SCHOOL INFRASTRUCTURE NSW
Cooler Classrooms Program

CCP Guidelines

Existing Schools

Revision: V7-27

Contents

1.0 Introduction

This Guideline details the methodology to be adopted to achieve the required thermal comfort and indoor air quality in existing permanent learning spaces and libraries forming part of the School Infrastructure NSW Cooler Classrooms Program.

The Guideline is to be read in conjunction with the Educational Facilities Standards and Guidelines (EFSG) suite of information to aid in the planning, design and use of NSW Department of Education school facilities. This Guideline is not developed to be an indication of entitlement. It should therefore not be used as a benchmark by which current schools are assessed.

While the Guideline provides matters for consideration and minimum standards, the materials and building practices detailed are not exhaustive. These documents are not intended to limit designers, in consultation with relevant stakeholders, from exercising creativity in providing alternative solutions within the available project budget.

Any departures from this Guideline should be detailed and substantiated for concurrence from appropriate stakeholders so the principles of this guideline are fulfilled.

This Guideline is to be used in conjunction with site inspections to ensure the design and installation of equipment specified within the Cooler Classrooms Program causes minimal disruption both during installation and in the finished state and is an appropriate solution for the existing site conditions.

Scope

The scope of this Guideline is limited to air conditioned, naturally ventilated spaces.

This document sets out the methods to be used to create and maintain the thermal comfort and indoor air quality performance that are to be achieved. This document does not address the detailed design and specification that should be implemented to comply with the proposed criteria.

In learning spaces or libraries air conditioning will not be replaced unless it is beyond its operational life, outdoor air supply fans and controls will only be installed to spaces where new air conditioning systems are installed. In the future new air conditioning, outdoor air supply fans and controls will be progressively installed to spaces as the operational life of the existing air conditioning system is reached.

Although workshops are noted as learning spaces these spaces will not be air conditioned.

How to use this guide

The relevant guidelines requirements are split into the following sections:

2. Air Conditioning.
3. Outdoor Air Supply.
4. Control and Operation.
5. Solar PV.
6. Acoustics.
7. Associated Issues.

Designers are to understand and apply all current applicable Acts, Regulations, Codes, Standards and Guidelines.

2.0 Air Conditioning

Aim

To achieve appropriate thermal comfort levels in existing permanent learning spaces and libraries.

Performance Criteria

Indoor Design

Indoor design temperatures for determination of system capacities inside all air conditioned spaces are as follows:

- Summer 26°C DB
- Winter 19°C DB

Ambient Design

Ambient design temperatures for determination of system capacities are to be based on the Australian Institute of Refrigeration, Air Conditioning & Heating (AIRAH) guidelines for “comfort” conditions for the location concerned. Review the AIRAH conditions for suitability and increase or decrease where appropriate considering the location of the proposed project, Bureau of Meteorological data and school occupancy periods. Designs are to recognise that schools are:

- Not occupied for extended periods in December and January school holidays.
- Generally not occupied after 3pm on schools days.

Operating Tolerance

Select systems capable of operating without failure and under full load conditions in outdoor ambient temperatures of:

- 46°C in summer.
- -10°C in winter.

Capacity Criteria

Air conditioning system capacities are to be sized based on the following:

- For kitchen areas based on exhaust and other ventilation systems being off.
- Equipment load of 30w per occupant for portable computer.
- 6L/s per person of outdoor air.
- Inclusion of a 10% safety factor in the heat load calculation software.

System Selection

Air conditioning systems are to be:

- Selected to achieve the sensible heat load capacity. Total heat load capacity may in some instances therefore not be achieved or alternatively will be exceeded.
- Derated for specific ambient conditions, room conditions and pipework lengths.

  (Some contractors are ignoring this and manufacturers do not seem to be challenging these issues when selecting for contractors. Some selections are therefore undersized for the duty).

Refrigerant Concentrations

Air conditioning systems are to be designed to comply with the requirements of Australian Standard AS5149 with respect to refrigerant concentration limitations within the occupied spaces.

Occupancy

Learning space occupancies:

- Standard Classroom : 30 Pro-rata occupancy for smaller classrooms
- Library – Primary : 40
- Library – High : 50
- Laboratory : 30

Pro-Rata Occupancy & Room Size

Classrooms sizes vary significantly due to education policy of the day. Classrooms may also have been created in spaces that were not originally intended for use as classrooms. As a guideline when considering whether to pro-rata occupancies, note :

- An average size classroom is 60M^2, so for 30 students this represents 1 student per 2 M^2.
- Classrooms between 45M^2 and 80M^2 will typically all house a class of 30 students, so within this range there should be no need to pro-rata occupancies.
- Classroom occupancies should not be reduced from 30 based on furniture count or advice from school staff. Each classroom is to have the flexibility to house a full complement of students even if not setup this way.
- Where classrooms are under 45M^2, pro-rata occupancies based on area however for a designated classroom, not below 15 students.
- Where classrooms are over 80M^2, pro-rata of occupancies will depend on the space usage, ie Some larger classrooms :
  - Will still only be housing a single class.
  - Are an unusual and inefficient shape, however it should be apparent where they are still a single classroom environment in which case there should be no need to pro-rata occupancies.
  - Will obviously be setup to house additional students in which case occupancies should be pro-rated.

Application

Type

System: Air conditioning systems are to be selected to suite the specific application requirements and considering thermal zoning, usage patterns and concurrent heating and cooling scenarios and include:

- Reverse cycle split package systems.
- Reverse cycle variable refrigerant flow (VRF) systems.
- Heat recovery variable refrigerant flow (VRF) systems.

Indoor Unit Type: Fan coil units are to be applied in the following order of preference:

1. Under ceiling units
2. Wall mounted units
3. Ceiling cassette units
4. Concealed bulkhead units
5. Concealed ducted units

Preference

The use of exposed fan coil units 1 & 2 remains SINSW preference due to their cost effectiveness and simplicity of installation. The preferred “under ceiling” unit provides:

- In most cases a tidier overall outcome with fewer exposed services.
- In most cases quieter operation than wall mount units.
- A condensate pump providing potential for more flexibility and a tidier drainage reticulation.
- More even air distribution and less draughts than wall mount units.

