

MCC OFFICE TOWER REFURBISHMENT

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ABSTRACT

Manukau City Councils existing offices in New Zealand are located within the 12 story Civic Building in Manukau. It is one of the first office refurbishment projects in New Zealand to be designed in an attempt to achieve a New Zealand Green Star Office Certified Rating. The project is currently in the early rounds of assessment with the New Zealand Green Building Council and is working towards a potential 4 or 5 star rating which if achieved will be a very pleasing result for the project.

The overall concept for the air quality and space conditioning and comfort centres on a significantly innovative mechanical ventilation system design that removes the need for air handling units but still provides increased fresh air capability via an especially innovative through the façade ventilation system direct to the ceiling void.

This solution provides the lowest energy returns for air conditioning by taking advantage of the available free outside air cooling. The system also removes the space requirement for vertical risers, removes the need for the large vertical and horizontal ducts and removes the need for air handling units. Not only is the Mechanical system a sustainable solution it is also a cost saving to the capital cost of the project.

Not only are the energy savings significant but the associated reduced capital cost, space reduction and embodied energy savings associated with the design provides instant pay back on the innovative sustainable solution.

Indoor Environment Quality

- minimum fresh requirement exceeding NZ Standards by 50%
- CO2 monitoring installed and increased fresh air capability when conditions permit
- Automated operable blinds with manual override for daylight glare control
- External views available to 90% of work settings
- Internal noise levels controlled and high frequency ballasts installed to improve occupant comfort
- External shading provided by innovative re use of existing façade.

Energy

- HVAC and lighting design enable the fit out to operate at or potentially above the equivalent 4 Star nzGBC rating
- Electrical sub-metering provided for light and power and other major energy uses

Water

- Base building fixtures replaced to further improve potable water efficiency

Innovation

- Exceeding Green Star benchmarks for outside air supply
- All refrigerants will have Ozone Depleting Potential (ODP) of zero
- Maximised daylight, dimming and lower overall lighting levels with increased uniformity
- Through the Façade ventilation design solution.

KEYWORDS:

Innovation; Desire; Commitment; Challenge; Architecture;

INTRODUCTION

Council building gets major upgrade –
(Friday, 18 May 2007, 1:11 pm Press
Release: Manukau City Council

A major refurbishment of Manukau City Council's Civic building started this month (May 2007), the first since the iconic building was completed in 1976.

A construction contract for \$10.4million has been awarded to Mainzeal Interiors Limited for the refit, which is expected to take 19 months to complete.



The refit will include changes to the layout of work space to maximise space and natural light, more meeting rooms, improved filing and storage space, an improved Emergency Management Crisis Centre and the refurbishment of the public committee and meeting rooms including the Council Chamber.

Manukau City Council Economic Director Rick Walden says that the refurbishment has been a long time coming and has been driven by a number of factors, in particular the need to upgrade the 30-year-old air conditioning system.

“Upgrading the old air conditioning system alone would have required significant work to the building and for floors to essentially be gutted, so we have taken the approach that it is prudent that all upgrade work is undertaken at the same time.”

Mr Walden says that the council has not made the decision to upgrade the building lightly, but the age of the building meant that if the council was going to remain located where it is then the work simply had to be done.

“The refurbishment will mean more staff are located within the civic building, therefore reducing the need for the council to lease other space in the city centre, and will result in an improved environment for staff.”

Client Brief

In effect the client brief provided to the Architects, Wanley Simpson and Andrew Tu'inukuafe of Creative Spaces and to all members of the design team is more or less covered in the council issued statement above.

Manukau City Council have made a commitment to sustainability and climate change and a extract from their 2000/2001 Environmental Report identifies that MCC have been looking long term into the now, widely talked about issues of sustainability and climate change since the turn of that last decade.

Climate Change Council Strategy No. 2 Regional Co-operation and Growth

2.4 Identify a vision for the City to 2020 and align Council activities accordingly.

Manukau is the first council to develop a Greenhouse Gas Emissions Inventory to respond to climate change resulting from increases in greenhouse gas emissions which cause 'global warming'. This is timely as the Local Government and Environment Select Committee is due to report on its investigation into the role of local authorities on climate change. The inventory is the first stage in developing the Manukau Climate Change Action Plan which is being co-ordinated through Council's Strategic Group.

