GABRIELS HEARNE FARRELL

BUILDING ENVELOPE REPORT

SUNNINGDALE PRIMARY SCHOOL

22nd May 2019

For

EIW ARCHITECTS

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1. INTRODUCTION

This report considers a wide range of acoustic and building envelope issues to be addressed during the design and documentation of the proposed Sunningdale Primary School. It is based on the Schematic Design drawings issued May 4, 2019.

The report addresses the design requirements as set out in "Part 5.14 - Acoustics & Building Envelope" of the Department of Education Primary Schools Brief.

In accordance with 5.14 of the PS Brief, the range of issues considered includes:

- Site factors (including Environmental Acoustics)
- Natural Ventilation
- Daylight
- Energy Efficiency of Building Envelopes
- Acoustics

2. SITE FACTORS (ENVIRONMENTAL ACOUSTICS)

Noise emission from one premises to another is governed by the Environmental Protection (Noise) Regulations, 1997. However, most activity noise emissions from schools are considered to be *Community Noise* and are technically exempt from compliance with the regulatory Assigned Noise Levels, as discussed below:

According to Regulation 16 and Schedule 2 (Item 4), the "exempt noise" applies to:

> *"Noise emitted from a recreational or educational activity on educational premises under the control of the principal. The activity may include musical instruments, but not mechanical equipment"*

It is our opinion that the proposed Sunningdale Primary School has been appropriately planned, in relation to minimising environmental noise.

A summary of noise sources requiring consideration is set out below:

2.1 Dedicated Kindergarten / Pre-Primary Outdoor Play Areas

Although technically exempt from complying with the Environmental Protection (Noise) Regulations 1997, complaints from kindergarten and pre-primary outdoor play areas do occur. In these cases, the CEO of the local government can enforce compliance with the noise regulations even if technically outdoor play areas are exempt.

In relation to this project the risk of noise complaint from the kindergarten / pre-primary play areas is minimal given that Teaching Block 1 has been oriented appropriately, whereby the building itself is acting as a significant acoustic barrier between the play areas and the nearest residences.

2.2 Covered Assembly / Music Block

The orientation of the Covered Assembly block is ideal, in that the covered assembly area is not facing directly towards the nearby residences.

2.3 Mechanical Equipment

The noise emissions from the air-conditioning condensers, evaporative coolers, and various roof exhaust fans will need to fully comply with the Environmental Protection (Noise) Regulations 1997. An assessment of the potential environmental noise emissions will be undertaken during the Design Development stage once preliminary equipment selections have been made by the mechanical consultant.

2.4 Fire Pumps

Fire pumps and tanks are proposed on the western side of the site, approximately 45 metres away from residences. Given that the fire pumps need only operate for 20 minutes duration for testing purposes, the noise transmission to the residences must not exceed L_1 55 dB(A). This is on the basis that the testing will

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only occur during daytime hours. Our preliminary assessment suggests that the following acoustic specification is required for the diesel fire pump(s):

- The diesel exhaust (ie cowl above roof level) must not exceed a noise level of 85 dB(A) at 1 metre. This will likely require residential grade mufflers/silencers; and,
- The radiated noise emissions from engine must not exceed 97 dB(A) at 1 metre. This is on the basis that the pump room will be a basic, non-attenuated construction with no more than 1.5 m^2 of external louvres/grilles.

2.5 School sirens

The school sirens that are used to signal the beginning and ending of break times are deemed to be a 'mechanical device' as defined by the Environmental Protection (Noise) Regulations 1997 which means that technically the sirens are required to comply. However the reality is that school sirens will not comply with these noise regulations as their sole purpose is to be heard at distances.

Notwithstanding the above, things can be done to minimise the noise transmission to residences and therefore reduce the risk of complaint:

- Have more sirens/speakers spread around the school, rather than having one or two sirens in the centre of the school. Having more speakers will mean that the volume from each speaker can be significantly lower and therefore will reduce the overall noise emissions to neighbouring residences.
- Selected sirens should have reduced annoying characteristics, and the length of time that the siren is played should be limited.
- Any sirens located near the boundary of the school should be faced/directed back towards the school.