Multiple Manufacturers

Base designs on solutions that are available from multiple manufacturers. Solutions based on features that are only available from a single manufacturer are not acceptable.

Heating & Cooling

Systems are to be capable of delivering heating and cooling concurrently in different learning spaces.

Installation

Placement

Equipment is to be arranged to provide good service access. Placement of equipment is to consider the school operational requirements and should have minimal impact on the day to day function of the school. In determining locations for equipment:

- Wherever possible locate condensing units at ground level on plinths or proprietary support structures.
- Do not locate condensing units:
  - In high traffic areas, sporting areas, special use areas, gardens, paths, below overhead structures etc.
  - Anywhere offering a climbing opportunity.
  - On a roof unless there are no ground level opportunities.
  - On a wall unless it is certified structurally adequate and/or uses secondary support either by propping from the ground or hangers from eaves above.

Protection

Provide secure enclosures around all condensing units located on ground or where wall mounted less than 2m above ground to the lower edge of the support.

Individual Units: For individual condensing units provide heavy duty fully welded RHS or RSA metal framed enclosures incorporating heavy duty mesh with maximum 50mm openings and bolted to the supporting surfaces. Enclosures are to provide 250mm minimum clearance on all sides and additional clearances as necessary to facilitate maintenance access. Enclosures are to be hot dipped galvanized after fabrication.

Provide access via tool lockable access doors/panels. Position doors/panels to enable full service access without the removal of the enclosure.

Groups of Units: For groups of condensing units provide an enclosure of black powder coated security fencing on a concrete slab of the full size of the enclosure. Size the enclosure to enable sufficient clearances for servicing of the equipment from within the enclosure.

Fencing to be minimum 1800 high constructed of fully welded galvanised steel, minimum 25 x 25mm square tube vertical fence pickets flat tops, spaced at a maximum 125mm spacing and supported by a minimum of two 40 x 40mm square tube cross rails. Incorporate a tool lockable access door.

Temperature Control

Temperature control is to be automatic via the AC manufacturers integrated air conditioning system controls to manage cooling and heating operation and maintain room temperature.

Accurate Sensing: Temperature sensing must consider the proximity of outdoor air delivery to fan coil units. Where fan coil units are remotely installed, or influenced by the proximity of the outdoor air supply, temperature sensors located in the fan coil units are not acceptable as they will read the mixed air condition and drive the system incorrectly.

Remote Sensing: In these situations, provide remote temperature sensors for the fan coil units located in the occupied zone to ensure that the actual room condition is read correctly.

AC Brand Sensors: Note that these are AC manufacturer's temperature sensors and have no interface to or interaction with the programmable controller. In most cases there will need to be a sensor for each fan coil unit as only limited models from some manufacturers can provide a single sensor to control multiple fan coil units.

Reticulation of Services

Reticulation: Pipework, conduit and drain routes are to be clearly defined to give clear direction to contractors. Concept lines joining fan coil units and condensing units with no indication of how they specifically reticulate through the building are not acceptable.

Condensate Drainage: Drainage provisions are to be specifically defined. Solutions should be assessed while on site and the specific route and discharge requirement clearly specified. Condensing unit drainage should also be provided to ensure condensate does not drain across trafficable areas during system heating operation.

Arrange reticulation paths parallel to building lines and structures, optimised to minimise visual impact and consolidate as many services pathways as possible. Where exposed to view in utility type areas, utilise cable tray to provide a neat appearance.

Concealment: Generally, reticulated services; pipework, conduits etc. are to be concealed from view, where possible within existing building elements. Where visible in occupied areas internally or externally, cover all services:

- External Services: Provide proprietary protective and decorative ducting, Colorbond or galvanised steel to house all pipework and conduits and the like. Match Colorbond colours or paint steel to match the associated surfaces.
- Internal Services: Provide proprietary extruded aluminium ducting with clip on aluminium covers. For small runs of control cabling, rectangular plastic ducting with removable covers is acceptable.

Existing Systems

Air Conditioners: Existing air conditioning systems, excluding window/wall mounted RAC units, will be retained unless they are deemed to be beyond their operational life.

Where existing air conditioning units are to be replaced and the system includes significant existing infrastructure, the system concept may be suitable to retain where effective and the in good condition. Typically, this will apply to larger ducted systems where replacing the AC unit and retaining the remainder of the system would be more cost effective and/or provide a better performing outcome, than demolishing the system and providing an exposed system concept preferred above.

Evaporative Coolers: Where evaporative coolers serve areas that are to be air conditioned, they are to be demolished. Where an evaporative cooler also serves other non learning areas that make up a significant proportion of the units capacity, recommission the cooler to continue delivery to those areas by reducing its duty. Where the other non learning areas are a small proportion of the evaporative coolers capacity, demolish the cooler and provide air conditioning to those areas so that they are not worse off. In these instances

Where existing evaporative coolers serve kitchen spaces, they may be suitable to retain (where in good condition) as a means of providing tempered makeup air to the spaces during exhaust system operation.

Demand Control

Demand Response Enabling Devices (DRED) are to be included to all air conditioning systems either as standard inclusions or by means of adapter cards. DRED functionality will not be implemented as part of the CCP unless specifically identified as a requirement.

Demolition

Remove any service, fitting, or equipment item that becomes redundant as a result of the work.

Decommission, disconnect, and remove from site, without damage or impairment of any remaining systems or equipment. Remove all associated services materials, pipework, electrical cabling, support structures etc. Make safe and label all redundant service point terminations where these are approved by the Superintendent to remain. Make good remaining surfaces including but not limited to:

- Where equipment was mounted on a plinth, demolish the plinth, and make good the surface with new slab and topping or to match the surrounding surface.
- Where ductwork, pipework, electrical wiring or conduits are removed from building elements :
  - Make good the penetrations to match the existing surface including brickwork, carpentry, plastering, repainting etc.
  - Reinstate the operation of window sashes and replace window sashes where needed to achieve the functionality.
  - Decant and dispose of refrigerant in line with EPA regulations and industry guidelines
- Repaint areas where demolition exposes unpainted surfaces.

Implementation

The following examples show various outcomes.

Equipment Cages

Aluminium

Well made cage with removable panels. Note :

- Cut brick sills to accommodate trunking.
- Saw cut pathway to facilitate condensate drainage to nearby garden bed.

