Common science

Lindsay Johnston examines the application of many effective but common sense, environmentally responsive principles to the design and construction of the Monash Science Centre.

This review of the Monash Science Centre at the Clayton campus of Monash University in the eastern suburbs of Melbourne, by Williams Boag, continues the educational theme of *ar* ESD case studies, reinforcing the observation that university clients are investing in the long-term efficiency and performance of their buildings, thus delivering a 'triple bottom line' of reduced energy costs, improved user comfort and doing the right thing for the environment by reducing greenhouse gas emissions.

The Science Centre is located on an open sloping site in a parkland campus setting and is a multiple-use facility of 1350 square metres, constructed in one to three-storey configurations. From the outset, the project had ESD principles embedded in the brief and the objective to deliver on these within a conventional budget framework has been successfully achieved. Visually, the building speaks clearly of these environmental underpinnings through its primary form, detail and materials selection. The principal function of the building is as an exhibition and meeting venue where primary and secondary school students can interact with research scientists and their work, thus engaging the general public in an understanding of the role of science in today's world. Through its expressive environmental design, the building provides a learning experience in itself for visiting students and the public. Accommodation consists of exhibition, teaching, reception, gathering and support spaces, external exhibition areas and circulation, amenities and storage. The primary elements – the exhibition hall and teaching wing – are formally expressed and the diagram allows for future expansion.

The building is correctly located on an east-west axis and key passive and active environmental features include a geothermal heating and cooling system using the nearby lake as a heat source and heat sink, a cross section that promotes stack-effect air movement, solar chimneys of black sheet metal located on the north facade to drive cross ventilation, an underfloor water-based heating system and heat collection in enclosed window boxes. The climate in this part of Victoria is temperate with an average rainfall of 657mm. Temperatures range from an average minimum of 6˚C in winter to 14˚C in summer and average maximum 13˚C in winter to 26˚C in summer. Average sunshine hours range from three in winter to eight in summer. There are good diurnal (day/night) temperature differences in summer that facilitate cooling through night purging and in winter reasonable sunshine facilitates solar access and useful heat gain to the classroom wing. The internal environments of the building are generally naturally ventilated without air conditioning but with introduced winter heating. Only the administrative offices are air conditioned. The naturally ventilated spaces are targeted at 2-3˚C within external ambient temperature in summer with improved perceived comfort achieved through good air movement. Design temperatures in the air conditioned spaces are targeted at 26˚C in summer and 19˚C in winter, with cooling and heating loads minimised by the application of good passive design strategies.

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Monash University Science Centre.
Clayton VIC
Williams Boag. Architects

Lindsay Johnston. Review
Peter Bennetts. Photography.

Design team 'modus operandi' The project was carried out using traditional project delivery methods but, as is essential, a specialist energy/environmental consultant was engaged at concept design stage prior to the appointment of the other engineering consultants.

Site excavation An existing earth mound to the north of the building, constructed from earlier excavation of the nearby storm-water retention lake, ensured that minimum excavation was required to site the building. The strategic design makes use of the site falls, which are integrated into the section and planning.

Orientation A long and narrow configuration with an east-west axis maximises northern and southern facades, optimises natural ventilation and daylight and minimises difficult east and west windows.

Sun control External solar shading has been provided to all perimeter windows, configured to restrict unwanted direct solar heat in summer and avail of welcome solar access in winter.

Thermal efficiency A thermally efficient envelope has been achieved through limiting the window area to below 40 percent of the wall area and through the inclusion of insulation levels as recommended by the Sustainable Energy Authority Victoria. At extra cost, double glazing could possibly have improved this performance, particularly on the south elevation.

Thermal mass Availing of the potential of thermal mass to moderate internal temperatures holding daytime warmth in winter and night time 'coolth' in summer, three-metre-high internally exposed precast concrete thermal mass walls have been integrated within the exposed envelope walls of the exhibition hall.

Daylighting Effective penetration of glare-free daylight has been achieved through accurate predictive testing to ensure a high level of controlled natural light using strategies such as evenly distributed openings, light shelves and high level windows integral to the building design.

Natural ventilation The building takes advantage of natural ventilation in a number of ways. A combination of automatically controlled and manually operable ventilation openings facilitates the entry and exhaust of outside air. Automatically operable ventilation openings are controlled by a centralised building management system. High level openings in the teaching and auxiliary areas allow cross ventilation and the exhaust of hot air. In summer, night purging is used to remove heat and chill down thermal mass to emit 'coolth' the following day.

