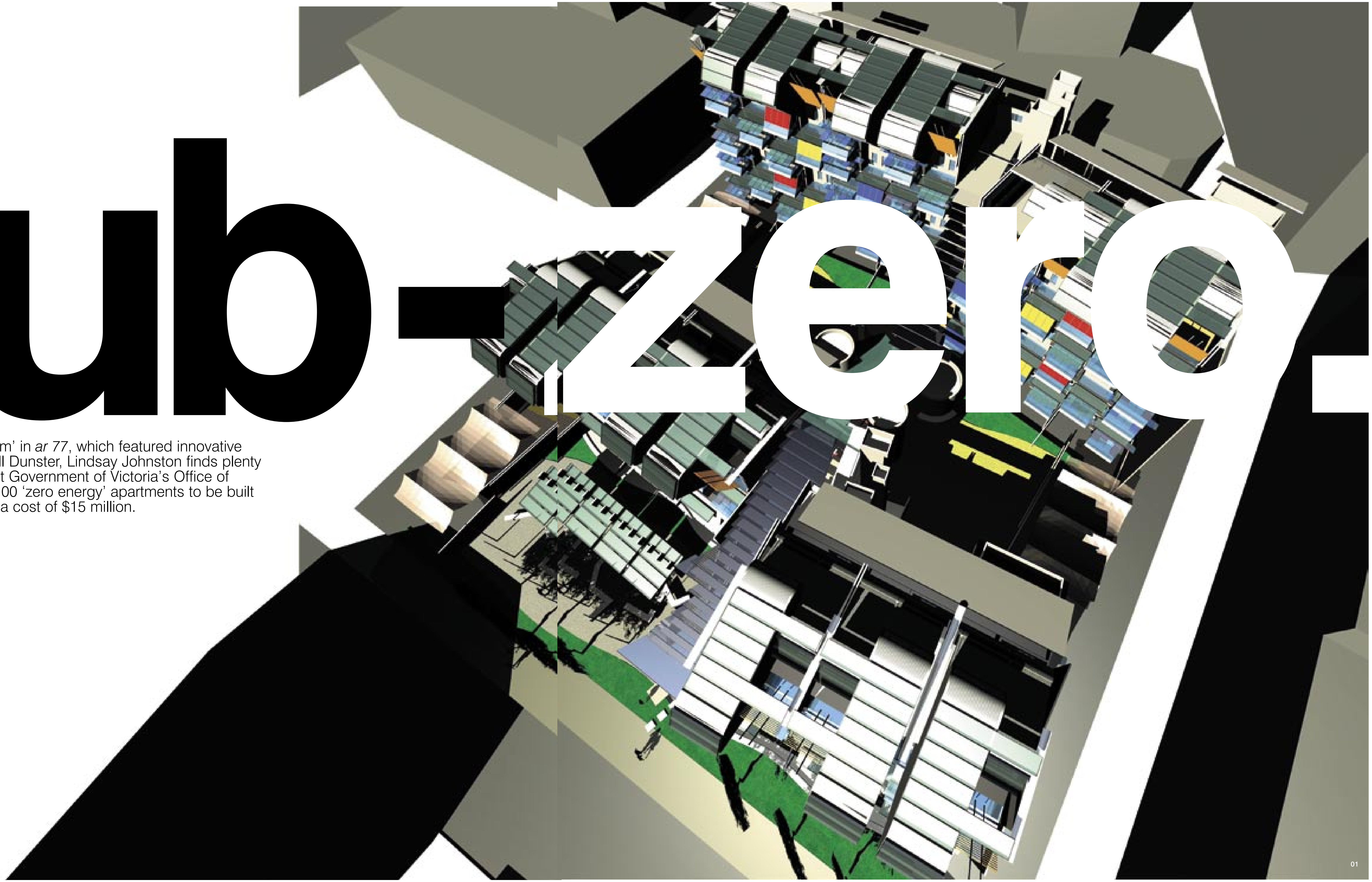
Sub-zero.