Galvanised Steel

Cage by “Cage Enterprises” with lockable removable panels.

3.0 Outdoor Air Supply

Aim

To assist in providing appropriate indoor air quality in air conditioned spaces. Outdoor air will be controlled to maintain an operational range of 800-1200ppm CO_2 and such that the average daily CO_2 concentration does not exceed 1,500ppm for more than 20 consecutive minutes in each day.

Performance Criteria

Outdoor air is to be provided to all newly air conditioned spaces via mechanical ventilation systems irrespective of natural ventilation provisions to an area. The system is to satisfy the following criteria:

- Designed to achieve 6L/S per person.
- Balanced via a manual variable speed controller
- Based on 30 students in a typical classroom and prorated for smaller or larger spaces.

Application

Scope

Outdoor air systems will only be fitted to learning spaces and libraries where new air conditioning systems are installed under the CCP program. Outdoor air systems will not be fitted to learning spaces where existing air conditioning systems are being retained.

Type

Provide outdoor air systems to suite the specific application and facilitated by:

- Non ducted solutions utilising single piece wall/window mounted fans generally for classroom type learning spaces.
- Window/wall mounted fans or ducted mechanical supply ventilation systems for larger spaces such as Libraries or where specific site limitations make use of the window/wall fans impractical in classroom spaces.

Bushfire Risk

Using the NSW Rural Fire Service bushfire prone land online mapping tool, determine whether the property is designated as bushfire prone. Where designated as bushfire prone, incorporate bushfire screens to ventilation openings to the requirements of AS3959. Installation must ensure that no embers can bypass the screens. Incorporate access for cleaning of the bushfire mesh screens including access for removal if required.

For window or wall mounted fans, provide an external fabricated mesh screen enclosure to encase the fan.

Window/Wall Fans

The window or wall mounted fans are to be Vortice manufacture, Vario models 230/9 AR and 300/12 AR with electric shutoff dampers from Allvent or equal. Note that air filters are not required for window/wall mounted fans. The fans are to include:

- All necessary options to enable window, wall or ceiling mounting.
- Vortice speed controller model C2.5 to operate up to two fans within the same learning space.

The nominated speed controller can control multiple fans. It is provided for commissioning purposes only and is to be installed out of site in a location that is inaccessible to students and staff, most commonly within the MCP located at high level in each classroom.

Select fans in accordance with the following table. The air quantities represent the maximums available from the number of fans serving a space and compensates approximately for the increased acoustic impact resulting from multiple fans operating within a space.

Total Achievable Outdoor Air Quantities				
Fan Size	Number of Fans Serving the Space			
	1	2 ✳	3 ✳✳	4 ✳✳
230/9	110L/s	180L/s (90L/s each)	255L/s (85L/s each)	340L/s (85L/s each)
300/12	200L/s	320L/s (160L/s each)	480L/s (160L/s each)	640L/s (160L/s each)
Notes				
✳	Two 230/9 fans or two 300/12 fans are preferred for the standard learning space requirement of 180L/s as they result in the lowest noise level. A single fan should only be used where it is not possible to accommodate the two fans and subject to the Project Managers approval.			
✳✳	More than two fans may be acceptable in some situations however a ducted system may still be a more appropriate solution aesthetically and acoustically. Discuss options regarding application of the fans and obtain input and approval from the Project Manager, the design consultant and an acoustic consultant.			

INSTALLATION

Direction : The fans are to be mounted in reverse such that their operation in exhaust mode will supply air into the room.

Location : The fans can be mounted:

- Through walls.
- In glazed window panels subject to consideration of the following:
  - Natural Ventilation : Each room must retain the ability to be naturally ventilated for periods when the air conditioning & outdoor air fans are not operating. Where window operation would be compromised by the installation of fans, assess the available openable area against current NCC requirements to determine whether window installation is viable. Where the total available window openings do not satisfy NCC requirements, wall mount the fans. Where wall mounting is not possible, seek direction from the Project Manager.
  - Bushfire : Where the school is designated as bushfire prone, window mounting may not viable due to the need to provide mesh covers over the fans, unless the mesh covers can be mounted onto a solid panel replacing the glass.
  - Glass Type : Where windows are laminated, window mounting may not viable as the glass cannot be cut in situ. It must therefore be feasible and cost effective to remove the window element for offsite cutting.
  - Blinds and Curtains : Effective rearrangement and provision of new blinds and curtains may not be practical in some cases considering the need for effective light block out.

Where possible, locate the fans:

- As high as possible to minimise draughts.
- Distributed along the same facade at approximately quarter points however maintain a minimum 5m separation between fans where possible.
- Arranged to avoid air discharge directly towards, or in the vicinity of the fan coil units.
- With the indoor cover inverted to provide an upwards discharge. (The fan label will be upside down).

For single storey buildings with reasonable roof space, window/wall fans can also be installed through the ceiling with a short flex duct connection to an eaves grille. This approach simplifies builders work associated with wall penetrations and retains full window function.

Alternatives: Where alternatives to the Vortice fans are proposed, they must achieve the same or better operational and acoustic performance. Alternatives are to be acoustically tested to validate the acoustic performance is equal or better than the Vortice fan. The contractor must provide acoustic test results from an acoustic consultant to demonstrate actual acoustic performance as part of any submission for consideration of an alternative fan. The fan must be tested at multiple airflows and separately for each size proposed.

In Line Fans

In line fans provided as part of ducted solutions are to be:

- Suitable for reduced speed operation via a speed controller without producing motor humming noise and may therefore require EC motors. EC motor fans can be commissioned via a spare analogue output from the programmable controller.
- Selected for the duty and to satisfy this guidelines acoustic criteria.

Supply Source

Outdoor air is to be sourced from locations that will maximise the quality of the air. Selected locations should consider and compensate for:

- Proximity of vent pipes and exhaust discharges. Separation of intake and exhaust points should exceed statutory minimums considering the extent of contaminant and odour.
- Increased summer temperatures on metal roofs, western walls, etc.

Wherever possible, outdoor air should be sourced from wall mounted intake louvres, eaves mounted grilles etc. Roof mounted intakes are not preferred due to water leakage risk and increased roof temperatures.

