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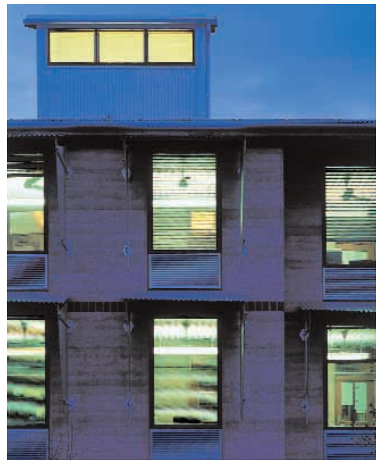

Deep Green.

Continuing our series on environmentally sustainable architecture, Lindsay Johnston assesses the new buildings at the Thurgoona Campus of Charles Sturt University.

There is an emerging 'taxonomy of green'. Low technology solutions to simple environmentally sustainable lifestyles are 'light green' – the villager in the developing world, the frugal retreat in the bush. High technology solutions that progress towards sophisticated, comfortable, partial environmentally sustainable lifestyles are 'mid-green' – much of today's 'green' architecture, the high embodied energy building covered in photovoltaic panels. Low or resource efficient technology solutions that can deliver a sophisticated, very comfortable and environmentally sustainable lifestyle are 'deep green' – there are very few examples so far. ■ 'Deep green' requires tenacious commitment to closing the resource loops. Moving away from the linear processes of 'take and waste' to cyclical processes of 'harvest and recycle'– zero resource consumption, zero emissions, zero waste, zero environmental impacts. ■ The Charles Sturt University Thurgoona Campus, site and buildings, by CSU Director of Design, Marci Webster-Mannison, is at least 'dark green'. This project is one of the first larger scale developments in Australia to comprehensively and rigorously pursue autonomy and sustainability. ■ A recent EU book on climatic architecture suggested that "Climatic architecture involves designing with climate: for wind, shelter, and outdoor space; light and daylight; heat and warmth; cooling and ventilation. People made buildings thus for thousands of years, and when the majority of architects realise the importance of working with and not against climate, the term climatic architecture will change, by itself, to architecture". ■ It is worth pondering why Webster-Mannison's buildings have been passed over in RAIA State Awards, and particularly in Environment Awards. Is a building that sits outside the continuum of current norms of 'good architecture' as determined by criteria of style, but which performs exquisitely, any less good architecture than an exquisite stylistic 'piece' that performs poorly? The Thurgoona Campus buildings are in a lineage of 'ex-centric' architecture – Bruce Goff, Herb Greene, Paolo Soleri, Ton Albers, Kota Kawasaki, Gregory Burgess. On my thorough visit to the site, on a glorious sunny cold winter day, the depth of understanding of environmental issues, the rigorous commitment to closing the resource loops, and the functional performance of the whole complex were most impressive. The conceptual integrity and many of the details of the exteriors and interiors were, in my opinion, delightful. What a pity this work so far has not been recipient of a major RAIA Environment Award.

Charles Sturt University. Thurgoona Campus, NSW.
CSU Design Director,
Marci Webster-Mannison. Architect

Lindsay Johnston. Review
Derek Swalwell. Photography

01 The neat complex of new buildings.
02 Window shading detail of office building.
03 Evening view of office building exterior.

■ **Project description.** The Charles Sturt University Thurgoona Campus, outside Albury in regional New South Wales, experiences extremely hot windy summers (42˚C) with low humidity and cold sub-zero winters presenting difficult conditions for low energy buildings. ■ The School of Environmental and Information Sciences comprises 2969 square metres of office accommodation for close to one hundred staff and post graduate students, specialist teaching space, research facilities and a herbarium. ■ The 1180 square metre Teaching Complex comprises 200-seat and 100-seat lecture theatres, two 60-seat flat floored teaching spaces and two 30-seat tutorial rooms.

■ **Site layout.** Early decisions favouring passive techniques and water conservation were critical in developing the site plan. The main pedestrian spine, roads and services follow the contours, punctuated by existing trees. Natural drainage patterns and the water management system define discrete precincts for the residential, core and academic buildings.