Manukau currently contributes around 4% of New Zealand's total greenhouse gas (GHG) emissions. Most of Manukau's emissions are carbon dioxide (92%) sourced from domestic and residential energy use and transport emissions. This equates to just under 8% of the country's total carbon dioxide emissions and assuming continued economic growth this is predicted to rise to around 9% over the next decade. The increase is likely to result from increased energy demand and transport activities. The Inventory indicates that Manukau does not appear to have capacity for planting forests to off-set its emissions.

Many of the existing council buildings such as the widely acclaimed Tupu Youth Library were concept and designed in order to become show cases for energy efficiency and sustainability. The MCC overall brief for their new offices reflects this ongoing commitment.

As the project evolved it also become possible to help demonstrate how some elements of a project that can seem like negative headaches such as a total reuse of the existing structure can actually be turned around into producing a great Green Building outcome.

Design Philosophy

The design philosophy established for the project has evolved over time to be where it is today, MWH joined at the hip through the Design Concept phase with Dave Fullbrook from eCubed have been able jointly to provide a overall solution that is quite exceptional especially considering the extreme constraints placed on the design concepts by retaining 100% of the existing building structure, façade, windows and cores.

Factors that encouraged the sustainable building design practices in the upgrade of the Civic Centre upgrade included.

- The Urban Form Design & Development (UFDD) work strand of the Auckland Sustainable Cities Programme has recently identified an objective of achieving a commitment to Sustainable Public Buildings in the Auckland Region by 2007.
- Agenda 21 and Cities for Climate Protection Programme.
- The promotion of sustainability in Government operations through programs such as the Sustainable Development Programme of Action, Govt and EECA's Energy Wise Government Programme.

PROJECT DESCRIPTION

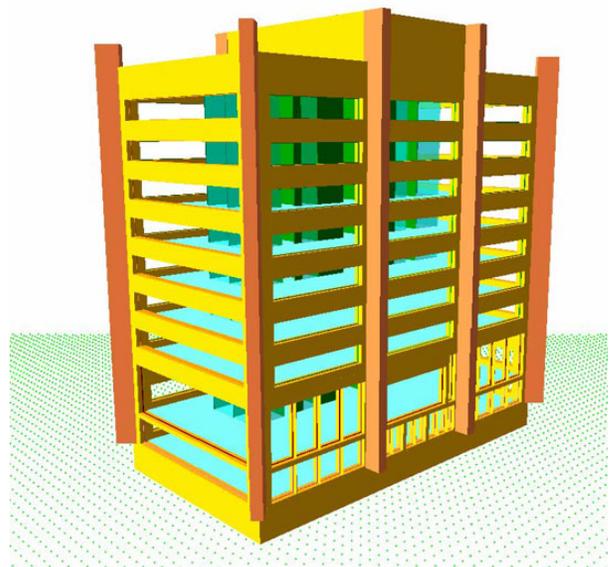
Improved Energy Efficiency

Energy is used in the Civic Centre principally by lighting, small power and air conditioning with secondary uses including hot water supply.

Ceilings have been replaced and new lighting installed with direct energy savings due to more efficient T5 fluorescent office lighting and new generation compact fluorescent down lights there are secondary benefits in terms of reduced air conditioning loads and associated energy consumption.

New lighting reduces the power demand and air conditioning load to 11 – 12 W/m². This is reduced still further on the open plan floor plates to 8 – 9 W/m² by using perimeter switching and occupancy sensor switching to the toilets and infrequently used areas.

Similarly with the planned migration from CRT computer screens to LCD computer screens by the Council this also reduces both direct energy use and indirect energy use by air conditioning. With CRT computer screens energy use is probably in the order of 15/m². This is reduced to 10 – 11 W/m² by using LCD screens.



Taken together the use of T5 lighting and LCD screens reduces the lighting and small power use and associated air conditioning load from 33 – 35 W/m² to 18 – 20 W/m² or a 40 – 45% reduction in direct energy use and a 53 – 60% reduction including air conditioning load reduction.

Reduction of solar load is also achieved by the use of reflective internal blinds. External shading is partially provided by the retention of the existing façade and its overall unique design. These windows were the subject of much debate and the energy modelling of the solar shading of the existing arrangement changed the Architects assumption that the windows would be moved out from the existing recessed position. While the direct sun light would have been the same the resultant energy increase of moving the windows out changed the overall concept. A good result and a great example of the engineer working in conjunction with the Architect to achieve a complimentary result all round.