Commissioning

Commissioning of the outdoor air supply is to be undertaken by a specialist commissioning contractor to:

- Commission the required air quantities with a proprietary air balancing flow hood system within the tolerance of +5% and -0%.
- Submit test data as well as details of, and current calibration certificates for the flow hood system.

Air Relief

Ensure adequate relief air provisions considering that classroom doors and windows will be closed during normal OA operation. The reduced design quantity and leakage allowances through doors and windows may be sufficient. However where the inherent leakage is deemed inadequate, most likely in more recent and Section J compliant buildings, additional provisions may need to be made. It is not expected that complex motorised solutions will be provided, possibly a door grille or ceiling grille into a roof void.

4.0 Control and Operation

Aim

The aim of the proposed control and operation is to facilitate:

- Operation of the air conditioning and mechanical ventilation systems to deliver appropriate thermal environment and indoor air quality.
- Convenient use and automation requiring minimal intervention of school staff.
- Optimisation of energy usage.
- Monitoring of room and ambient air properties to assist in :
  - Operation of the air conditioning and mechanical ventilation systems.
  - Providing visual feedback to students regarding air quality and energy usage.

Application

Systems

Control and operation of the air conditioning and ventilation in each learning space and library will be provided via:

- The inbuilt air conditioning unit controls to control temperature.
- A programmable controller for each learning space to manage the starting, stopping and status indication of the systems, implementing the operating function outlined below.

CO_2 measurement will be used to determine operation of the outdoor air fan. Room temperature measurement will be used to limit the operation of the outdoor air fan during higher indoor conditions. Enthalpy measurement will be used to determine favourable ambient conditions.

Controls will only be fitted to learning spaces and libraries where new air conditioning systems are installed under the CCP. Controls will not be fitted to learning spaces where existing air conditioning systems are being retained.

Control Panels

House control equipment within Mechanical Control Panels (MCP). MCPs are to be tool lockable and labelled with the source of supply. Provide MCPs to serve either:

- A group of rooms, with panels located remotely in a service space, store room, dedicated cupboard or the like.
- A single room, with panels located within each room, preferably at high level.

  This is the preferred solution as it results in the least amount of exposed services reticulation and negates the need for OA fan an fan coil unit local electrical isolation.

Location

CO_2 & Temperature: Locate sensors:

- In each learning space and library, adjacent to the student seating area.
- As a result of vandalism to the first tranche of schools, mounted at a height of 1500mm, protected with a welded perforated stainless steel sheet cover.

Outdoor Conditions: Locate sensors:

- Outside each building containing learning spaces and libraries.
- Mounted at high level, where there will be no direct sunlight or radiant effect from adjacent fabric.

User Interface Panel: Locate panel:

- Generally adjacent to room entries and to the new ceiling fan controller.
- Mounted at a height of 1500mm.

User Interface

Provide user access for operation of the systems via a Local Control Point incorporating:

- Pushbutton.
- Green, Blue and Yellow mode indication lights.

Mount lights and pushbutton on a brushed stainless steel fascia plate (detailed below), flush mounted in wall elements. Where flush mounting is not achievable, surface mount using a stainless steel mounting block.

Engrave the panel as follows:

- Panel Title : "Air Conditioning & Ventilation"
- Pushbutton : "Push to Start or Stop AC"
- Blue Light : "Air conditioning operating"
- Green Light : "Outdoor conditions favourable. Open windows instead of AC"
- Yellow Light : "CO2 Levels High. Open windows or turn on AC"

Remote Controllers

Utilise wired remote controllers for all air conditioning systems. Users of the learning spaces and libraries are not to have access to proprietary air conditioner remote controllers. Controllers are to be located :

- Within MCPs where they are located inside the learning space.
- Where MCPs are centralised outside the space served, locate remote controllers adjacent to the fan coil unit at high level, concealed in a plastic enclosure with non-transparent screw fixed cover.

Operating Function

Operation

Start the air conditioning system when the Start or Stop AC pushbutton is pressed. Once operating via the pushbutton, stop the system:

- On expiry of an adjustable run on timer function (initially set to 2 hours), or
- When the pushbutton is pressed again within the run on time above.

Where multiple units serve a space, start all units within that space and operate the units in parallel.

Settings

Set the air conditioning system controls for:

- Automatic heat/cool changeover.
- Automatic fan speed.
- No swing. (adjust air distribution manually to minimise draughts).

  (Where multiple fan coil units are used, arrange the rear vertical air flow direction blades to direct the air flow away from the other units).

Temperature Control

Automatic via the AC manufacturers integrated air conditioning system controls to manage cooling and heating operation and maintain room temperature.

- Room operating temperature range of :
  - Cooling : 24°C and 25.5°C;
  - Heating : 19.5°C and 21°C.

(It is important that this is implemented correctly for each system as this is not the default operating range for most fan coil units and will require specific configuration and some discussion with the manufacturer).

Outdoor Air

Start the outdoor air fan :

- When the air conditioning system is operating and the CO_2 concentration exceeds 1200ppm for 10 minutes;
- At 4pm if the CO_2 concentration is above 450ppm;

Stop the fan :

- When the air conditioning system is operating and :
  - the CO_2 concentration drops below 800ppm for 10 minutes.
  - The room temperature exceeds 28°C for 10 minutes. Restart the fan when the temperature is below 27°C for 10 minutes.
  - The room temperature drops below 18°C for 10 minutes. Restart the fan when the temperature exceeds 19.5°C for 10 minutes.
- When the CO_2 concentration drops below 450ppm for 20 minutes or after 8pm.

Where multiple fans are used, operate the fans in parallel.

Indication

A/C Operation: Illuminate the blue mode indication light whenever the air conditioning system is operating. Turn off the light whenever the air conditioning system is not operating.

Outdoor Conditions: Illuminate the green mode indication light whenever the outdoor air temperature and humidity is within the following range (adjustable) 18°C – 24°C and below 70% RH. Turn off the light whenever conditions are outside this range.

CO_2 Concentration: Illuminate the yellow mode indication light whenever the CO_2 concentration exceeds 1500ppm for 10 minutes. Turn the light off whenever the concentration drops below 1400ppm for 10 minutes.

