ENVIRONMENT DESIGN GUIDE

JAMES STREET MARKET, BRISBANE – A SUBTROPICAL RETAIL CASE STUDY

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Summary of Actions Towards Sustainable Outcomes

Environmental Issues/Impacts

- The Australian subtropical climate presents challenges and opportunities for climate-responsive designs. The James Street Market in Brisbane used climate-responsive design strategies to reduce the energy use and greenhouse gas emissions of a commercial food market.

Learnings

- Strong client support resulted in the construction of a climate-responsive and environmentally-conscious development. The building owner is also critical for ensuring the building operates according to the original design intent.
- The use of natural ventilation and natural lighting for food and produce markets is a commercially and environmentally successful model.

Related EDG Papers

- TEC 2, May 2007, 'Natural Ventilation in Passive Design'
- DES 2, February 2003, 'Revisiting Energy Efficiency in Commercial Buildings'
  DES 4, May 2006, 'Thermal Mass in Building Design'
  DES 42, May 2001, 'Thermal Comfort in School Buildings in the Tropics'
- GEN 60, November 2004, 'Implementing Energy Efficiency and ESD from a Development Perspective'

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In the Australian subtropics, high rainfall, warm weather and humidity present unique challenges and opportunities for architects tasked with designing eco-sensitive projects. Located in Fortitude Valley, an inner suburb of Brisbane, the James Street Market utilises climate-responsive design to increase energy efficiency and reduce associated environmental impacts. Completed in 2002, it stands out as a leading example of climate-responsive design in the subtropics. This paper details the market's design, construction methods, key features and lessons learned.

Keywords:
Subtropical design, climate-responsive design, natural light, natural ventilation

People enjoying the James Street Market's covered mall. (Image: S Jannides, 2010)

1.0 PROJECT DETAILS

Site Address	22 James Street, Fortitude Valley
Region	South East Queensland
Type of Development	Retail/Commercial
Land Area	4,105m² approximately
Internal Area	Ground floor 1,833m², First Floor 233m²
Courtyard Area	370m² approximately
No of storeys	1 storey + Mezzanine
Cost	$3,000,000
Year of Completion	2002
Project Owner/Developer	Calile Malouf Investments
Architect	Cox Rayner Architects
Structural and Civil	McVeigh Consultants
Electrical and Mechanical	Connell Mott MacDonald
Hydraulic	BRW Enterprises
Landscape	Gamble McKinnon
Interior designer	Cox Rayner Architects
Planning Consultant	Keilar Fox & McGhie, Lincolne Scott/ Building Safety Services
Traffic and Transport	Adam Pekol Consulting
Builder	Hutchinson Builders

Awards

Australian Institute of Architects National Award for Commercial Architecture, National Award for Commercial Buildings, 2003

Australian Institute of Architects Beatrice Hutton Award for Commercial Architecture (Qld), 2003

Australian Institute of Architects / Brisbane City Council Subtropical Architecture Award (Qld), 2003

2.0 INTRODUCTION

Climate change mitigation is driving demand for energy-efficient and environmentally conscious commercial buildings in Australia. In the Australian subtropics, high rainfall, warm weather and humidity present unique challenges and opportunities for the architects tasked with designing eco-sensitive projects.

The case of the James Street Market in Brisbane's Fortitude Valley shows that climate-responsive design is an effective approach for reducing the environmental impact of commercial developments. The James Street Market combines climate-responsiveness, environmentally sensitive design strategies and smart planning to create a more sustainable retail precinct.

This paper details the design strategies featured in the James Street Market, the project that kicked off a renaissance in climate-responsive commercial building design in Brisbane.

3.0 BACKGROUND

James Street Market was completed in 2002 and provides an indoor/outdoor retail environment that accommodates Brisbane's subtropical climate. The market site was formerly an industrial site that was cleared, filled and decontaminated prior to development. The project brief was to create a 'destination lifestyle' precinct with a range of fresh food, dining and homewares outlets.

