Presentation Notes:
Greening our Tertiary Buildings.
NZGBC – Summit – October 2009

What are the important decision making processes that a building owner follows in the specification of new or refurbished buildings that lead to environmental sustainability in the outcome?

I will describe those processes in the context of new buildings at the University of Canterbury since the mid 1990's to the present day where the newest building on campus, NZi3 ICT Innovation Institute has been awarded the first Education Building 5 star rating.

The University relocated to the suburban Ilam Campus over a lengthy period from the late 50's, through the 60's to mid 1970's, when the Central Library and Registry functions completed the move. As a result, the campus has a significant number of 60's buildings in the Engineering and Science precincts. (the feeling is of buildings designed in England in the 50's and built in New Zealand in the 60's) and a large number of 70's buildings in the Arts precinct.

A common theme appears to have been the construction of buildings which were too small upon completion, and to then add another floor once the paint had dried on the main building. The pop top floors occurred throughout the Science and Arts precincts and have the qualities of skyline garages generally sitting on top of solid mass structures. The environmental conditions of pop tops are markedly inferior to the buildings they were added to and act as a demonstrable sign post to what can happen when decisions are made with drivers in terms of expediency and low capital cost that then flow on to issues related to occupancy, comfort and operational cost over time.

There were no buildings constructed on campus in the 80's. The University embarked on a significant building programme in the mid to late 90's that increased the built environment on campus by some 25% taking us to a campus square meterage in excess of 225,000m^2. The building programme was well under way before I joined the University in 1997 and the last of the new buildings, MSCS Maths Computer Science. (now known as Erskine) was working its way out of the ground. Law and Commerce, New Central Lecture Theatres, Engineering 5 Level Buildings were all either occupied or very close to occupancy.

The investment in a relatively short time frame had been immense and intense and invoices totalling over $2million a month were crossing my desk for authorisation of payment to a scale I had certainly not witnessed previously when working in the Health Sector where deferred maintenance and deferred investment had been taken to the degree of an art form.

For its major new buildings, the University had developed a strategy of compiling an extensive brief and running an architectural competition to

assist in the appointment of design consultants. Looking back through those briefing documents you begin to see the University articulating its requirement for buildings whose life would span 100 years plus, whose design would incorporate energy efficiencies, whose design efficiency and use of materials would reduce operating costs and whose planning would allow socialising of the University community in an enhanced campus experience.

Wasn't the University simply talking about sustainability in design?
The terminology of environmental sustainability wasn't present in those early briefs but the essence and the expectation of a sustainably quality was there and was picked up and acted on by our consultants. The sustainability features became simply "common sense" and part of our expectation, not features that would be significantly analysed and costed separately before proceeding.

The early briefs required that:

"The University campus wide heating policy is to implement thermal storage capacity in each of its new major building developments"

"To contribute positively to the working and the experience of the University from staff, student and visitor viewpoints."

The briefs talked of "home bases – spaces of belonging."

"Provision of indoor and outdoor spaces that support students social needs."

"The University anticipates that its new buildings would remain both functional and aesthetically pleasing throughout their 100 year lifetime."

The Maths & Stats/Computer Science or Erskine Building was one of those whose design was commissioned by way of an architectural competition in the mid to late 1990's. The briefing papers talked about Environmental control achieved by Design

- individual offices with natural ventilation
- controlled solar penetration
- computer laboratories should be placed on the South side of the building
- essential that the building form is energy efficient in order to minimise air conditioning and mechanical ventilation and maximise natural ventilation.

Energy efficiency guidelines were part of the brief, materials specified to be of long term durability, offices to be clustered around social hubs and post

graduate spaces to have a sense of community promoted by the ability to set up ones “own space”.

The Erskine building was designed by Architects (Patrick Clifford and Michael Thomson) with the engineering design by Ove Arup (Dave Fullbrook).
The building focus coming out of the functional brief was energy efficiency – the designers focused as a team on a passive low energy building, maximising both natural ventilation and large amounts of daylight.