Fault Condition : Illuminate the yellow light as follows to indicate potential device fault. :

- If the fan is stopped at 8pm on 3 consecutive days, indicating that CO_2 concentration has not successfully dropped below 450ppm, flash the yellow mode indication light once every 30seconds until the CO_2 concentration again drops below 450ppm.
- If the sensor provides a full signal or no signal (0V or 10V for 0-10v range) for 48 hours, flash the yellow mode indication light once every 15seconds until intermediate values are again recorded.

System Shutdown

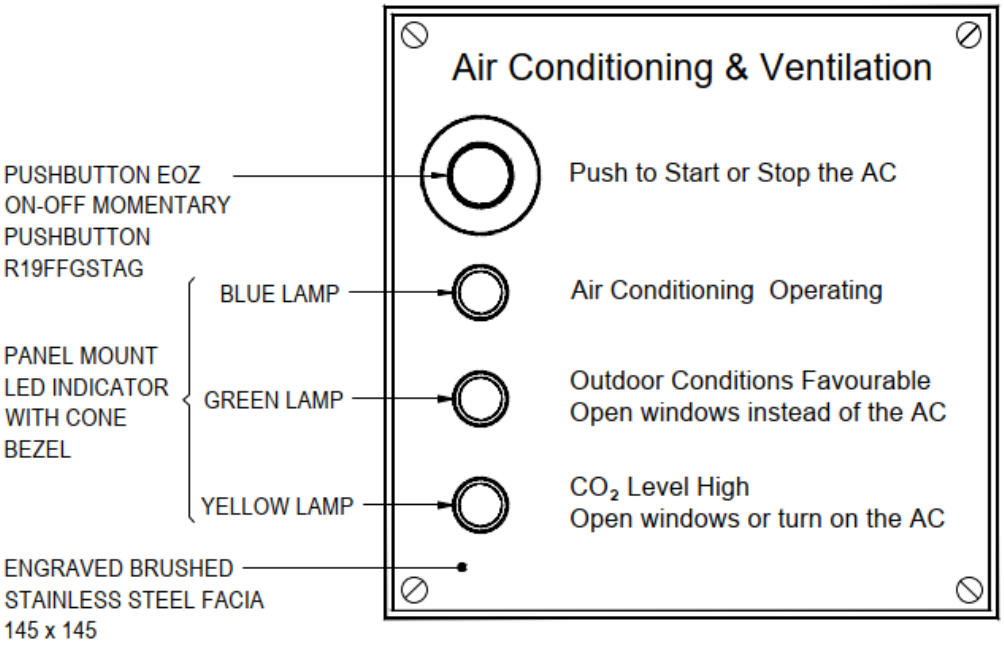
Provide automatic shutdown of all new ducted outdoor air supply systems and ducted fan coil units, in accordance with NSW Table E2.2b of the BCA.

Stop the system(s) on activation of any installed fire detection and alarm system or sprinkler system. Where not already provided, provide one or more space detectors as required by BCA Specification E2.2a and complying with AS1670.1. Restart the system(s) on clearance of the smoke or fire trip reset.

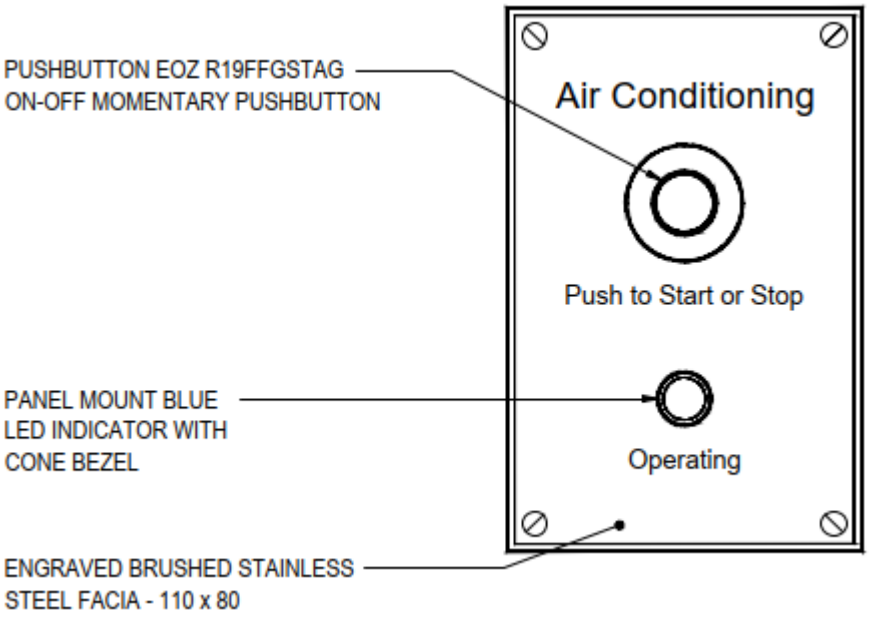
Where smoke detectors are provided for shutdown only, do not activate a fire alarm.

User Interface Panel Layout

For rooms with AC, CO_2 and enthalpy indication:

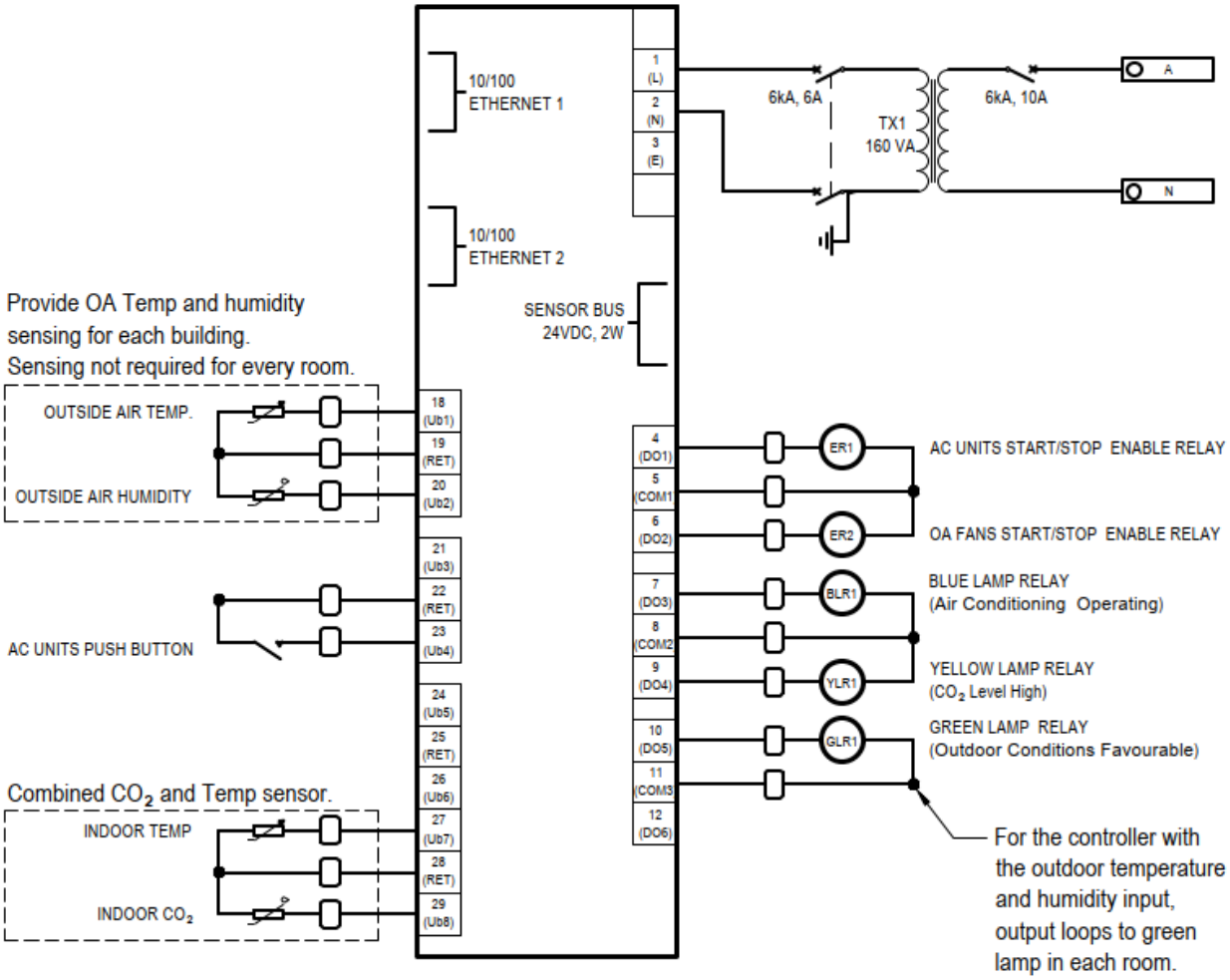


For smaller rooms with AC only:



System Control Schematic

Diagram is based on a Schneider MP-C-15A. Other controllers will also be suitable to provide the required functionality. Controller type to be adjusted to suit the number of AC systems and outdoor air fans.

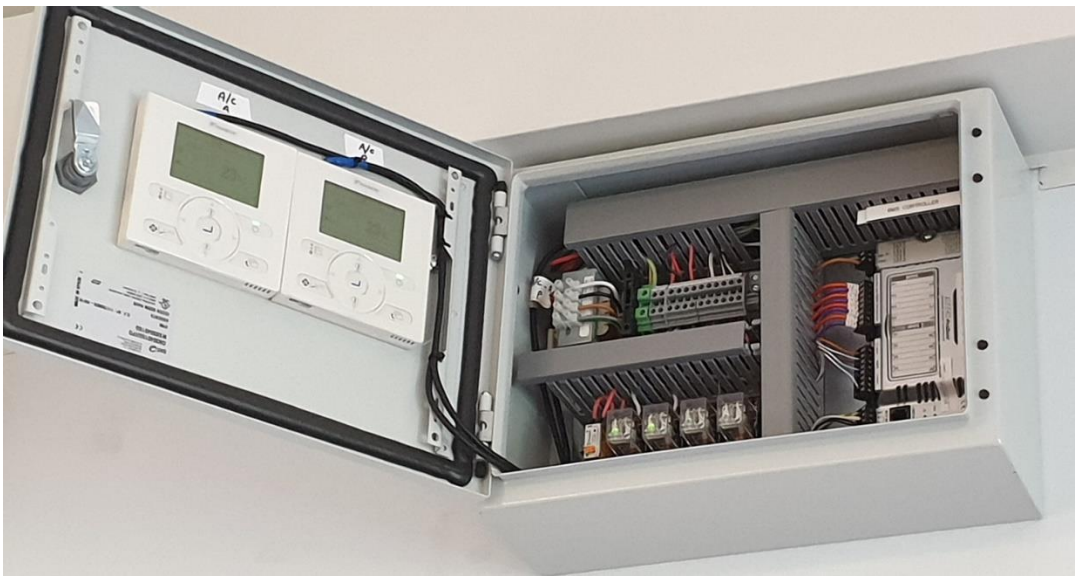


Implementation

The following examples show various installation outcomes.

Mechanical Control Panels

All equipment located in a proprietary panel, Elsteel WM4-420 located at high level in the classroom.



Local Control Point

Preferred

LCP using preferred button and lights as specified in the detail above. Note the text is not well placed due to the location of the screw fixings.

Not Preferred

LCP using non preferred button and lights. Clumsy appearance and stick on labels

MCP, LCP & Sensor Combination

The combination of these items is not preferred. CO2 sensor should be in the student seating area, MCP at high level and LCP close to the entry door.

5.0 Solar PV and Batteries

Aim

To provide PV sized such that the total energy consumption of the new AC systems is offset by the total energy generated by the PV, irrespective of whether the school can make use of the power generated at any particular time.

The approach acknowledges that a significant portion of the power generated by the PV will not be utilised by the school, rather fed back to the grid.

Application

Installation

Generally installation of the PV will occur during or following the installation of the air conditioning.

Capacity

Utilise the CCP PV Capacity spreadsheet provided to calculate and confirm required capacities to the Project Manager prior to completion of tender documents.

Where the calculation determines a required capacity of less than 5kw and there is no PV currently installed at the school, nominate a minimum 5Kw system be provided.

The PV contractor will design the systems and will assess the extent of available and suitable roof area for accommodation of the PV and as a result, may reduce the capacity of the system determined under the CCP.

6.0 Acoustics

Aim

To ensure appropriate measures are taken to maintain noise levels within learning spaces as close as possible to the Recommended Internal Noise Level.