A Variable Refrigeration Volume (VRV) air conditioning system has been provided This system was selected as a result of its relative ease of installation, spatial requirements and the ability to install it in a phased / staged manner as is required for the project. . It is also relatively energy efficient and provides heat recovery and heat pump operation for heating which is approximately three times more efficient than heating by direct electricity. Its main disadvantage is that it lacks the 100% free cooling ability to the same extent of an all air system. In order to overcome this we have increased outdoor air quantities by 200% via use of existing perimeter soffit grilles at each floor on a variable volume outdoor ducted air arrangement. In this way the system combines the benefits of a full air system with that of an all air system.

In detail the recommendations for improved energy efficiency include.

Temperature and Humidity Range

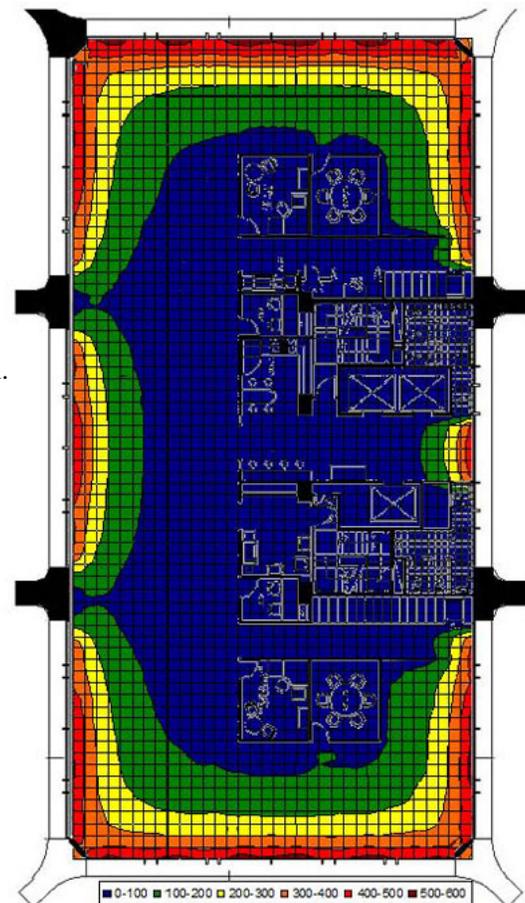
- New VRF air-conditioning system
- Relatively wide internal air temperature range 20°C to 24°C.
- Uncontrolled humidity but within the range of 40 – 60%RH

Outdoor Air Rates

- Minimum outdoor air rates provided by mechanical system to be double (200%) those of AS 1668.2 2002 with air quality sensing and variable air volume control.

Office Lighting

- New high efficiency lighting and lighting control system including perimeter and occupancy switching and reduced cleaning mode.
- Office lighting design to provide a maintained illuminance of 400 lux average and uniformity of 0.85 as measured at the working plane (700mm above finished floor).
- High frequency ballasts to 95% of NLA
- Maximum installed W/m² of light fittings.
 - 10W/m² for open plan office areas
 - 12W/m² for cellular office and meeting rooms



Hot Water Supply

- 80% of domestic hot water to be supplied by solar hot water system with electric boost. (NB: This option is still be evaluated on a cost benefit basis and is less favourable due to the height of the building, the only area available for the solar panels is the roof so a large amount of water is required to be pumped up to the roof and returned to the ground floor and basement where the demand is required by kitchens and showers)

Electrical Metering

- Electrical sub metering to allow for energy management and reporting to be provided for: - Main supply - HVAC - Floor by floor lighting and power - External lighting and other plant (lifts etc)

Controls

- Control zones for lighting and HVAC accommodate energy efficient after hours use (zones as per Indoor Environment Quality Localized Comfort Control)
- Modulating control 0%-100% on all building services plant and equipment
- Plant maintains efficiency at partial load
- Plant is stable reliable and energy efficient at low (after hours) loads
- Simple, intuitive, adaptable, comprehensive user interface
- Pre- occupancy point by point end to end verification of control operation is built in to the contract documentation.

