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Ecolibrium

Common good

A Games facility
built for all.





Common good

As one of the key venues for the Gold Coast 2018 Commonwealth Games to be held next month, the Gold Coast Sports and Leisure Centre has been designed to accommodate a range of sports, with both the short and long term in mind. **Sean McGowan** reports.

Located on the Nerang-Broadbeach Road in Carrara – adjacent to Metricon Stadium – the \$105 million Gold Coast Sports and Leisure Centre is a multi-purpose facility incorporating two 6,000m² mixed-use indoor halls connected by a pedestrian plaza.

Totalling some 16,500m², the centre also accommodates meeting and function rooms, associated support facilities, 460 underground carparking spaces, and the new headquarters and training home of the Gold Coast Suns (AFL) Football Club.

As well as the City of Gold Coast having permanent offices within the facility, it is also anticipated that the centre will become home to Queensland's premier state representative sporting bodies. In "Games mode" this April, the centre will play venue to four sports: badminton,



In "Legacy" mode after the Commonwealth Games, the centre will become an important community facility.

para powerlifting, weightlifting and wrestling. The Hall 1 show hall will feature a grandstand capacity of 5,300 people (including players and officials).

After the Games, the venue will become an important community facility. In "Legacy mode", it will support a range of ball sports, including elite and community-grade basketball (14 courts), netball (10 courts) and badminton. It will also provide vital space for exhibitions and community events.

To cater for such varying use and occupancy numbers, the Gold Coast Sports and Leisure Centre features a unique, energy-efficient multi-mode ventilation design by building services and ESD engineer, Norman Disney & Young (NDY).

BALANCING STAKEHOLDER NEEDS

NDY's involvement in the project began with an invitation to tender for the building services design works – including ESD – as part of the BVN Architects' (as principal consultant) submission to the Queensland Government's Department of State Development (DSD).

The consultant was initially engaged for pre-design and schematic design phases through the principal consultant in November 2013. NDY was later novated to the managing contractor, Hansen Yuncken, to complete the design and oversee the project through the tender and construction phases.

NDY project leader and senior associate John McIntosh says the main challenge was working with so many stakeholders, who all had their own needs and requirements.

"The key stakeholders were the Department of State Development, whose focus was capital cost and program; the City of Gold Coast whose main focus was legacy and ongoing costs; and the Gold Coast 2018 Commonwealth Games Corporation (GOLDOC), whose focus was firmly on Games mode and what infrastructure could be built into the legacy works to cater for the Games."

A number of community stakeholders associated with the various sporting groups to be accommodated in the facility were also consulted.



The halls have been designed to minimise air conditioning.

These included groups representing basketball, netball and badminton.

“The stakeholders attended every design meeting and workshop throughout the design stages,” McIntosh says, “and actively contributed to the design outcomes.”

From the initial design meeting, NDY project director Andrew Gentner, M.AIRAH, says a key driver for the project was to maximise the ability of the

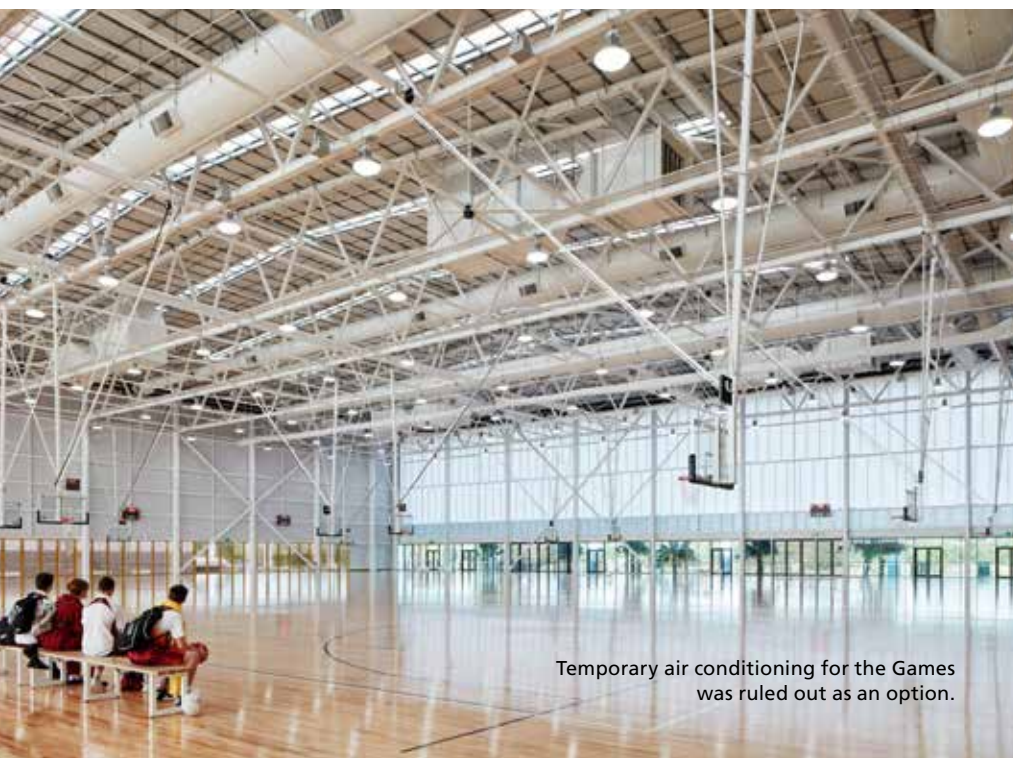
centre to operate in natural ventilation mode or mechanically assisted ventilation modes. The idea was to minimise the requirement for the halls to operate full air conditioning.