Requirement

Air conditioning & mechanical ventilation systems shall be designed in accordance with the recommended internal noise levels noted in table noting recommended internal noise level criteria below:

Area	**Recommended Internal Noise Level, dBLA$_{eq}$**
Arts and Craft Studios	45
Computer Room Teaching	45
Laboratories Teaching	40
Libraries – General	45
Libraries – Reading Areas	45
Open Plan Teaching Areas	40
Study Rooms	45
Teaching Spaces - Hearing Impaired	30
Teaching Spaces - Primary and Secondary Schools	40

Acoustic Assessment

Provide acoustic assessment to ensure these criteria are achieved. Consider equipment sound power levels, the anticipated room acoustic conditions and where relevant, specify enclosures, duct treatment and diffuser / grille acoustic requirements. In general:

- All plant and equipment is to be vibration isolated to prevent the transmission of structure borne noise and vibration.
- All plant and equipment is to be selected and designed to comply with any necessary consent authority noise codes.
- The noise criteria within this guideline is to be met inclusive of noise contribution of any externally located equipment such as condensers.
- Noise to the classrooms is to exclude adverse characteristics such as low frequency or tonal components.
- Noise levels shall be measured over a sufficient duration to capture all operational noise characteristics and temporal variation of the noise associated with the equipment.

Boundary Noise: Noise nuisance caused by proximity of condensing units to neighbouring property boundaries should be considered. Where a potential nuisance exists, raise the issue with the Project Manager for guidance.

Compliance

1. Concealed FCU & Outside Air Fans

Noise levels due to the simultaneous operation of outside air fans, any external plant and equipment such as the condensers and any concealed air conditioning units shall not exceed the recommended acoustic criteria.

These noise levels shall be met when the equipment is operating at the required duty, and measured at 2m from any casing, ducting, air inlets and outlets, or at any possible seating position, whichever is closer.

Adverse Noise Characteristics: In addition to achieving the recommended acoustic criteria, the equipment shall be selected and designed to prevent adverse noise characteristics such as low frequency, tonal or narrow band signals. Where such components are expected to be generated by the equipment, design allowance is to be made for these components.

Corrections for an adverse characteristic shall be made in accordance with AS 2107-2016 Acoustics – Recommended design sound levels and reverberation times for building interiors Appendix D. The equipment shall satisfy the recommended acoustic criteria inclusive of any necessary corrections set out with AS 2107-2016 appendix D.

2. Exposed FCU & Outside Air Fans

The combined noise levels due to the operation of outside air fans and external plant and equipment such as the condenser shall not exceed the recommended acoustic criteria.

These noise levels shall be met when the fans are operating at the required duty, and measured at 2m from any casing, ducting, air outlets, or at any possible seating position, whichever is closer.

It is acknowledged that exposed fan coil units may not be able to satisfy the recommended acoustic criteria. However care must be taken to select with low noise output and with sufficient capacity that the required duty for the room can be met when the unit is operating on medium speed. For a classroom:

- Two fan coil units are preferred, even though three or four may provide a better acoustic outcome.
- One fan coil unit should not be used as these are generally noisier than two.

Fan Coil Unit Selection : Noise levels from an exposed fan coil unit shall not exceed 39 dBA, when measured on high speed, in an anechoic chamber and at a distance of 1m horizontally and 1m below the fan coil unit, in accordance with Japanese Industrial Standards.

Adverse Noise Characteristics: In addition to achieving the recommended acoustic criteria, the equipment shall be selected and designed to prevent adverse noise characteristics such as tonal or narrow band signals. Where such components are expected to be generated by the equipment:

- The exposed fan coil unit shall be reselected such that there is no adverse noise characteristic.
- The OA fan shall be selected and / or designed such that there is no adverse noise characteristic.

The presence of an adverse noise characteristic shall be determined as per AS 2107-2016 Acoustics – Recommended design sound levels and reverberation times for building interiors Appendix D.

The combined noise level due to the outside air fan and any external plant shall satisfy the recommended acoustic criteria inclusive of any necessary corrections set out with AS 2107-2016 appendix D.

7.0 Associated Issues

Heaters

Existing unflued gas heaters are to be removed from all spaces within the scope with the following exceptions

Ceiling and Wall Fans

Where currently installed, ceiling fans shall be retained. Where not installed and it is feasible and practical to do so, ceiling or wall fans shall be installed in existing learning spaces and libraries.

Ceiling Fans

Provide ceiling fans where the top of the blades are no lower than 2400. Provide low noise white ceiling fans including adjustable/step speed controllers and 16 pole motors made with high grade copper windings and silicone steel stators with sealed bearings. Provide a wired remote controller to control multiple fans, adjacent to the room entry incorporating:

- On/off /3 speed operation switch.
- Reversing switch for heating mode operation.
- 3 hour run on timer.
- Use “reduced maximum speed” controllers where fan blades are less than 3.0 m above floor.

Install ceiling fans positioned to suit building features with respect to luminaires to avoid reflections and stroboscopic effects. Provide fans with a minimum 1400 blade sweep. Position underside of blades mounted no less than 2400AFL and no higher than 2700AFL. Mount at least 300mm below the ceiling. For high and angled ceilings provide extension rods and pitched ceiling kits.

Wall Fans

Where ceiling fans cannot be used, provide low noise oscillating wall fans including manual tilt adjustment, adjustable/step speed controllers and DC motors. Provide fans with a minimum 400mm blade diameter. Install wall fans by rigidly fixing into backing framing. Include a standard 3 pin flat pin plug/socket connection to enable replacement and servicing. Provide a wired remote controller with a remote On/off /3 speed switch located adjacent to the room entry.

Blinds & Curtains

Where installation of outdoor air fans affects the use of existing blinds and curtains, modify the blinds and or curtains and provide new supplementary blinds and curtains to provide the same level of light block out.

FM and Maintenance Strategy Direction

All plant and equipment installed will be integrated into the SINSW FM maintenance contract. Due diligence data collection created during the program will be shared with SI FM and Asset Departments to ensure the records of the equipment is up to date.

Maintenance of plant and equipment following the defects liability period is not part of this scope of works.

Electrical Infrastructure Upgrades

The installation of additional and upgraded air conditioning will in some cases require the electrical infrastructure to be upgraded outside school bounds.