Following the ESD feature 'Eco Urbanism' in *ar 77*, which featured innovative urban housing in the UK by architect Bill Dunster, Lindsay Johnston finds plenty to celebrate in the success of the recent Government of Victoria's Office of Housing competition for the design of 100 'zero energy' apartments to be built in the Melbourne suburb of Windsor, at a cost of $15 million.



01 Graphic aerial view of DesignInc's winning entry.

Introduction.

Bill Dunster's catchcry of 'ZED' for 'zero energy development', illustrated through his 'Bedzed' project under construction in Beddington near London, sets an agenda into which few in Australia have been brave enough to buy. The predominance of private sector funded development, that places short-term profit before long-term sustainability, combines with a willingness to compromise at all levels when it comes to balancing today's capital costs against tomorrow's environmental costs. There are few examples where all parties have been prepared to 'go the full distance' towards serious and innovative environmental solutions.

It is to the immense credit of the Government of Victoria, the Office of Housing, the RAIA and all involved in the conceptualisation and realisation of this design competition that there is a design outcome with real prospects of implementation. Great encouragement is also to be drawn from the fact that 43 architectural teams submitted credible entries within a very short (too short?) time frame of seven weeks. The competition winners were the Melbourne office of DesignInc, under the leadership of John Macdonald, with an exciting and innovative scheme that forever puts to bed the notion that environmentally responsible architecture needs to be compromising. Second place went to Hayball Leonard Stent under the leadership of Richard Leonard and third to Fooks Martin Sandow Anson under the leadership of Greg Anson. Many other well-regarded firms were in the field, with entries ranging from concentrated 'stand-alone' icons dominating the space, to lower-scaled clusters colonising the whole site. The most successful proposals were in a simpler format utilising two to four roughly parallel blocks on an east-west axis facing north-south. The spectrum of forms and styles varied from slick commercial to mundane boxes. In many cases, the environmental offerings held far greater promise than the architecture.

In *ar 77*, Herbert Girardet expounded that dense inner-city urban renewal is a primary step towards a sustainable city. The site at Raleigh Street is less than 5km south of Melbourne's CBD, just east of Albert Park and St Kilda Road and immediately accessible to public transport and urban infrastructure. Studies of total lifestyle energy consumption show that energy consumption, and associated greenhouse gas emissions, arising from private car use dwarf those arising from the individual dwelling. The brief, therefore, facilitated maximisation of density, commensurate with maintaining standards of amenity and the scale and character of the neighbourhood, and minimisation of parking provisions for private cars.

Dr. Robert Vale (co-author of the *The Autonomous House* books) and Professor Roger Fay, both experts in matters of sustainability and the built environment, were invited to help configure the brief for the competition and were, no doubt, instrumental in setting the dramatically rigorous trinity of principles: Zero CO2 emissions. 200-year design life. Water consumption at 50 percent of conventional levels.

The radical demand for a 'zero energy' solution was to force entrants to confront the solution of autonomous development, rather than opting out and buying in a 'green power' option. The brief called for answers to a suite of environmental performance criteria. Few project proposals today demand this level of detail. To validate environmental performance this detail is essential, and foreshadows a future modus operandi.

The winning scheme.

The scheme is considered to successfully address both the visual architectural expression and the conservation and enhancement of the community's resources. It is technically well resolved offering reasonable proposals for the minimisation of the consumption of non-renewable resources and efficient use of renewable resources. Sensible articulation of the building bulk provides for the creation of strong and highly useable external areas visualised as urban courtyards. The massing of the major elements responds to demands for minimum impact and appropriate streetscape scale, and avoids the appearance of one large public housing development. The proposal provides a clear expression of sequenced movement through the site with a clearly expressed pedestrian circulation system threading from building form to building form via the generous courtyard spaces. The unique example of environmentally sustainable development displays its function to the street.

Edited from the jury chairman Peter Crone's report on the winning design by DesignInc.

Extract from the statement of the winning architects DesignInc., Melbourne.