“Energy efficiency, capital cost and ongoing running costs were all at the forefront of design discussions with the stakeholders,” Gentner says.

The initial brief from the Department of State Development was to provide a

naturally ventilated facility for legacy community sports use, with “bump-in” air conditioning provided for Games mode. However, the City of Gold Coast (as the building owner and operator) also wanted the ability to stage major sporting, leisure and exhibition events throughout the year, with a view towards permanent air conditioning as and when needed.

Through design “optioneering”, verification and cost analysis, it was determined the temporary air conditioning solution for the Games only was both inefficient and unnecessarily expensive.



Temporary air conditioning for the Games was ruled out as an option.

“ The Gold Coast Sports and Leisure Centre features a unique, energy-efficient multi-mode ventilation design ”

LESSONS FROM THE CONSULTANT

NDY project leader and senior associate John McIntosh shares some of the lessons learned from the Gold Coast Sports and Leisure Centre project.

1. Listen to and involve the stakeholders
2. Understand all the different stakeholder briefs
3. Determine the most suitable design strategy to address all brief requirements
4. Ensure stakeholder buy-in to the proposed design strategies.

It also offered no legacy benefit to the community.

This led to the mechanical services brief being amended to include the provision of full air conditioning to the halls. The ability of the centre to operate in natural ventilation mode, or mechanically assisted ventilation modes had to be maximised. This minimises the requirement to operate full air conditioning.

MULTI-MODE

In response, NDY designed a unique multi-mode ventilation system that minimises the energy consumption of the facility while maximising occupant comfort.

This resulted in the provision of a four-step ventilation solution with:

- Step 1:** Operation of façade louvres to provide natural ventilation
- Step 2:** Operation of high-volume, low-speed fans in conjunction with the louvres
- Step 3:** Mechanically assisted ventilation utilising the hall smoke exhaust fans
- Step 4:** Full air conditioning.

This system was designed to be controlled by the building management system (BMS) based on ambient and internal conditions, with optional operator input in relation to the particular use, if required.

“The Gold Coast climate provided opportunity to maximise natural and mechanical ventilation of the halls,” says Gentner.

Extensive computational fluid dynamics (CFD) modelling was undertaken to determine the optimal arrangement, location and orientation of intake louvres, as well as fan locations and mechanical ventilation openings.

This was vital to prove the performance of each of the ventilation steps.

SIZING THE SYSTEM

One of the key design challenges of the multi-mode system was in sizing the air conditioning systems to best cater for both Games and legacy populations.

McIntosh says the initial Games-mode occupancy levels were briefed by the Department of State Development and GOLDOC.

The following table summarises the various design populations the facility was required to accommodate.

As well as CFD modelling, extensive heat-load modelling was undertaken on all operating scenarios.

This optimised the size and configuration of the central chilled water plant, as well as sizing the air handling units (AHUs).

Particular attention was also given to the design of the system to cater for badminton – one of four feature sports to be hosted at the Games.

“Extensive heat-load modelling was undertaken to establish the optimum sizing for the layout and selection of ductwork and diffusers to meet badminton air movement requirements,” says McIntosh.

Under badminton conditions, a minimum of 1.5 air changes per hour, and a maximum of 0.1m/s air velocity across the field of play are required so as to minimise air currents and the “drift” of the shuttlecock as it moves across the court.

ENERGY EFFICIENT DESIGN

The central chilled water plant designed by NDY comprises two large centrifugal chillers, and a low-load chiller located in a rooftop plant room, with cooling towers adjacent. This chilled water is distributed to dedicated AHUs serving each functional area.

Constant-volume units serve the halls and function rooms, while variable-volume units were used to serve the council offices and the Gold Coast Suns facilities. All AHUs and fan-coil units (FCUs) feature high-efficiency motors, with economy cycle operation and outside-air control provided to the AHUs.