Refer to “Appendix A: 5. Classroom Comfort Program L3 ASP Design Brief” for requirements.

Equipment Selection

System design and equipment selection is to be based on:

- Value for money.
- Fitness for purpose.
- Reliability.
- Minimal running cost.
- Minimal maintenance.
- Minimal maintenance cost.
- Appropriate equipment in NSW remote areas.
- The total initial capital cost of the system including design, project management, and builder and building services works in connections etc.
- Resources (energy and where applicable water) consumption.
- The replacement of component parts.
- Warranty.
- Disposal costs.

Specifically air conditioning equipment should:

- Support sustainable design principles including reducing energy consumption; and
- Be easily accessible and serviceable and easy to maintain with minimal impact on school operations when maintenance is being performed.

Selected equipment must be at least the market average star rating. In categories where no star ratings are available, equipment purchased should be recognised as high efficiency either by being ENERGY STAR® accredited, in a high efficiency band under Australian Standards or being above-average efficiency of Greenhouse and Energy Minimum Standards (GEMS) registered products.

As Built Documentation and Sign Off

Drawings:

- Set of AutoCAD drawings in hard copy.
- Electronic copy of AutoCAD drawings: USB or emailed.

Manuals:

- Complete set of all manuals in hard copy.
- All relevant warranty, maintenance, specification, data information etc. applicable to the goods/services/materials used in the project.
- Electronic copy of drawings: USB or emailed.
- Operations manuals.
- Maintenance manuals.

Specifications:

- Equipment specifications.
- Purchase sources of all products used.

Sign Off:

- Record of sign off from the Project Manager.
- Record of sign off meeting with school & AMU.
- Record of any uncompleted works and associated completion programme.
- Record of all defect works and associated completion programme.

Learning Space and Libraries Determination

Background

The Scope Summary Report (SSR) provided by the Project Manager confirms areas to be provided with air conditioning. The project scope is to be based on this report.

In some cases where the SSR has been created based on an older site audit, some inconsistencies may occur as a result of subsequent changes at the school.

In addition, the Asset Management System (AMS) plans provided by the Project Manager include room numbers that do not align with the Cooler Classroom program number of a learning space as many of the Cooler Classroom learning spaces are made up of several AMS open rooms connected together. Further, some schools list the purpose of a room differently to the AMS records.

Requirement

During the consultants site visit, the SSR scope and room usage is to be validated for accuracy and any anomalies raised for clarification with the Project Manager. The explanations below confirm the criteria used in determining the areas to be air conditioned and will assist in such an assessment.

Determination

Existing permanent learning spaces and libraries to be included within the program are as follows:

PRIMARY SCHOOLS

- Home Base: Home Base (HB) and associated Practical Activity Areas (PAA). These spaces are usually one open space for the purpose of the program although they are shown in the AMS as two rooms they are not separated by walls and therefore considered one space for the purpose of the program.

  If a PAA is separated by walls then it will be considered a separate space. In these instances the spaces may require separate A/C.

- Libraries: Libraries and associated areas are considered a learning space and where these reading/study/seminar rooms are used by students and are immediately accessed from the library space then they are considered learning spaces for the purpose of the program. Where these rooms are :
  - Larger than 17M^2, provide separate air conditioning and outdoor air supply, however no additional monitoring controls. Provide a single stop/start pushbutton with 2 hour run on timer, blue indication light and interlock AC operation with the outdoor air fan.
  - Smaller than 17M^2, no air conditioning, outdoor air or controls will be provided.

  Library offices or storerooms will not be air conditioned.
- Withdrawal Rooms: Generally these rooms are small and are connected to one or more Home Base classrooms. As these rooms are small and adjacent to the home base classrooms it was agreed these rooms would therefore not need a separate A/C and fresh air system and would share a suitably sized A/C and fresh air systems with the adjacent home base connected by vents/louvres through a door, wall or ceiling duct or by opening the common door. Although they are considered a learning space they would be cooled by an adjacent A/C & fresh air system. Some withdrawal spaces are larger "shared" withdrawal and separate to existing Home Base. In these instances the spaces may require separate A/C and fresh air system. Where a withdrawal room is a separate room away from a connected HB and it is larger than 17m2 then it will be air conditioned.
- For the above library reading rooms & HB withdrawal rooms, generally larger than 17m2 fitted with A/C and fresh air system, the controls should be limited to a single pushbutton and blue light for AC operation, do not provide any other controls.

SECONDARY SCHOOLS

- General Learning Spaces (GLS)
- Libraries: Libraries and associated areas are considered a learning space and where these reading/study/seminar rooms are used by students and are immediately accessed from the library space then they are considered learning spaces for the purpose of the program. Where these rooms are :
  - Larger than 17M^2, provide separate air conditioning and outdoor air supply, however no additional monitoring controls. Provide a single stop/start pushbutton with 2 hour run on timer, blue indication light and interlock AC operation with the outdoor air fan.
  - Smaller than 17M^2, no air conditioning, outdoor air or controls will be provided.

  Library offices or storerooms will not be air conditioned.
- Practical rooms including specialist learning spaces and workshops:
  - Laboratories.
  - Kitchens and hospitality spaces used by students for learning (including enclosed hospitality spaces used for serving/bistro learning activities).
  - Performance and Fitness workshops (but not gyms).

EXCLUSIONS AND DESIGN METHODOLOGY

No other areas are considered as a learning space for the purpose of the Cooler Classrooms program.

If learning spaces share an existing A/C system with a non-learning space the existing shared system should be modified to continue servicing the non-learning space when the new A/C system is installed for the learning space. If this principle cannot be satisfied due to the existing system being beyond its serviceable life or physically difficult then the new A/C system should service both areas so there is no loss of existing conditions. Rooms not to be AC as part of the Cooler Classrooms programme include:

- Preparation rooms (Food and science).
- Library workrooms that are separated by walls from the main library.
- Storerooms.
- Any eligible room less than 15m2 adjacent to an air conditioned space.
- Any room with open or meshed walls.

- Rooms fitted with an external roller door.
- Workshops.
- Hot metal area that is separated from a workshop.
- None enclosed work space.
- Tin sheds.
- Craft room (if not a learning space or PAA).
- Seminar rooms (which are not part of a library).
- Study spaces.
- Darkrooms.
- Any space not used for learning by students.