A series of thermal chimneys along the northern wall of the exhibition hall induces cross ventilation at low levels assisting with natural cooling of the space where the occupants will be. The chimneys are fan-assisted to allow for the removal of heat build-up during periods of high occupancy and for night purging. These fans are reversible so that, in winter, warmer air collecting below ceiling level can be pushed down the chimneys to floor level.

Heating and cooling The main heating system for the building uses a geothermal heat pump linked to the adjacent lake or storm-water retaining pond. Heated water is circulated through underfloor coils in the exhibition hall and the teaching area, and through panel radiators in other areas of the building. Heat collection and rejection from the pond to the water in the geothermal system eliminates the need for any energy intensive air-cooled condensing equipment. Further heat recovery is achieved through the recirculation of high-level warm air to the occupied areas at lower levels. In the classrooms, this is done by manually reversing the flow of the ceiling fans. Passive heat collection in the enclosed window boxes in the teaching wing reduces heating demand in this area.

The geothermal heat pump system is used to chill water for the air conditioning of the administration areas on the ground floor.

Lighting system Low voltage and energy saving lighting is installed throughout. The lighting system complements the use of natural light in the building and this has been followed through to external lighting at night. The teaching block has luminaires with electronic ballasts facilitating a daylight dimming system remotely controlled by a photo-controller panel which allows the light levels of the classrooms to be electronically controlled in accordance with the available daylight, thus reducing unnecessary energy usage. Areas also have motion detection to turn lighting on and off as people enter and leave each room.

Energy demand Energy demand is currently assessed at approximately 23,900 kWh/annum or 17.7 kWh/sq.m/annum.

Renewable energy Although providing only a small proportion (two percent) of the overall energy demand of the building, a 1 kW photovoltaic array has been installed on the roof of the classroom wing, independently funded under the Commonwealth Government Photovoltaic Rebate Program for Community Use, to showcase renewable energy technology. The system currently produces approximately 500 kWh/annum and it is intended that this array will be expanded in the future.

Infiltration In addition to well-sealed operable windows, an air lock has been provided to the main entrance to prevent loss of heat from the building.

Internal zoning All areas have individually zoned sub-floor heating. Only the administration area on the ground floor is an air-conditioned zone.

Vertical access – lift and stairs Primary circulation to upper and lower levels is via a connecting stair. A passenger lift has been provided for disabled access.

Building management system The Building Management System (BMS) uses Direct Digital Controls (DDC) technology to control and monitor electrical, mechanical, fire, lift and security systems. It is an integral part of the environmental performance of the building, controlling the motorised opening and closing of windows and wall openings and the operation of the heating system.

Water Investigations at design stage were carried out on storm-water retention and re-use, grey-water recycling and on-site sewerage storage and treatment. These strategies were not incorporated in the building design primarily due to cost constraints. The building is reported to have low levels of water consumption.

Waste The University has a number of recycling services available including bottles and cans, cardboard disposal, computer and electronic equipment recycling, paper recycling, and printer cartridge recycling.

Transport Bike racks have been provided at the building and users can take advantage of the existing public transport network at Monash.

Building longevity The buildings have been designed and sited to allow future additions and extensions to occur with minimal disruption to the existing building, and without compromising outlook or orientation.

Materials The materials selected for the project have been assessed on the basis of renewability, recycled components, re-usability, functionality and durability, including an assessment of embodied energy and environmental impact in respect of toxicity. For instance, timber window frames with external aluminium glazing adapters achieve good thermal performance and meet the University requirement for a low maintenance exterior finish. The notable visible feature of the building is the timber cladding, which is of Yellow Stringybark hardwood planks, sourced from sustainable NSW forests.

Lindsay Johnston acknowledges the assistance gained from the detailed environmental notes on the Monash University Science Centre provided by Williams Boag Architects.

Lindsay Johnston is an architect and specialist environmental consultant and Conjoint Professor in the School of Architecture at the University of Newcastle, NSW.

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01 The brick-clad exhibition hall also serves as a meeting venue where students and the public can interact with scientists.
02 Detail of the teaching wing.
03 Black metal solar chimneys aid cross ventilation.
04 Windows on the east and west facades have been kept to a minimum.