Initially, environmental performance wasn't an immediate requirement – the focus was on how to generate a lifestyle appeal rather than merely a retail one. Expert advice from retail consultants recommended conventional typologies, such as a 'fresh food barn' without glazing; however the clients chose to pursue an alternative approach which was open to climate-responsive design.

Early conversations between the client, Calile Malouf Investments, and the architect in the conceptual design stage established the desire to create a strong sense of public space. Further conversations between the client and architect confirmed the goal of maximising the interface between the commercial space with the surrounding public realm.

According to Michael Rayner of Cox Rayner Architects:

> Neither client nor architect solely championed the climate-responsive design aspects for their own sake; rather they became synonymous with the wider design objective of doing something few other retail settings facilitate: i.e. to enjoy fresh air, breezes, sunlight penetration, the sight and sound of rain, instead of the unusual enclosed setting.

The design had to work within several parameters: elevated floor level to allow for flood levels; height limitations from a covenant on the site; and an easement for vehicular access. These factors mitigated against climate responsive design, as providing space for natural air flow was complicated by the elevated floor level and low height limit.

4.0 CLIMATE-RESPONSIVE DESIGN

The James Street Market, in the inner-city Brisbane suburb of Fortitude Valley, is located within Australia's subtropical climatic zone. This climate is characterised by hot humid summers and cool dry winters. Brisbane's latitude is 27.5º south of the equator, and thus solar access is predominantly from the north. South-eastern morning sun and south-western afternoon sun contribute significantly to solar heat gain during summer.

The market site experiences prevailing cooling summer breezes from the south and south-east in the morning, with afternoon breezes from the east and north-east. The winter morning winds are predominantly from the south-west, with the afternoon breezes originating from the north-east, east and west.

The site receives substantial rainfall. Average annual rainfall in Brisbane is approximately 1200mm, over 110 rainy days per year. Most of the rain falls between October and April. With approximately 30 per cent of days being rainy days, it is essential that the mall be covered so that the space can be used all year.

Other microclimatic factors taken into account include neighbouring buildings shielding it from the western sun; a delivery lane with potential to channel breezes through the mall; an open car park with eastern solar access; and a tree-lined streetscape providing shade to the footpath and road.

Retractable windows assist with the natural ventilation of the market and allow patrons to enjoy the subtropical climate. (Image: CF Jones, 2010)

5.0 APPLICATION OF CLIMATE RESPONSIVE DESIGN PRINCIPLES

James Street Market's climate-responsive design uses local climatic conditions to increase the environmental performance of the building. This approach allowed the architects to produce a design that is in tune with environmental conditions and the subtropical lifestyle. Integrating passive design strategies produced a building that responds to the climate rather than excludes it, while providing the amenity expected of a shopping centre – an important consideration given that patron comfort is essential to an enjoyable shopping experience.

The passive design strategy was considered from the early stages of concept design through to the tenant's occupation of the building. The market's siting, layout and form responded to local climatic conditions to increase its environmental performance. Long-term operating costs were taken into account in the pre-design stage, and appropriate passive design strategies identified. The design response used the subtropical climate to reduce energy use associated with lighting and air-conditioning.

Lighting

The market was designed to utilise natural light. In an internalised development, the middle of the building usually does not receive natural light and customers may be unaware of the weather conditions. In contrast, the market building uses natural lighting throughout. Sunlight is accessible to all tenancies either directly or indirectly, which reduces the need for artificial light. Building orientation, large glazed exterior walls, and sections of translucent roof sheeting allow sunlight to permeate the complex. Adjustable sunshading devices installed in the market hall allow for users to control sunlight throughout the day.

Passive Ventilation

The completed design encourages natural cross and stack ventilation. Northern and southern entrances capture and channel cooling summer breezes through its length. The layout of the market buildings captures both morning and afternoon breezes. The Fortitude Lane and Central Street entrances channel south-easterly and southerly breezes into the courtyard to cool the covered space. North-easterly winds pass through the landscaped car park before entering the building. Large operable windows in the tenancies capture prevailing breezes, and windows located opposite doors, and the narrow floor depth of the tenancies, promote cross ventilation.