Design population summary table

Part of Project	Games Mode	Legacy Mode Sport	Legacy Mode Exhibition	Legacy Mode Major Event	Legacy Mode Hall 2 Major Event
Hall 1 Show Hall	2,750	5,000	1,500	5,202	500
Hall 2 Community Hall	2,750	500	1,500	500	4,000
Gold Coast Suns	206	206	206	206	206
Level 2 Function Facilities	1,089	1,089	1,089	1,089	1,089
Level 3 Commentary Box	–	8	–	8	–

Source: NDY



Totalling 16,500m², the centre accommodates the HQ and training facility for the AFL's Gold Coast Suns.

All building services have also been designed to sit above the designated flood level.

BENCHMARKING

The design of the Gold Coast Sports and Leisure Centre sets a new standard in occupant comfort in relation to the use of natural and multi-mode ventilation systems in a sub-tropical environment. It also measures up so far as energy efficiency is concerned.

As per the requirements of the design brief, benchmarking against the GBCA's Green Star – Public Building v1 rating tool, as well as the One Planet Living Design Principles, was completed.

One Planet Living forms a holistic framework to provide guidance for local government, businesses and the built environment – comprehensively addressing key sustainability issues and effectively making a sustainable lifestyle a reality (see breakout).

“These 10 principals are set as goals for the Commonwealth Games events,” says Gentner. “Consequently, the Gold

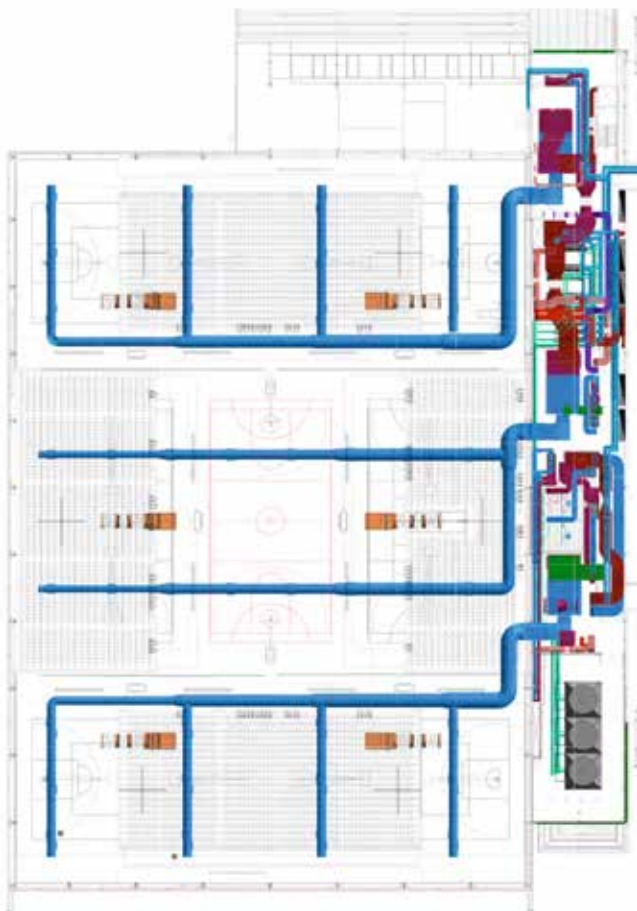
To further the energy efficiency of the systems, variable-speed drives (VSDs) are installed on all fans and pumps. An energy metering system is also installed.

Importantly, the system design provides flexible operation of the systems to suit all combination of centre uses at any particular time.

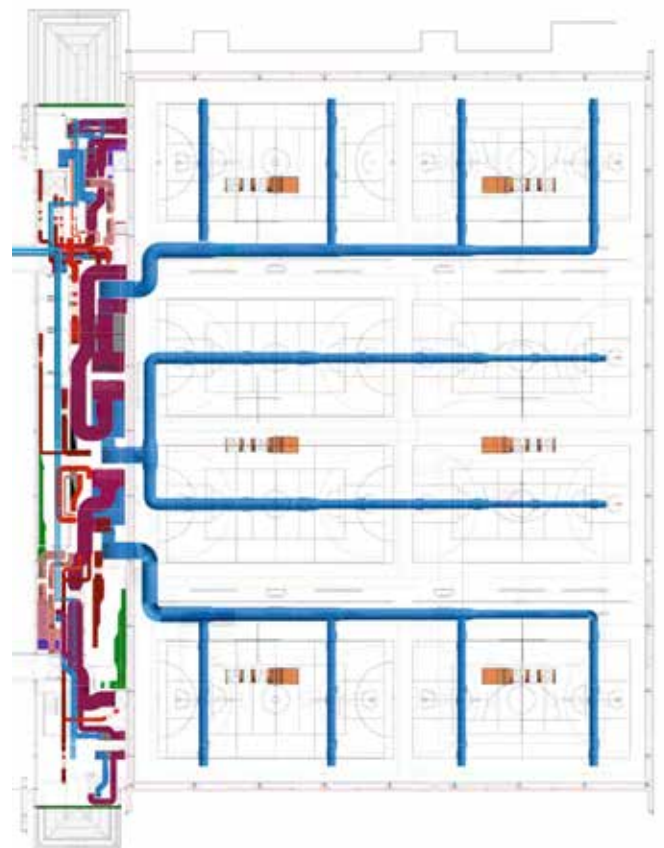
“The mechanical system enables the operator, via the BMS, to nominate the