The features of the Erskine are:

- The functional design brief set low energy consumption and natural ventilation where possible, as a priority

- UC stakeholders and users were involved from the early stages of functional brief development and throughout the construction process

- Traditional and innovative design solutions were developed in parallel for assessment, and review analysis

- 3 Dimensional thermal modelling of both natural and mechanically ventilated spaces was carried out

- An on line user manual was developed for the users of the building to explain and educate them in the use of the ventilation and heating mechanisms

- Post occupancy evaluation has assisted as a catalyst in informing future design briefs

- The lower internal heat load spaces, the academic offices are naturally ventilated and oriented to the North/North West allowing passive solar heating. The have extensive adjustable solar and wind shading and take advantage of a magnificent outlook to the Southern Alps

- Natural (and smoke extract) ventilation is assisted by the stack effect of the atrium

- Passive solar temperature moderation is achieved by the use of exposed thermal mass, insulated Thermomass walls, exposed concrete block work and exposed structural soffits

- The high internal heat-load spaces, teaching rooms, computer laboratories are orientated to the south to reduce heat gain and glare and are double glazed

- Ventilation is by under floor displacement through hollow structural floor units which also provide active fabric energy storages

- Extensive natural daylight via the atrium and double height spaces is a feature of the building

- Natural light is supplemented by a highly efficient lighting system

- Cooling of the building utilises a natural aquifer under the building

- Plant operation and motorised window opening is controlled by a computerised BMS

- An energy audit of the building demonstrated an annual energy use equivalent to 140 KWh/m^2 compared to a University building benchmark of 185 KWh/m^2

- The floor units are multi functional in that they serve as structure, air distribution, cable distribution, ceiling surface and exposed thermal mass/heating-sink.

In 2001 a formal post occupancy evaluation of the Erskine Building took place. The building reached a level of satisfaction (measured by noise, lighting, overall comfort, summer and winter temperatures) in the top 5 percentile of the 2001 benchmark data set.

The UK benchmark for perceived productivity for 2001 was minus 1.87%. The productivity score at MSCS was plus 9.85 (percentile 97%). This indicates that occupants think that the building boosts their productivity at work by about 10% compared with their experience of other working environments.

The design focus of the Erskine Building and the influence of the ideas that come from working with the architects and engineers set the University further on a path that environmental sustainability in building was closer to simply a common sense approach than that of a project "% cost add-on".

The percentage increase in campus built square metres of the building programme and the expenditure of our full cash reserves led to the early 2000's focus on building reconfiguration and refurbishment with less emphasis on increasing m^2.

In recent years a combination of EFTS growth, new initiatives and external revenue has again seen some new building activity on campus. The most significant of new buildings is the new School of Biological Sciences, a $25.5m Research Block. Design work started prior to the NZi3 project and construction is now underway with completion due mid June 2010.

The School of Biological Sciences and Natural Step Framework

The Natural Step, an international non-profit organisation that began in Sweden in 1988 identified four conditions that must be met if the

biosphere/society system (and the economy which depends on these) is to be sustainable.

The first three conditions describe the main mechanisms by which humans are impairing the functioning of natural systems (on which people depend) while the fourth concerns the need for people to be able to meet their needs.

The Natural Step system conditions for sustainability: In the sustainable society, nature is not subject to systematically increasing ….

1. … concentrations of substances extracted from the Earth's crust

2. … concentrations of substances produced by society

3. … degradation by physical means,

And people are not subject to conditions that systematically

4. … undermine their capacity to meet their needs.

The University worked with Dr Lin Roberts of The Natural Step NZ and our design consultants, Courtney Architects and Powell Fenwick Engineering Consultants to integrate The Natural Step Framework into the School of Biological Sciences.

It was important for the full design team and the building occupants to have a common understanding of the urgency of sustainability and a framework for developing it. A Natural Step workshop was held over two days which included Facilities Management staff particularly those who would operate and maintain the new building, School of Biological Sciences academic staff, technical staff and post graduates who would occupy the building and the full range of design and cost consultants who made up the rest of the team.