A high skillion roof allows for stack ventilation to expel hot air from the mall on days when cross ventilation is ineffective. The central sheltered mall allows fresh air to flow through the main circulation zone of the development, contributing to the passive cooling of the precinct.

Passive Cooling

All market tenancies are equipped with air conditioning, with climate control necessary to some to maintain the freshness of produce. Some tenancies, such as the café, do not always have the air conditioning turned on, and instead have all their windows open to maximise natural ventilation. The windows are only closed on extremely hot days, to maximise the efficiency of the air conditioning.

A number of passive strategies were used to cool the building without mechanical assistance. The windowless north-western elevation built of concrete panels shields the building from unwanted afternoon sun. The close proximity of adjoining buildings also assists in shading the western facade. The building takes advantage of the thermal mass of the shaded concrete floor in the mall to assist in maintaining a more constant, cool temperature. The passive cooling is aided by the aforementioned cross and stack ventilation measures.

Thermal Heating

The market uses passive strategies to heat the building during winter. The thermal mass of the concrete floor in the courtyard assists in maintaining a constant temperature. The large glazed sections of the market hall capture morning winter sun for warmth. The building minimises its exposure to the undesirable winter winds by providing a sealed and windowless facade to the west.

Landscaping

The landscaping surrounding the market also worked with the subtropical climate. Indigenous Tuckeroo trees have been planted as shade trees in the car park and were chosen for their ability to withstand flooded soil. The planting strategy was to space them so that they would provide adequate shade.

Benefits of Passive Design

Anecdotal evidence suggests the market's passive design strategies have resulted in reduced energy demand and cost savings. Most of the energy savings were due to reduced reliance on air-conditioning and artificial lighting. The passive design corresponds with ongoing high patronage and low tenant turnover.

The design of the market has additional benefits for the neighbourhood. The open and permeable James Street front facade promotes its engagement with the subtropical climate and the connection between the development and the surrounding neighbourhood. Unlike most other retail developments in the vicinity, the market provides shade and shelter to the street with large roof overhangs. The pedestrian thoroughfare includes an outlook from surrounding streets and adjoining developments and integrates an 'internal' street to socially and commercially activate the market. The central public gathering space is comfortable year round and provides a relaxing outdoor/indoor public space. Tall spaces to create a sense of openness and sheltering allows for alfresco dining. The design of the development also contributes to the diversity of building types in the streetscape.

6.0 BUILDING CONSTRUCTION

The layout, form, and construction material of the James Street Market is shaped by the objectives of climate responsive deign. The market is essentially three separate buildings that are connected by a covered mall, and a long and narrow form oriented to the south-east and north-west.

Floor System

The structural floor is a concrete slab-on-ground which is unfinished throughout the market. A concrete slab was selected as it is economical, minimises disturbance of previous industrial site fill, and effectively bridges over the existing stormwater drain that runs under the building.

Wall Systems

The wall systems are used in response to orientation, passive design strategies, fire rating requirements and aesthetics. The structural wall system varies between steel framing and tilt-up concrete panels, and the envelope consists of a mixture of lightweight and masonry cladding.

Steel framing is the dominant construction system, and large open spans are possible without supporting columns or walls to disrupt open spaces. This allows the creation of an open, naturally lit spaces, such as the market hall and the enclosed courtyard. The large steel spans also allow large window and door openings in the external wall plane. Floor to ceiling windows in the market hall sit independently from the steel structure and work as a non-loadbearing line of enclosure.

Lightweight cladding is used predominantly on the southern and eastern facades, where exposure to the sun is less severe. The northern, eastern and southern facades have large window and door openings to allow for visibility, cross ventilation and solar gain. The steel-framed walls are clad with painted fibre cement, fibre cement with ceramic tiles, timber or glazing.