3. NATURAL VENTILATION

This school will be provided with reverse-cycle air-conditioning throughout (except for the covered assembly area). Even though all habitable spaces will include mechanical cooling, the PS Brief requires that natural ventilation strategies still be incorporated as an energy conservation measure. In accordance with the PS Brief, natural ventilation is to be provided via low level external ventilation openings for all habitable spaces (standard window and door apertures).

3.1 External Ventilation Openings

All habitable spaces are required to be provided with external ventilation openings to admit fresh air into the space. External ventilation openings can consist of; openable windows, operable louvres, and external doors. Ideally, external ventilation openings should be provided on opposites sides of a space, to enable cross-flow ventilation. However, as discussed above, it is acknowledged that this is not practical in the H-Pattern Teaching Block design.

Regardless of location, a minimum extent of external ventilation openings must be provided for each space. This minimum requirement is to comply with Part F4.6 of the BCA, which stipulates that external ventilation openings must be equal to or greater than 5% of the floor area of the space. However, we recommend that where possible external opening areas to multi-occupancy areas be ≥ 6.25%. This is in response to recommendations set out in AS 1668.2 for spaces without cross-flow, that accommodate students < 16 y/old.

A review of the total ventilation area per space should be conducted, to ensure the minimum 5% and desirably 6.25% of floor area quota is achieved, including windows, doors and operable louvres.

3.2 Ceiling Fans

Even in air-conditioned spaces, ceiling sweep fans are recommended in all multiple occupancy areas including; Teaching, Activity, Office and Staff Areas. The ceilings fans provide necessary air-movement for comfort, which is especially useful on days where a breeze is not available.

It is essential that all fans located below light sources (artificial or skylights) be fitted with clear perspex blades to minimise any light strobing effect. Location and sizing of ceiling sweep fans should be carried out by the Electrical Consultant, to provide an even coverage of the occupied areas, as far as is practical.

4. SECTION J 'ENERGY EFFICIENCY'

It has been agreed with Building Management and Works that this project shall be designed to comply with the BCA 2016 (Amendment 1) version of Section J. This is because the Australian Building Codes Board have advised that there is a 12 month transition period with regards to the Section J 2019 requirements.

Set out below is a summary of the Section J requirements of the Building Code of Austalia. These works are assessed in relation to compliance with the 'Deemed-to-Satisfy' provisions of Part J1 to J8 (Energy Efficiency) of the Building Code of Australia (BCA), 2016 Edition. The 'Building Envelope' consists of the elements separating a conditioned space from either the external environment or a non-conditioned space.

Parts J1 to J3 relate to the Energy Efficiency of the Building Envelope for each storey. Part J4 has been removed from the 2016 edition of the BCA. Compliance with Part J5 to J8 requires separate consideration and compliance reporting by the relevant building services consultants, as follows:

- Part J5 - Air-conditioning and Ventilation Systems (Mechanical Consultant)
- Part J6 - Artificial Lighting and Power (Electrical Consultant)
- Part J7 - Hot Water Supply and Swimming Pool and Spa Pool Plant (Hydraulics Consultant)
- Part J8 - Facilities for Energy Monitoring (To be considered by all consultants)

4.1 Building Classification

CLASS OF BUILDING: Class 9b
CLIMATE ZONE: Zone 5

4.2. Part J1 - Building Fabric

4.2.1 *Thermal Construction - General (CLAUSE J1.2)*

The specified insulation must comply with Australian Standard 4859.1 and must be installed appropriately. This means that the insulation must be installed with appropriate overlaps, must form a continuous barrier and must maintain its design thickness.