The building form evolved from the direct expression of the environmental criteria. Rooftop maisonettes cantilever out from lower storeys to provide summer shade and juxtapose the main building mass. The evolution of a flexible unit plan meant the north facades could be broken down into a pattern of solar balconies and solid bedroom walls.

Designing for the 200-year life span, not only for materials, but building function, broke the building components into permanent and ephemeral parts. The structural blade walls were designed for permanence, with thermal mass and integration of the building services, while the infill apartments are expected to constantly evolve to changing socio-economic conditions; with the choice of lightweight materials, expressed in a more fragmented application, reflecting this proposed flux.

These building forms are all tied together with the communal 'Green Spine', which is a crossroads of the functional and social aspects of the site – expression of the water tanks, rainwater collection, access to courtyards, thoroughfare to parking/street and access to lift cores – designed to emphasise community awareness and promote functions of the building.

Edited from Robert Vale's report on the ESD strategies.

This is a design which offers a technically exciting solution within an interesting and imaginative architectural form. While it relies on novel technologies, it avoids the problem of building in hardware that may have a short life, and it offers considerable technical flexibility should further analysis of the design suggest that simpler solutions may be more suitable. The scheme provides an excellent and detailed range of technical information. It follows a basic strategy of reducing demands and then meeting these demands from on-site resources. The buildings make good use of reasonable levels of insulation and thermal mass, combined with appropriate northerly orientation and solar access, resulting in minimal requirements for space heating in winter. Cross ventilation combined with shading avoids the need for summer cooling. A detailed breakdown of appliances, equipment and lighting shows excellent attention to detail and energy demands for the whole complex are taken into account. A novel system has been chosen to provide electricity, hot water and auxiliary space heating using solar thermal conductors and a micro turbine run off a solar heated working fluid. Whether such a system would be as reliable in practice as conventional photovoltaics is not known, but the buildings could be modified easily to suit photovoltaic technology and conventional solar water heaters if needed. The water strategy follows the same plan of reducing demand and then meeting it from on-site resources. There is a practical strategy for re-use of water and an emphasis on the separation and appropriate treatment of water of different degrees of purity. Longevity and durability of the scheme are provided by the use of concrete cross-walls and concrete floor construction supporting lighter recyclable claddings and infill panels.

Site. The site faces north to Raleigh Street with an area of 4838 square metres and a slight fall of one metre from south-east to north-west. It is adjoined by six to seven storey buildings to the west and lower buildings to the east and south.
Density. The winning design incorporates 60 x one bedroom units of 55 square metres each and 40 x two bedroom units of 85 square metres each. The total FECA (fully enclosed covered area) is in the order of 8000 square metres with a resulting FSR of 1.7:1.
Massing. The development is separated into four buildings cleverly skewed to avoid direct overlooking and improve solar access. This geometry brings a dynamic to the plan form. Each building is single loaded with a northerly aspect. Three landscaped courts of varied character are created.
Height. Two buildings to the north are four storeys plus two storey rooftop pod maisonettes. Two buildings to the south are seven storeys plus two storey rooftop pod maisonettes over a semi-basement parking area. Over grade, the highest element of the north buildings is about 18 metres and the highest of the south buildings is about 24 metres.
Pedestrian access. The design diagram clearly shows a pedestrian permeability at ground level. The two north buildings and the two south buildings are linked around common access cores with stairs and lifts. Open access balconies are located along the southerly sides of each building. Disabled access is provided to all apartments.
Vehicle access. A loop access arrangement is proposed with one-way access to on grade parking at the east and west and semi-sunken parking under the south buildings.
Parking. As the development is close to the CBD and adjacent to public transport, gross parking requirements were one space per five single bedroom units and one space per every two bedroom unit, totalling 52 spaces for 100 units. Generous storage is provided for bicycles.
Construction. Robust and primary construction is of tilt-up walls and precast concrete floors. External walls are sandwich panels with 150mm concrete inner leaf, 50mm rigid insulation and 50mm concrete outer leaf. Party walls incorporate a services cavity for ventilation, pipes and wiring. Roof structures are of plantation timber. Secondary construction elements are of renewable and recyclable materials.
Solar access and control – all living rooms have a northerly aspect and achieve optimal winter solar gain. Northerly windows are shaded from summer sun. There are minimum east or west windows. Many units have a novel solar balcony, which allows climate modification between internal and external conditions.
Thermal mass. The heavyweight construction of concrete walls and floors is exposed internally to store daytime solar heat gain in winter and emit night-time warmth, and to facilitate night cooling in summer and emit daytime 'coolth'. Corrugated wall finishes improve thermal exchange with thermal mass.
Insulation. R2.5 wool/polyester batts in external walls with 150mm thermal mass on the inside. Walls of pod maisonettes are lightweight construction with R3.5 insulation and roofs to pods have R4.5 insulation.
Ventilation. The single loaded plan form of each apartment facilitates natural through ventilation. The service cavity in the party walls is used to ventilate internal bathrooms, toilets and laundries and eject heat from the rear of refrigerators.