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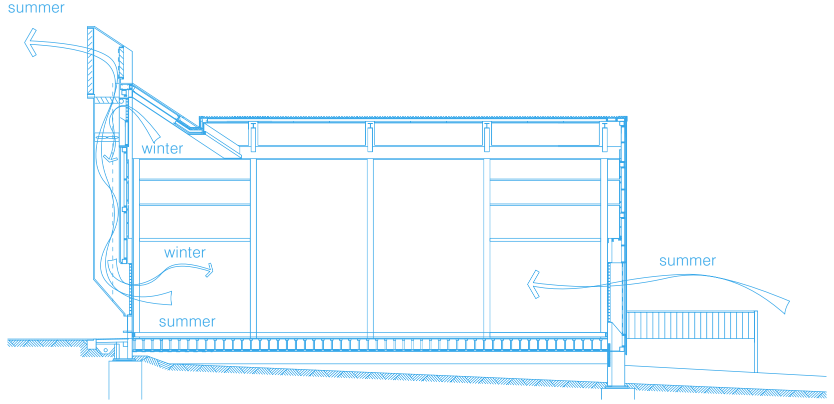
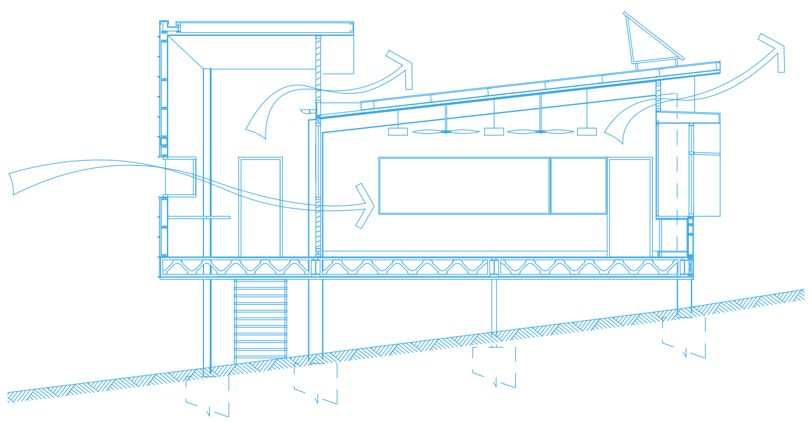
Project summary Monash Science Centre, Monash University Clayton campus, Melbourne ■ **Principal architects** Peter Williams, David Tweedie (project architect, design & documentation), Tim Lang (project architect, contract administration) ■ **Project team** Andrew Croxon, Trang Vu, Phillip Brady ■ **Project manager** Bruce Davis, Monash Projects & Planning **Consultants** ■ **Structural & civil engineers** Kuter Consulting Engineers ■ **Mechanical & electrical engineers** Bassett Consulting Engineers ■ **Hydraulic engineers** C. R. Knight & Associates ■ **Quantity surveyor** Donald Cant Watts Corke ■ **Builder** Kane Constructions ■ **Landscape consultant** Paul Thompson ■ **Environmental engineer** Scott Wilson, Irwin Johnston ■ **Size** 1350sq.m ■ **Time to complete** 15 months ■ **Client** Council of Monash University, Monash Science Centre – Professor Patricia Vickers-Rich **Materials** ■ **Walls** Generally steel structure with timber stud infill with Tyvek sarking and polyester batt bulk insulation; precast concrete wall panels at low level around exhibition hall to provide thermal mass ■ **Cladding** Exhibition hall - KD Yellow Stringybark Cladding from North Eden Timber; Classroom wing Custom made zincalume pan cladding; Stramit Mini Corry; Vitrepanel supplied by Atkar ■ **Roof** Stramit zincalume decking ■ **Guttering** Custom made zincalume box gutters ■ **Paint** Dulux MIO paint finish to all exposed structural steelwork ■ **Paving** Harcourt Granite supplied by Giannarelli & Sons ■ **Windows** KDHW frames with Capral St Lucia Suite external glazing adaptors; glass & WRC louvres from Breezeway; sashless sliding windows from Cowdroy ■ **Doors** Custom made solid core and glazed doors ■ **Hardware** Lockwood door furniture and locks; Dorma pivots; Raven door seals ■ **Heating system** Combination of subfloor polyethylenehydronic looped coil system with aluminium heat spreading plates and conventional radiator panels connected to Origin Energy Water Furnace GeoExchange system utilising geothermal loops in the adjacent lake **Interior materials** ■ **Ceilings** Plasterboard, including CSR Gyprock Perforated ceiling panels ■ **Internal walls** 13mm plasterboard including CSR Fyrchek & Impactchek; slotted MDF board panels from Atkar in Exhibition Hall; internal Vitrepanel from Atkar ■ **Paint** Dulux paint with MIO finish to all exposed steelwork ■ **Lighting** Fluorescent & metal halide fittings from various suppliers including Thorn, Australume, Moonlighting, Spectra, Austube and Minitronics ■ **Flooring** Structural plywood flooring throughout ■ **Floor finishes** Exhibition hall - Blackbutt Armourply from Big River Timbers with Tung Oil finish; classroom wing - Tarkett Sommer Linosom Veneto Linoleum; Interface 'Tatami' Carpet Tiles; entry Harcourt granite supplied by Giannarelli & Sons ■ **Classroom fittings** 'Boss' Lab sinks, taps and safety equipment from Broen Australia; pinboards & whiteboards from Educational Writing Boards of Australia ■ **Sanitary ware** Caroma