4.2.2 *Roof / Ceiling Construction (CLAUSE J1.3)*

In Climate Zone 5 the overall roof/ceiling construction is dependent upon the Solar Absorptance Value (SAV) of the external roof surface. The higher the SAV, the greater the amount of roof / ceiling insulation required. The required amount of total insulation compared to the SAV is shown in the table below:

Roof / Ceiling Types & Total System R-Value Requirements (Downwards)	
Roof upper surface Solar Absorptance Value (SAV) of ≤ 0.4	R3.2
Roof upper surface Solar Absorptance Value (SAV) of 0.4 ≥ 0.6	R3.7
Roof upper surface Solar Absorptance Value (SAV) of > 0.6	R4.2

Table 1 - Required Total System R-Values for Roof / Ceiling Systems

Due to the above requirements, we would recommend that a lighter colour be chosen that has an SAV of less than 0.4, however we understand that the external roof colour typically has an SAV of less than 0.6. This requires the total roof/ ceiling value to be R3.7 (downwards). This can be achieved by the following system:

- 75mm thick foil faced fibreglass insulation (eg Anticon 80) compressed between the underside of the metal deck roofing and purlins, with at least 40mm space between foil face and adjacent ceiling insulation; and,
- Minimum R2.0 insulation installed on top of the ceilings.

The actual roof/ceiling insulation requirements will be confirmed once a colorbond roof colour has been selected.

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The roof/ceiling thermal insulation strategy required to meet Section J must incorporate at least 75mm thick Anticon blanket insulation installed in traditional format directly under roofing (without spacers). Additional fibre batt/blanket insulation is provided over all ceilings to make up the required balance of the Total System R-value. This approach is **essential** for rain noise control, as well as to provide the required acoustic absorption directly over ceilings. Provision of reflective foil membranes under roofing (eg air-cell) will **NOT** provide adequate control of rain noise, especially where ceilings are perforated / metal strip.

4.2.3 *Roof Lights (CLAUSE J1.4)*

Any roof light serving a conditioned zone must meet certain requirements based upon the floor area served, as well as the shaft length. Part J1.4 of the BCA requires these minimum values are met, however Part 4.2.5.2 "Domed Skylights" of the Primary School Brief states minimum thermal performance values above and beyond those required in the BCA. Therefore the Primary School Brief requirements will also meet the BCA requirements.

Note – The Solatube DS range of skylights are recommended for this project.

4.2.4 *Building Envelope Walls (CLAUSE J1.5)*

Part J1.5 of the BCA requires certain levels of thermal performance for the walls around the *conditioned* spaces. The R-value requirements depend on the extent of shading of a wall and also its thermal mass, from a low of R1.8 to a high of R2.8.

In order to reduce the number of external wall insulation types (and therefore improve constructability and risk of contractor error), we propose an alternative solution. Essentially the alternative solution allows the unshaded cavity masonry walls to be reduced from R2.3 to R1.8 performance by upgrading the insulation in the steel framed walls from R1.8 to R2.8.

The following methodology was used for this process:

- The average R-value of the external walls of each building was calculated, based on the minimum deemed-to-satisfy insulation values required by Section J.
- The average R-value of the external walls of each building were re-calculated based on all cavity masonry walls being insulated to R1.8 performance (ie Air-cell Permicav within the cavity), and increasing all steel framed walls to achieve an R-value of R2.8.
- As per the data outlined in Appendix B, the average R-value of the alternative insulation approach for each building is higher than the deemed-to-satisfy approach, therefore is considered an acceptable alternative.

In summary, all external cavity masonry walls are to be insulated to R1.8 performance installing Air-cell Permicav in the cavity, and all external steel framed walls are to be insulation to R2.8 performance. Options for achieving the R2.8 performance for the steel framed walls include:

- External cladding + top-hats + sisalation (foil side facing outwards) + stud frame with minimum R2.1 wall batts + internal plasterboard lining.
- External cladding + top-hats + stud frame with R2.5 wall batts + internal plasterboard lining.
- External cladding + Air-cell Insulbreak 65 + stud frame with R2.5 wall batts + internal plasterboard lining.

4.2.5 *Floors (CLAUSE J1.6)*

No insulation required to concrete slab-on-ground systems without in-slab heating or cooling in Climate Zone 5.

4.3 Part J2 - Glazing

The external glazing has been assessed by using the Glazing Calculator provided by the Australian Building Codes Board. The glazing will be assessed during the Design Development stage to ensure that it is compliant with Part J2 of the BCA.