■ **Structure, construction and services.** Unreinforced rammed earth forms structural walls and columns. Curved corrugated steel roofs are supported by composite plywood beams and plantation softwood trusses. Structural use of recycled timber involved ongoing review in relation to local availability. An earth covered in-situ concrete barrel vault roof economically spans the main lecture theatre. There is no air-conditioning in any of the buildings and the campus is not connected to the main sewer.

■ **Solar access and sun control.** The buildings are sited on a mainly west-east axis to allow maximum sun penetration from the north and to eliminate solar loads from east and west. Sun shading devices and roof overhangs are well arranged to eliminate high summer sun and admit low winter sun. The clerestory windows, mostly facing south, and high level windows in the thermal chimney stacks, admit light into the centre of the buildings.

■ **Thermal mass.** High thermal mass is provided through 300-600mm thick rammed earth exterior and internal walls, concrete ground floor slabs and suspended in-situ slabs to upper floors and ceilings and is designed to hold warmth in winter and 'coolth' in summer. There is no wall insulation. Methodical thermal monitoring of the rammed earth walls is planned and may allay concerns that the thermal mass exposed to summer sun transmits heat into the buildings in summer and that the mass exposed to the south transmits cold into the buildings in winter. Anecdotal evidence suggests that the buildings are performing very well thermally. The main lecture theatre is buried under a grassed mound and substantially surrounded by the natural temperature of the earth, thus moderating heat losses and gains from extreme external temperatures. The commitment to rammed earth thermal mass structural internal walls limits opportunities for future flexibility.

■ **Insulation.** The metal roofs and areas of lightweight wall are insulated with natural wool. All windows are single glazed. In a cold climate like Albury, double glazing, especially on south facing windows, would have enhanced the thermal performance, but raised the capital cost.

■ **Space and water heating.** In winter, direct sunlight is admitted into the buildings though the well placed north facing windows and retained in the exposed thermal mass of the concrete floors and rammed earth walls. The roofs of the buildings are mounted with an extensive array of water filled solar collector panels at 37˚ pitch, the optimum for Albury. The majority of these are for space heating and cooling purposes and a few are for domestic hot water. The heat collected into the solar panels is transferred to water held in insulated tanks and can be boosted by a gas boiler. In winter, the hot water is circulated through a system of coils of polyethylene pipe cast into the concrete floor and ceiling slabs, with ribbed soffits to assist thermal transfer to the air, thus warming the usable spaces. The operation of this system is automatically controlled by the sophisticated central computerised building management system. The latter keeps ventilation louvres closed in cold weather.

■ **Space cooling.** The buildings are designed with innovative use of 'stack effect' induced natural ventilation created by the thermal chimneys, which are a prominent feature of the roofscapes. The building management system automatically opens low-level louvres under the windows and at the top of the thermal chimneys once the external temperatures fall below the internal temperature, thus inducing night time cooling of the thermal mass inside the buildings. Cold water is circulated through the coils of pipes in the floor and ceiling slabs. The cold water is created at night by thermal exchange of the tank water with water circulating through the roof-mounted solar panels that dissipate heat into the cold night air, and with water being pumped up from the reservoirs to the supply dams. ■ In the earth covered lecture theatre, stack-induced ventilation enters through low-level vents under the seats that feed from a thermal labyrinth in the plenum under the precast concrete raked auditorium floor and up through the louvres at the top of the prominent roof-mounted thermal chimney. A novel mist-spray waterfall at the air intake to the under floor plenum pre-cools the air using passive evaporative cooling. Additional cooling uses a geothermal exchange system of polyethylene pipes laid one metre under the ground. Heating and cooling in the lecture theatre can be supplemented by hot or cold water circulated through a hydronic system of polyethylene pipes cast into the floor slabs. There is a dual water tank arrangement with one tank of hot water and one of cold to supply warmth or 'coolth' in the transitional periods when there could be demand for both heating and cooling. ■ Classrooms generally have high level clerestory windows which open to provide high level ventilation and are fitted with external wind baffles to prevent prevailing winds neutralising the natural stack effect. Three classrooms on the lower level of the two storey building have an ingenious shared thermal chimney that penetrates out though the upper floor and roof.