Office Equipment and Appliances

- Flat screens for PC displays
- Low energy appliances and printers

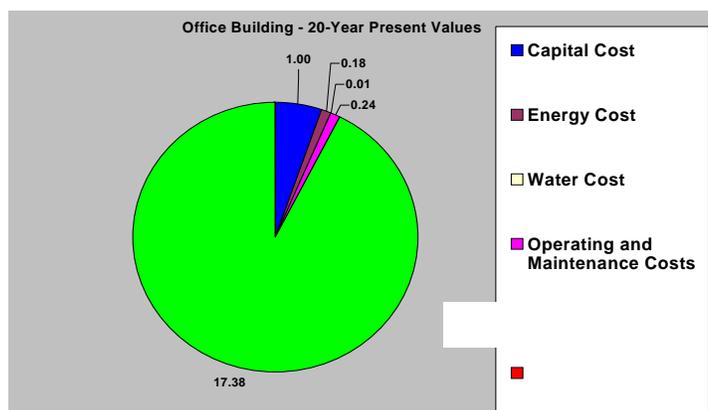
New HVAC and Lighting System Commissioning

- Independent verification of commissioning process
- Pre-occupation commissioning period of 2 weeks with zero defects at handover
- Building user manual in addition to the normal O&M manuals
- Fine tuning and continuous commissioning during the first year of building operation

IMPROVED INDOOR ENVIRONMENTAL QUALITY

At the same time as improving the Civic Centre's energy efficiency parallel opportunities exist to improve its indoor environmental quality. In considering the benefits of a Sustainable Office Type Building the relative present values over a 20-year period are quite revealing:

Fig. 1 shows the importance of salary costs relative to the total operating costs associated with the building.



The 20-year present value of salaries is some 17 times the value of the initial cost of a building yet salary costs and productivity are rarely considered during the design process. Indoor environmental

quality can account for a 5-15 % effect in terms of improved comfort, health and productivity. The factors which influence it include

- Personal control of environment
- Indoor air quality.
- Visual quality.
- Acoustic quality

Personal Control of Environment

- Maximum HVAC and Lighting control zone size limited to
 - Perimeter 50 m²
 - Internal (beyond 5m) 75 m²
- Controls accessible to users with centrally determined influence

Indoor Air Quality

- Outdoor air minimum ventilation rates
 - Open plan 1.5 l/s/m²
 - Meeting room areas provide additional 2.0 l/s/m²
 - CO₂ or air quality sensing and VAV control of outdoor air quantity
- Outdoor air filtration standard to EU7.
- Facility for separate un-recirculated supplementary tenant general extract (photocopiers/ meeting rooms etc) and kitchen extract system provisions.
- Water based low VOC paints to all interior spaces
- Ceiling tiles certified to have a low particulate emission
- Adhesives, sealants, materials and other finishes are water based low VOC where such systems are available
- All plywood is Phenol Formaldehyde bonded
- All MDF is “low formaldehyde MDF” as defined under class A of BS.EN 622-1:1997
- All particleboard is “low formaldehyde particleboard” as defined as Class 1 under BS.EN 312.1996
- A 2 week elevated bake out period of each refurbished office floor is built into the programme to minimize chemical loading due to finishes

Visual Quality

- Glare control by internal reflective blinds
- Lighting is suitable for LCD flat screen use and in accordance with CIBSE lighting guide LG3 2001

Acoustics

- Work environment and lobbies are PNC 40 in open plan areas and up to PNC 45 in natural ventilation mode. Supplementary systems serving meeting rooms are PNC 35
- Ceiling absorption coefficient is > NRC 0.7
- Reverberation time 0.5 seconds in open plan areas

IMPROVED RESOURCE USE

Complementary to the energy efficiency improvements described above would be measures to improve the use of other resources including:

- Reducing water use
- Using environmentally friendly materials
- Encouraging waste management and recycling.

Reducing Water Use

- Rainwater harvesting from the roof is still being considered to provide 70% of the predicted annual use for toilet cisterns and urinals and 100% water required for irrigation (This while a relatively easy and quite common application on the majority of buildings we now design is due to the height of the tower and significantly reduced roof collection area not as obvious a choice as it may appear)
- Basin taps are AAA rated featuring aerators, flow reducing features and be sensor driven with automatic cut off
- Showers heads are a maximum 6.75 litre /minute AAA rated and shower controls have automatic shut off controls
- All cistern flushed toilets are dual flush 6/3 litre AAA rated and urinals have sensor driven flush controls
- Water metering is provided for potable and flushing water supplies