Based on our experience of other primary school projects, in most cases standard clear glass will be sufficient for complying with Part J2 of the BCA.

4.4. Part J3 - Building Sealing

Part J3 of BCA 2016 sets out construction and detailing requirements to ensure air leakage and infiltration is adequately controlled. The following design issues must be addressed in the contract documents.

4.4.1 *Chimneys and Flues (CLAUSE J3.2)*

Not Applicable - None proposed

4.4.2 *Roof Lights (CLAUSE J1.4)*

Any roof light serving a conditioned space or habitable room must be sealed or capable of being sealed. This must be via an imperforate ceiling diffuser or the like, installed at the ceiling level, or a weatherproof seal, or a shutter system readily operated either manually, mechanically or electronically by the occupant.

It is our understanding that the Solatube skylights provided on Standard Pattern Primary Schools meet these requirements.

4.4.3 *Windows and Doors (CLAUSE J3.4)*

All external doors and external openable windows to conditioned spaces must be fitted with seals to restrict air infiltration. The seal may be a foam or rubber compressible strip, fibrous seal or the like. Seals to the bottom edge of doors must be of a draft protection device or similar (such as mechanical drop seal). Alternatively, specify windows to meet Australian Standard AS2047 (this should be incorporated into the window schedule as well as the project specifications).

The entry to any conditioned space of a building must incorporate a door closing mechanism (or airlock), where serving a conditioned space of ≥ 50m^2. This includes all external doors to classrooms, as well as any doors from conditioned spaces to non-conditioned spaces.

4.4.4 *Exhaust Fans (CLAUSE J3.5)*

Any miscellaneous exhaust fans to a conditioned space (including gas heated) must be fitted with a sealing device such as a self-closing damper. Note that this only applies to 'miscellaneous' exhaust fans, NOT those that are part of a system complying with AS 1668.2-1991 and AS/NZS 3666.1-2002. This should be addressed by the mechanical consultants as part of the system design.

4.4.5 *Construction of Roofs, Walls and Floors (Part J3.6)*

All internal sheeting linings forming part of a conditioned 'envelope' must be fully sealed at the ceiling, wall, and floor junctions via appropriate caulking, skirtings, cornices, etc.

4.4.6 *Evaporative Coolers (Part J3.7)*

Any evaporative cooling systems must be fitted with self-closing dampers. This is to be incorporated by the mechanical consultant should these be specified.

4.5 Part J4 - Air Movement

**** *This clause has deliberately been left blank as it has been removed from the BCA 2016*

4.6 Part J5 - Air-Conditioning & Ventilation Systems

To be addressed by the Mechanical Consultant.

4.7 Part J6 - Artificial Lighting & Power

To be addressed by the Electrical Consultant.

4.8 Part J7 - Heated Water Supply And Swimming Pool & Spa Pool Plant

To be addressed by the Hydraulics Consultant.

4.9 Part J8 - Facilities For Energy Monitoring

To be addressed by all design and building services consultants.

Buildings with a footprint of greater than 500m^2 are required to have the facility to record the consumption of gas and electricity. The proposed building foot print is measured at approximately 1,100m^2 and therefore requires this monitoring facility.

5. RADIANT HEAT BELOW COVERED AREAS

In the summer months there is significant solar radiation incident on metal deck roofs. Regardless of roof colour, it is important to control the amount of radiant heat being transmitted to below. This is a significant issue for the Teaching Block External Activity Areas (although now reduced in area), as well as the Covered Assembly Area, where there are no insulated ceilings.

Each 'Covered Area' must incorporate at least 75mm thick perforated foil faced insulation below the metal decking (e.g. nominal 80mm Anticon) – perforated foil face down. This controls radiant heat, and is also necessary for reverberation control.