■ **Lighting.** Daylight and views are provided by large, fully shaded, openable windows which provide adequate natural light for 85 percent of the year. Clever low energy, low cost, artificial light fittings used throughout the buildings are standard fluorescent strip lights fitted with a simple curved perforated steel shield that acts as a diffuser and provides uplighting to white ceilings. In the lecture theatre, bench-mounted task lights reduce heat loads and maintenance and provide flexibility for lighting during screen based presentations. In the offices, bench lights also provide task lighting that allows user control.

■ **Embodied energy, recycled and recyclable materials.** The locally sourced earth, with the minimum inclusion of cement as a stabiliser, has a relatively low embodied energy compared to other thermally massive materials. The use of concrete is optimised through insulation and the ribbed profile to the underside of the ceilings. Recycled timber is the preference for visible structural timber and interior linings, and plantation pine timber was used for roof and wall framing. Recycled materials also include an integral structural system of library shelving


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04 View through the complex with offices on the left, tutorial rooms on the right and the auditorium in the background.

05 The auditorium/lecture theatre with tutorial rooms to the left.

06 Auditorium entry.

07 The earth-covered auditorium extension.

08 Auditorium.

obtained from the dismantling of the Dixson Stacks at the State Library of NSW and associated 25mm cast glass flooring that has been strategically used through the buildings to admit natural light to lower levels.

■ **Benign materials.** There is a consistent commitment to non-toxic materials, such as wool and linoleum floor coverings, wool insulation and specially prepared non-toxic paints. Stainless steel mesh is used for termite protection. There is no use of MDF board or plastic laminates, and there is minimal use of PVC as the drainage system uses polyethylene and terracotta pipes.

■ **Water harvesting and re-use.** The stormwater recycling system, treatment of grey water in artificial wetlands and dry composting toilets obviate the need for connection to town sewerage or stormwater mains. Storm water is collected by the waterways, passes through in-stream wetlands to treat the water for aeration, sedimentation and nutrient removal, before depositing it in retention basins for re-use. Water is circulated by a windmill and solar powered pump from the retention basins to two supply reservoirs that are located at the highest point of the campus. Water is released into the top of the waterway system and to an irrigation main supply pipe. The recirculation of water and the presence of frogs minimises the creation of mosquito breeding grounds. The waterways and ponds also provide wildlife habitats. ■ Prominent steel water tanks integrated into the buildings store rainwater collected from the roofs and supply water for the evaporative cooling which is cleansed for re-use in a small wetland. ■ Grey water cleansing uses artificial wetlands for treatment and aeration with final disposal by sub-surface irrigation.

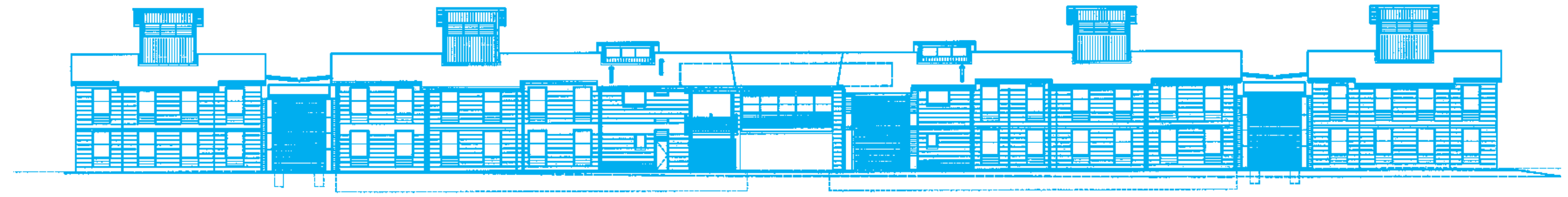
■ **Composting toilets.** Unusual for a substantial public-use building, all toilets are 'Clivus Multrum' dry composting toilets at both ground floor and at first floor levels (with a long drop pipe) with semi-basement composting chambers generally located on the warm north side of the buildings (to nurture the composting process) and accessed from outside for raking and removal of waste which is used for fertiliser.

■ **Design team modus operandi and modelling.** The passive and active thermal comfort strategies were developed in collaboration with Advanced Environmental Concepts and the local specialist firm Branco Boilers and Engineering. The design process crucially involved early design 'think tank' sessions where the whole team was brought together. The environmental performance of the key elements was assessed using computer modelling techniques.