Materials

- All paint is endorsed under the environmental choice labelling scheme where such paint systems are available
- Broadloom carpet (if used) is 'Environmental Choice' branded and modular carpet is 100% recycled face fibre
- All timber is from certified sustainable sources, e.g.:
 - Forestry Stewardship Council
 - Programme for endorsement of Forest Certification
 - Canadian Standards Association, Sustainable Forestry Initiative
 - ITTG accreditation (Imported Tropical Timber Group)
 - The "Eco-timber" trademarked scheme harvested under MAF sustainable forestry management plans or permits.
- Glass fibre insulation has recycled content of greater than 50%.
- Screen fabric is manufactured from 100% recycled PET.
- Where used Aluminium has a maximized recycled content
- Ceiling tiles contain no less than 40% recycled content.
- Air conditioning system exclude ODP refrigerants (e.g. R22)
- ODP also excluded in insulation materials

Waste Management and Recycling

- A site specific environmental and waste management plan in accordance with the REBRI guidelines is being worked on by MCC and planned to be adopted for the upgrade. Include

recycling waste sorting storage and removal facilities adjoining the central circulation zone and with access to goods delivery service area.

Energy Use and Demand

- We estimate the energy efficiency measures identified for the project shall yield reductions in energy consumption of approximately 30-40% in comparison to existing use. There shall also be a reduction in the peak electrical demand.

Water Use and Demand

- We estimate the water conservation measures shall yield reductions in water consumption of approximately 20-25% in comparison to existing use. There would also be a reduction in storm water and sanitary drainage flows. This figure will increase to 50-55% if the rainfall collection system is implemented.