number of mechanical ventilation steps available to suit the particular use or event,” says Gentner.

“For example, for recreational sporting events, the full air conditioning step may be disabled, allowing the BMS to automatically control between the remaining available steps. For Show Court use, exhibitions or trade events, all mechanical ventilation steps can be made available.”



Mechanical services layout Hall 1 (Show Hall)



Mechanical services layout Hall 2 (Community)

MULTI-MODE VS MIXED MODE

According to NDY's Andrew Gentner, M.AIRAH, there are a number of key differences between the unique multi-mode system designed for the Gold Coast Sports and Leisure Centre, and the mixed-mode systems commonly found in commercial building projects.

"Mixed mode is more of a hybrid system, with a single plant operating in one or two operating modes," says Gentner.











"The HVAC design for the Gold Coast Sports and Leisure Centre is a true multi-mode system utilising several unique systems in either stand-alone mode or a combination of manual or temperature-controlled and stepped parallel systems.

"This design maximises natural ventilation, minimises unnecessary use of mechanical ventilation or air conditioning and therefore maximises energy efficiency and minimises ongoing operational cost to the council."

Coast Sports and Leisure Centre has incorporated a number of ESD features to align with these principals and ensure sustainable design outcomes."

The centre's design also exceeds the minimum performance requirement of National Construction Code, Section J.

Says Gentner: "The modelled energy consumption of 4,400,000kWh per annum is expected to be significantly reduced by up to 30 per cent through the use of the multi-mode ventilation system."

One Planet Living design principles	
 Zero Carbon	Making buildings more energy efficient and delivering all energy with renewable technologies.
 Zero waste	Reducing waste, reusing where possible, and ultimately sending zero waste to landfill.
 Sustainable transport	Encouraging low carbon modes of transport to reduce emissions and reducing the need to travel.
 Sustainable materials	Using sustainable healthy products, with low embodied energy, sourced locally, made from renewable or waste resources.
 Local and sustainable food	Choosing low impact, local, seasonal and organic diets and reducing food waste.
 Sustainable water	Using water more efficiently in buildings and in the products we buy; tackling local flooding and water course pollution.
 Land use and wildlife	Protecting and restoring biodiversity and natural habitats through appropriate land use and integration in the built environment.
 Culture and community	Reviving local identity and wisdom; supporting and participating in the arts.
 Equity and local economy	Creating bioregional economies that support fair employment, inclusive communities and international fair trade.
 Health and happiness	Encouraging active, sociable, meaningful lives to promote good health and wellbeing.

GAMES READY

After reaching project completion in February 2017, the Gold Coast Sports and Leisure Centre hosted its first event – the 2017 Sudirman Badminton Cup – in late May 2017.

"The HVAC systems continue to operate as designed," says McIntosh. "And feedback from the City of Gold Coast and the Gold Coast Suns has been very positive.

"The result shows that with careful planning and use of computer modelling, even in a subtropical environment the use of natural and mechanically assisted ventilation can provide comfort conditions, while still offering the flexibility to provide full air conditioning for specific events."

As a key venue of the Gold Coast 2018 Commonwealth Games, the Gold Coast Sports and Leisure Centre stands ready as the world's sporting attention turns to the Gold Coast from April 4, 2018. ■

PROJECT AT A GLANCE

The personnel

- **Architect:** BVN
- **Builder:** Hansen Yuncken
- **Building services engineer:** NDY
- **Client:** Department of State Development, Infrastructure & Planning
- **ESD engineer:** NDY
- **Mechanical services contractor:** Coolmaster
- **Structural engineer:** Bligh Tanner

The equipment

- **AHUs:** Cooling & Heating
- **Air and dirt separators:** Masterflow Solutions
- **BMS:** Austec
- **Cooling towers:** BAC
- **Chillers:** Daikin
- **Dampers:** Polyaire
- **Diffusers:** Polyaire
- **Fans:** Fantech, Pacific HVAC
- **Heat recovery (pool):** Air Change Australia
- **Silencers and attenuators:** Fantech
- **Pumps:** WILO
- **VAV boxes:** Barcol Air

(Source: NDY)