Section exhibition hall



Section classroom wing

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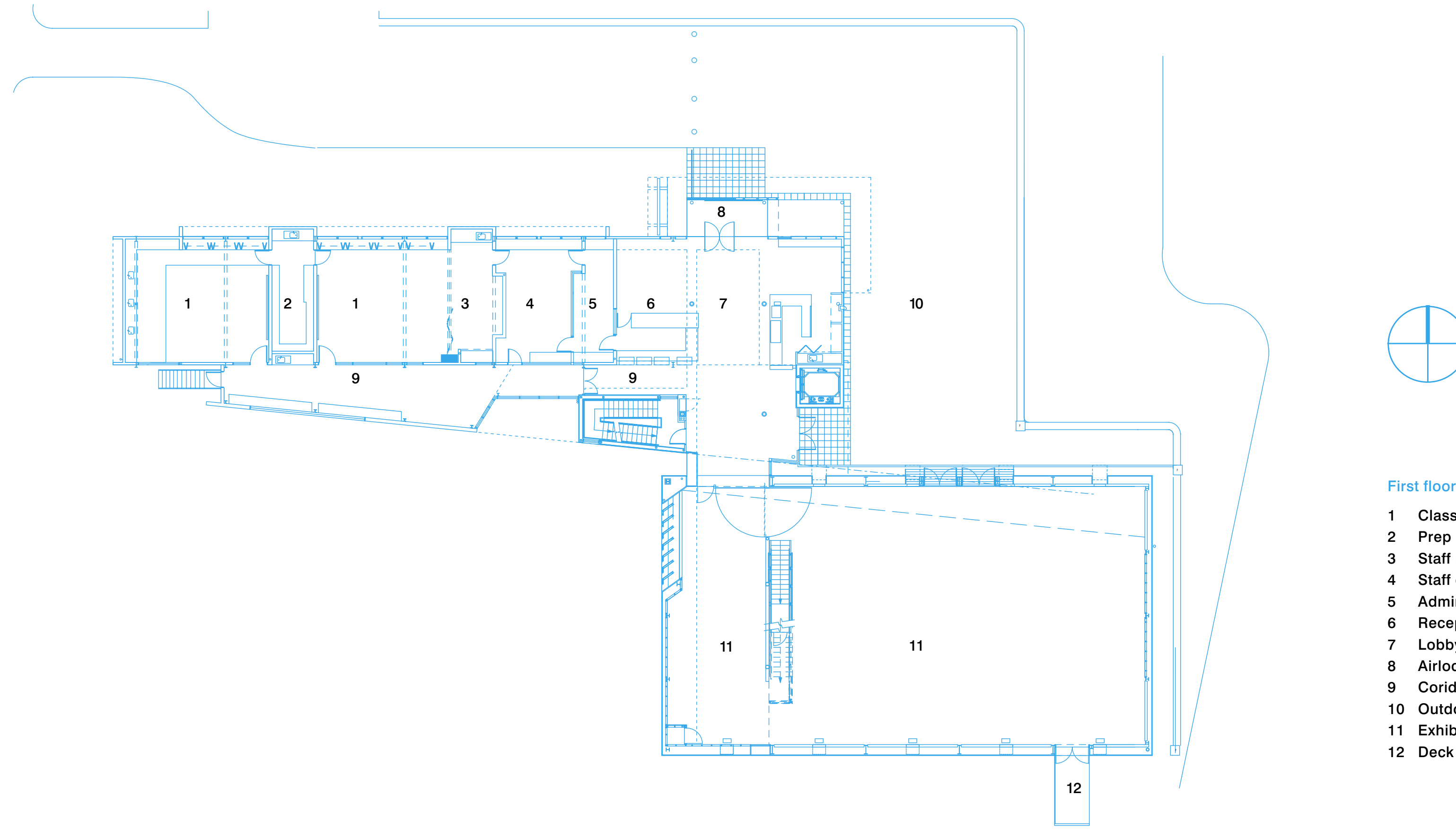

First floor plan

1 Classroom
2 Prep room
3 Staff room
4 Staff office
5 Admin
6 Reception
7 Lobby
8 Airlock
9 Coridor
10 Outdoor exhibition space
11 Exhibition space
12 Deck

05 - 06 The centre is sited in a parkland setting.
07 Part of the exhibition which is designed to educate students and the general public about the importance of science.