Heating and cooling. The passive solar design and effective use of thermal mass and insulation virtually eliminates the need for winter heating. Likewise solar shading and natural ventilation should obviate the need for air conditioning. Supplementary heating is available via a hydronic hot water circulation system from the micro turbine, provided only because elderly tenants may perceive the need for extra heating.
Lighting. All lighting fittings are compact fluorescent and the calculated demand will be 0.66KWh/day for single bedroom units and 0.75KWh/day for two bedroom units. Total demand for lighting, including common areas, is calculated at 4,463KWh/year.
Appliances and equipment – although difficult to control eventual tenant choice, care has been taken to identify appliances and equipment with low energy requirements, such as refrigerators that run on 0.85–1.3KWh/day.
Energy demand. The total energy demand for lighting, appliances and equipment for the apartment units and common areas is calculated at 192,477KWh/year. For the apartments alone the calculated demand for each apartment is under 5KWh/day. This does not include water heating or any space heating.
Energy production. The novel and innovative feature of this project is the proposal to use an on-site micro turbine generator to produce electricity powered by a closed loop of working fluid heated from 1500 square metres of solar collectors – a mix of compound parabolic concentrators and evacuated tubes. It is estimated that this system can produce 210,000KWh/year – enough to power the whole development.
Hot water. A by-product of a micro turbine system is an abundance of hot water. This 'free' hot water can be made available to all residents and to communal facilities, as well as being used to supply supplementary space heating via a water circulation hydronic loop.
Water consumption. Average water consumption in a Melbourne home is 450 litres/day. A target of 200 litres/day/unit was suggested. The winning design has this down to 138 litres/day of which 42 litres/day is recycled water treated on-site to supply toilet flushing and laundry needs, leaving a demand of 96 litres/day/unit for 'new' water. This results in a total demand of 9600 litres/day for 'new' water for the whole development.
Water harvesting. It is estimated that 2235 cubic metres (2,235,000 litres) of water can be harvested from 710mm average rainfall onto 3150 square metres of collection area giving 6122 litres/day 'new' water stored in 500 cubic metres on-site tanks. This leaves a shortfall of 3478 litres/day to be imported to the site from municipal water mains compared to over 40,000 litres/day for a conventional development.
Water re-use and treatment. The total water use of 13,800 litres/day can be reprocessed on-site using a combination of an aerated worm farm and electro-flocculation water treatment system. This can be stored and used for laundry and toilet flushing and for irrigation.
Maintenance. A detailed schedule of the maintenance frequency of the various materials envisages durability of the primary structure for up to 200 years, with periodic renewal of other elements from 10 years for floor finishes and external applied paints, to 10, 20, 50 and 100 years for other components and finishes.
Education. An important agenda is to provide a learning experience on sustainable lifestyles for the occupants of the development and the wider community and a display is to be incorporated into the development linked to a web site.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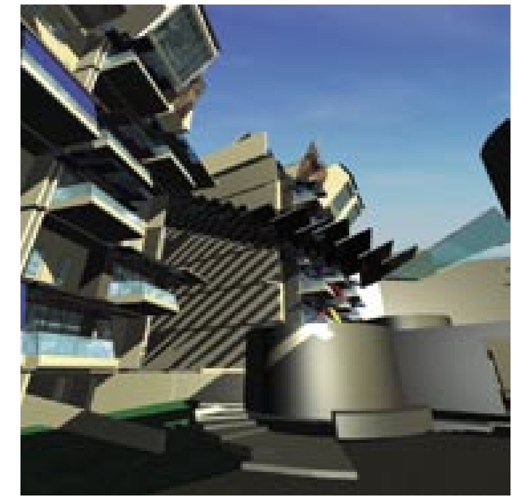
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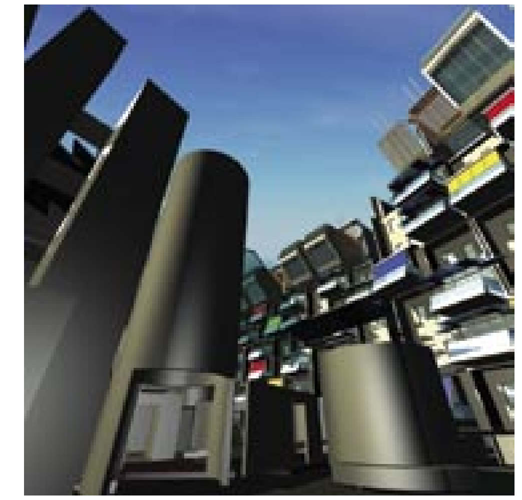
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02 - 05 Features of DesignInc's winning scheme, which is currently under development: rooftop maisonettes that cantilever out from lower storeys; structural blade walls designed for thermal mass and integration of building services; infill apartments which are expected to evolve as socio-economic conditions change; and, built forms linked by a communal 'Green Spine', designed to promote community awareness and the functions of the building.