As the design process evolved the group has had further workshops to test theories and progress. An EECA grant has been utilised for energy modelling and Dr Robert Vale used a peer reviewer. The design team has met at least monthly and sustainability is a regular agenda item on the PCG agenda. Design decisions have been made in the context of The Natural Step system conditions.

Efficient Use of Resources (TNS System Condition SC1)

- space utilisation study to ensure that the proposed additional space was really required. Existing building also reconfigured and reused.

- integration of mechanical and electrical services infrastructure – efficient distribution network of central ducts

- structure enables flexible open plan layout

- the artesian water used to cool the neighbouring building will be re-used for this building before being cooled in water gardens and discharged to an adjacent stream where it maintains a healthy flow to that stream

- a proposal to re-use fly ash from the University's boilers in the cement content did not meet a feasibility check as it had too high a carbon content

Energy efficiencies (TNS System Condition 1)

- use of buildings thermal mass

- wide rage of energy efficiency measures that are already standard on most UC buildings – occupancy sensors
    - T5 lamp technology
    - high efficiency light fixtures
    - power factor correction
    - BMS control of lighting, heating and ventilation systems
    - daylight sensors
    - high efficiency electrical motors
    - double glazing
    - variable flow fume cupboards

Renewable Energy (SCI)

The University currently has a centralised coal fired boiler which utilises a MTHW recalculation network to all central campus buildings. This heat source will definitely change in the life of the building so future proofing for alternative energy sources has been considered. The roof is being designed to be strong enough for Photo Voltaic panels and/or solar water panels.

Persistant Chemicals (SC2)

- no use of CFC's or HCFC's in the HVAC system

- landscaping will focus on low maintenance plants that don't require pesticides

- timbers that don't require treatment

- greening of laboratory practices.

Ecosystems and Water (SC3)

The aim is to integrate the buildings harmoniously with the natural ecology of the site to minimise water use and maintain and improve storm water quality.

- replacement of asphalt car parks with a new outdoor space including outdoor teaching and use of the adjacent stream

- rain water harvesting for toilets and grounds irrigation

- composting toilet and solar showers in the secure cycle stand

- storm water treatment through a water quality chain – permeable paving, rain gardens, vegetated walls

- use of plants in the atrium to help make it the “lungs” of the School, while providing a living demonstration of biological principles.

Social Sustainability (SC4)

- Increased intellectual collaboration through shared laboratory spaces

- Interaction between researches in related and differing principles
    - between academic and technical staff
    - between staff and post graduate students

- for the building itself to serve an educational functioning about biology ecosystems and sustainability

- provision of break out spaces which maximise the opportunities for the inter mixing of research groups

- research laboratories as group work space rather than isolated working spaces

As noted previously the building is under construction and is essentially in “watch this space” mode.

In between the design process on School of Biological Sciences and NZi3 the University had the opportunity to construct a small Health Centre. The architects were Courtney Architects and the services engineers Powell Fenwick.

It was relatively simple to transfer the brief requirements for the more substantial commissions to the smaller scale context of a Health Centre. Occupancy of the building presented a challenge in educating occupants what to expect. It is often the occupancy of a building that will determine its real level of sustainability and the expectation of staff and visitors towards full air conditioning of spaces as we expect in our vehicles presents a challenge.

NZi3 National ICT Innovation Institute

This has been a special project to work on and a special outcome. The Request for Proposal briefing stressed the importance of achieving a sustainable “green” building and the green credentials of the consultancy team were an essential evaluation feature of the proposals received.

The University acknowledges the skill of the Warren and Mahoney team and BECA, their sub consultants on the project.

The hallmark of the project was constant communication between the University and the designers in the sense of project control or User group meetings and although the identification and representation of the final occupants would not occur until construction was underway, the essence of the building as a bridge between academia and industry was well and truly captured.

Graeme Finlay will talk in more detail about the features of the NZi3 Institute but one of the critical success factors noted in recent months was the fact that the building is being used in the College of Engineering curriculum and is to be the focus of PhD research within the College.

To achieve a building that not only demonstrates leadership in sustainability but also becomes part of the curriculum and research processes that is the very basis of our University and is the true test of an educational green building.

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