Tilt-up concrete walls are used on the western facade to provide some insulation from the western afternoon sun, which are in turn shaded by adjoining buildings. The western walls are predominantly solid with few openings, to exclude the afternoon sun – and also for fire rating.

An external curtain to a street-side seating area of the wine bar at the front of building was installed after the wine bar occupied the tenancy. The curtain can be opened or closed depending on the weather or amount of sun protection required. This layered response is in keeping with the local subtropical vernacular.

Roof Systems

The steel-framed roof system works in conjunction with the steel-framed wall system to create the large spans required to free the ground plane. It allows flexibility of the size and location of the tenancies without the restriction of columns and load-bearing walls.

A 3100mm wide overhang to the north, east and southern sides of the building shades and protects the walls. The high ventilated roof in the mall encourages stack ventilation and also admits natural light into the space.

Windows and Shading Devices

Large eaves and window hoods protect openings and windows from unwanted sun and rain on the north, east and south sides of the building.

In the wine bar and café, the timber-framed window edges are also used as seating for patrons. The window frames used throughout the market are aluminium. Aluminium, though high in embodied energy, was selected for its durability, low maintenance and economical cost.

The slightly pitched roof over the central corridor expels hot air and assists passive cooling.
(Image: C Kai, 2009)

Maintenance

Low-maintenance materials such as concrete and glass have been used to minimise the amount of ongoing maintenance required. For example, although the initial costs were higher, external surfaces were tiled rather than painted when in prominent areas to reduce the amount of long-term maintenance. Western tilt-up concrete panel walls are unpainted.

Locally available plywood was used as ceiling lining rather than standard plasterboard and also for the soffit, because of its durability when it is protected from weathering. The plywood veneers are made from local plantation timbers and have weathered well. They have not required resealing, have maintained their colour and have not bowed or sagged.

Insulation

The building has the minimal thermal insulation required by the building code at the time of construction. According to the architect, rather than using insulation as the key climate-control measure, the combination of natural ventilation and shade was deemed sufficient in the subtropical climate.

7.0 KEY LESSONS

The James Street Market case study provides several key lessons for architects.

Strong client support resulted in the construction of a climate-responsive and environmentally conscious development. The indoor/outdoor public courtyard space was instrumental to the environmental performance of the development. This feature might have been sacrificed during the design phase if it weren't for the architects taking the time to communicate the benefits of the design to the client.

The engagement of the building owner is critical to ensuring the James Street Market operates according to the original design intent. In the case of James Street, the client/owner is also the building manager and selects its tenants.

The selection and support of the tenants is also critical to the success of the market. Tenants are introduced to the benefits of the passive design strategies and cooperate by adjusting the openings of the building according to the season to support cross ventilation.

The use of natural ventilation and natural lighting in the central market courtyard has proven to be a commercially and environmentally successful model. This is demonstrated by reduced energy use and associated cost savings, high rates of patronage, and low tenant turnover.

The development shows that consumers can embrace non-air conditioned buildings, even in a retail setting, which are commonly the most artificial and climatically remote building environments encountered in Australia. The open-air design of the James Street Market is an example where experiencing natural climatic fluctuations during the course of the days and seasons is an appealing feature.

The untested building type created significant financial risk for the client which the design team alleviated by keeping the building costs within the construction budget.

8.0 CONCLUSION

The James Street Market is an innovative climate-responsive retail building for Brisbane for which a local precedent did not exist. The open-air design responded to the local climatic conditions and used passive design strategies to reduce the energy used by the lighting, heating and cooling. Well suited to the subtropical climate and lifestyle, the market stands as a successful example of neighbourhood food retailing that provides an alternative to internalised retail precincts in comparable climate zones. The market has a human scale and provides a comfortable indoor/outdoor space in which to shop, and has become a local landmark in the revitalised Fortitude Valley precinct.

REFERENCES

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