Reflection.

This development is a publicly funded project for public housing tenants and it is hoped that a set of circumstances will emerge, either voluntary or mandatory, that will result in private developers taking a more innovative and long-term approach to urban planning. The breadth and depth of the expertise coming from the architectural profession through this competition was enormous, and – oh that governments and society would make greater use of it. Under the current flawed of Professor Allan Fells and the Australian Competition and Consumer Commission that "cheapest is best", this cannot happen. Roll on the day that we have capital investment in building stock that is predicated on a 200-year cost and energy life cycle that demands investment in good design – with proper time and research – and investment in quality construction and services systems capable of delivering quality sustainable living and working environments. If everyone holds their nerve and commitment, the Raleigh Street project will result in a stunning and highly innovative urban residential development with world-class environmental credentials that will set a benchmark for other future developments. It will demonstrate the shift in the mindset necessary to effect change. Let's hope that 'value management' doesn't compromise the eventual outcome.

The competition jury was Peter Crone (Crone Ross), Robert Vale (University of Auckland), Jim Holdsworth (City of Port Phillip), John McInerney (Supported Housing Development Foundation) and Jenifer Nicholls (Victorian Office of Housing) (four architects out of five), and the competition professional adviser appointed through the RAIA was John Davidson.

Professor Lindsay Johnston is Dean of the Faculty of Architecture, Building and Design, University of Newcastle, NSW.

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Project Team ■ Architects DesignInc., Melbourne – John Macdonald, Stephen Webb, John Sprunt, Frank Kruize, Jennifer Dudgeon, Ceridwen Owen **■ Consulting engineers** Ove Arup and Partners – Victoria Colla, Mark Davies **■ Quantity surveyors** Davis Langdon – Bob Hunt, Peter Karos, John Coffey.

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06 Second prize went to Fooks Martin Sandow Anson (FMSA) Architects for their strategy/solution.

07 Hayball Leonard Stent's third-placed entry.