REDUCED IMPACT ON COUNCIL AND OTHER LOCAL INFRASTRUCTURE

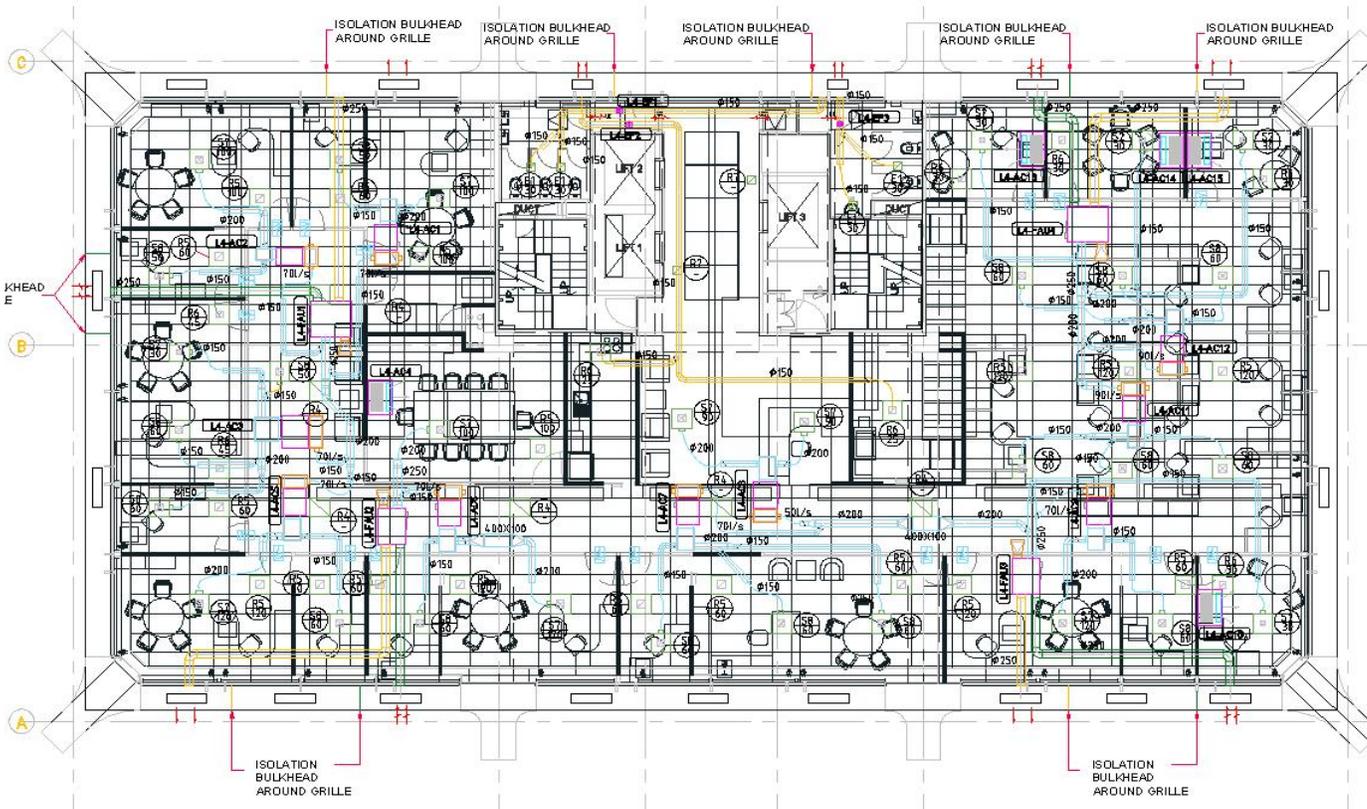
MEASUREMENT

The building has been designed targeting an equivalent 4 Star rating which represents *Best Practice* given the restrictions of the existing building. By comparison 5 Stars represents *New Zealand Excellence* and is probably the rating for the new Waitakere Civic Centre and 6 Stars represents *World Leadership* and is the rating of the new CH2 building in Melbourne. These higher ratings are however for new buildings with relatively generous budgets.

BRIEF EXPLANATION OF THE INNOVATIVE 'THROUGH THE FAÇADE' AIR CONDITIONING

In working with the existing building and a planned sustainable Green Building approach from day one as much of the existing features of the building were to be retained. This fell into some obvious categories when thinking about structure as it all made economic sense to retain as much as possible.

When discussing the air conditioning systems the decisions were not so obvious or indeed forthcoming.



A significant cost saving, space saving and time saving innovative option that is being implemented for the Manukau Civic project is a significant rethink of the 'standard' approach to air conditioning. MWH have successfully developed a 'Through the Façade' ventilation system that saves the project hundreds of thousands of dollars in time, plant space allowances and plant equipment costs.

The overall concept for the air quality and space conditioning system is a design that removes the need for roof mounted air handling units and the vertical ducts and riser shafts but still provides increased fresh air capability via an especially innovative through the façade ventilation system direct to the ceiling void.

This solution provides some of the lowest energy returns for air conditioning by taking advantage of free outside air cooling. And provides the building owner with more area per floor and hence increased efficiencies of the overall building.

Not only are the energy savings significant but the associated reduced capital cost, space reduction and embodied energy savings associated with the design provides instant pay back on the innovative and very sustainable solution.

CONCLUSION

MWH together with eCubed and Creative Spaces on behalf of Manukau City Council looked at the project from day one as an opportunity to explore the sustainable design attributes that were possible as part of the total upgrade of the Manukau Civic Centre.

The project and its design features provide

- Improved Energy Efficiency
- Improved Indoor Environmental Quality
- Improved Resource Use
- Reduced Impact on Council and Other Local Infrastructure
- Measurement

In implementing the sustainable building solutions associated with the upgrade, Manukau City Council is also demonstrating community leadership in terms of environmental responsibility.

In developing the upgrade for Manukau Civic Centre opportunities existed to implement sustainable building design practices which will lead to:

- Improved Energy Efficiency
- Improved Indoor Environmental Quality
- Improved Resource Use
- Reduced Impact on Council and Other Infrastructure

In adopting these principles the Civic Centre's asset value will also be improved and its ongoing use will be future-proofed.

ACKNOWLEDGEMENTS

Any acknowledgements on such a project can become a long list. Obviously Manukau City Council Economic Director Rick Walden and their Project Director John Duncan need to be embraced for providing the vision and commitment towards a sustainable building solution.

For myself, my own personal acknowledgement goes to Dave Fullbrook of eCubed Building Workshop. Dave has been promoting, teaching, designing, lecturing, and no doubt dreaming of sustainable designs and Green Buildings for as long as I care to remember. It is fulfilling to work with and know Dave. Not only should he be acknowledged for his input into this project but also for his overall commitment to the sustainable building industry as a whole.

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Tu'inukuafe, Andrew – Design Director Creative Spaces Architects

The Urban Form Design & Development (UFDD) work strand of the Auckland Sustainable Cities Programme commitment to Sustainable Public Buildings in the Auckland Region by 2007.

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