■ **Energy consumption.** Operational Energy savings in the order of at least 60 percent are anticipated, based on the monitored performance of similar buildings on the campus. The embodied energy is estimated at less than half that of typical university buildings. Energy consumption, greenhouse gas emissions and thermal performance have not been systematically analysed at this stage due to lack of resources, but a research project is currently proposed.

■ **Capital cost.** The capital cost of the SEIS building was somewhere between four percent more and 14 percent less than a conventional building, depending on how it is calculated. The Teaching Complex was a comparable cost to the lowest end of the range for university lecture facilities.

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



Elevation

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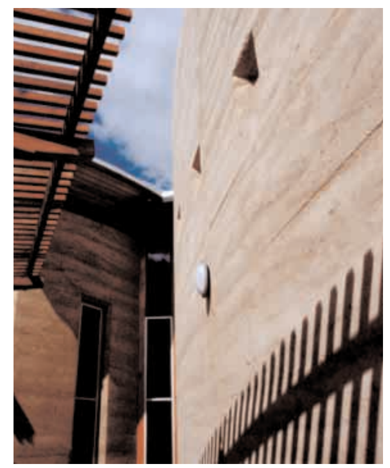

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'Deep green' requires tenacious commitment to closing the resource loops. Moving away from the linear processes of 'take and waste' to cyclical processes of 'harvest and recycle' – zero resource consumption, zero emissions, zero waste, zero environmental impacts.

■ **Project summary** Teaching Complex, Charles Sturt University ■ **Architect** Marci Webster-Mannison, Charles Sturt University (Office of Design) ■ **Design** Marci Webster-Mannison, Chris McInerney (Office of Design) ■ **Additional project team** Chris Nesakumar, Garry Crichton, Charles Sturt University (Office of Design) ■ **Structural & civil consultant** Belvoir Consulting ■ **Hydraulics consultant** COR Consultants ■ **Electrical consultant** Robert Pill ■ **Thermal modelling** Advanced Environmental Concepts ■ **Accoustics consultant** Escape Consulting ■ **Water management consultant** David Mitchell, Charles Sturt University ■ **Communications consultant** Phil Roy, Charles Sturt University ■ **Thermal systems design & constuction** Branco Boilers and Engineering ■ **Builder** Colin Joss & Co Pty Ltd

■ **Project** School of Environmental & Information Sciences, Charles Sturt University ■ **Architect** Marci Webster-Mannison, Chris McInerney, Charles Sturt University (Office of Design) ■ **Additional project team** Andrew Mathers, Charles Sturt University (Office of Design), SJPH Partnership ■ **Structural consultant** Scott Wilson Irwin Johnson ■ **Civil consultant** Esler & Associates ■ **Hydraulics consultant** Gary Tonkin Plumbing ■ **Electrical consultant** Lincolne Scott ■ **Mechanical consultant** Lincolne Scott ■ **Water management consultant** David Mitchell, Charles Sturt University ■ **Communications consultant** Phil Roy, Charles Sturt University ■ **Builder** Hilton Saunders/Andre van Egmond/Mark Orton/Graham Lawton, Charles Sturt University ■ **Building automation system** Siemens Building Technologies ■ **Landscaping** Jan Waddington/Rod Carver **Materials** ■ **Rammed earth** Earth Structures ■ **Windows** Aneeta sashless double-hung, Breezeway louvre windows ■ **Recycled timber** Nullabor Timbers ■ **Floor finishes** Forbo linoleum, Tuftmaster wool carpet ■ **Paint** Organoil, Clean Fresh Paints ■ **Recycled steel, shelving and glass flooring** Dixon Stacks, State Library of NSW, glazing by Town & Country Glass ■ **Insulation** Higgins wool ■ **Metalwork** H&S Metal Works ■ **Timber** Grants Timber & Hardware, Manns Timber & Hardware ■ **Termite protection** Termimesh ■ **Dry composting toilets** Clivus Multrum ■ **Solar hot water panels** Solahart

09 Auditorium foyer.
10 Staff rooms lead off the second-level atrium.

11 Exterior detail of rammed-earth wall.
12 Interior stair detail.
13 View from the seminar room balcony to tutorial rooms opposite.