To meet WorkSafe requirements, we understand perforated Anticon is installed over a safety mesh. Unfortunately safety mesh with wire spaced at 200mm centres does not usually provide adequate protection against vandalism and ball sports impact etc. To address this issue we have previously recommended that a small bird / chicken mesh be laid over the safety mesh to provide greater protection. The small mesh also helps limit large tears in the sisalation, however specifying heavy duty foil facing will also aid with this tearing.

6. DAYLIGHTING

6.1 Daylighting Within Classrooms and Other Large Spaces

In 2012 the Department of Education adopted a specific daylighting strategy within teaching spaces, library, staff areas, etc., following a trial of Solatube 750DS skylights at the Piara Waters Primary School (2011). Previously, strip skylights comprising of opal translucent roof sheeting shafted to ceiling diffusers were provided in all teaching / activity areas, as well as the library and covered areas. However, in response to concerns related to roof maintenance, and also to need to incorporate 'daylight dimming', dome type skylights such as the Solatube DS type are now to be used. This issue was addressed in the April 2013 update to the Primary School Brief.

The recommended number of Solatube DS skylights are outlined below:

- Teaching / Activity of 60 to 65m^2 floor area to have 4 x nominal 500mm diameter units.
- Teaching / Activity of 80m^2 floor areas to have 6 x nominal 500mm diameter units.
- Library – total of 12 x nominal 500mm diameter units. Need to avoid units located too close to perimeter walls.
- Staff Room to have 4 x 500mm diameter units, with 2 x 500mm to Conference.
- Admin Reception/Waiting Area to have 2x 350mm diameter units.

Minimum requirements for domed skylights are set out in the PS Brief (Architectural Brief - 4.2.6.2), including:

- Clear dome at roof level (not opal type).
- The shaft must be a rigid material, with a silver surface achieving a visible light reflectance of ≥ 95%. (flexible shaft materials are NOT acceptable).
- A prismatic / fresnel type diffuser is required at ceiling level. The diffuser must achieve a visible light transmittance of 90% or greater.
- The overall skylight assembly must achieve the following thermal performance:
  - Solar Heat Gain Coefficient (SHGC) of 0.25 or less.
  - U-value of 3.0 or less.
- Daylight dimmers are required to allow staff to control skylight light levels. The daylight dimmers must be electrically controlled, and have variable stop positions from fully closed through to full open. Each room must have synchronous control from one position, via wall mounted switch.

In accordance with the Brief, these thermal performance values must be NFRC or AFRC certified, with supporting documentation available for review.

6.2 Skylight to Toilets and Stores

The PS Brief calls for basic daylight levels to be provided to staff and student toilets, as well as the Sports Store, Gardeners Stores and Gardeners Workshop etc. Since windows are typically shaded by wide verandahs, small 'dome-light' skylights are to be provided.

For these small spaces, provision of the following is considered to meet the intent of the brief:

- Student toilets to have 1 x 350mm diameter unit,
- AAT's and UAT's to have 1 x 250mm diameter unit,
- The Sports Store should ideally have 2 x 350mm diameter units,
- Gardeners store and workshop to have 1 x 250mm diameter unit each.

Minimum requirements for these smaller domed skylights are set out in the PS Brief 'Architectural Specification', including:

- The shaft must be a rigid material, with a silver surface achieving a visible light reflectance of ≥ 95%. (flexible shaft materials are not acceptable).
- The overall skylight assembly must achieve the following thermal performance:
  - Solar Heat Gain Coefficient (SHGC) of 0.35 or less.
  - U-value of 3.5 or less.
- No dimmer mechanism required.

6.3 Covered Assembly Area

Note that it is still recommended that traditional strip skylights rather than domed skylights be provided to the Covered Assembly Area. This is based on the concern that a domed skylight assembly may not have sufficient impact resistance in areas accommodating ball sports. Also, without a suspended ceiling to accommodate shaft and diffuser, the result from clear domes would likely be a direct beam of daylight (i.e. intense glare patches), rather than even distribution. The opal translucent sheeting provides inherent light diffusion, adequate for covered areas, without incorporation of a ceiling level diffuser.

These strip skylights are to consist of opal translucent sheeting, with a visible light transmittance of approximately 70%. The recommended material is "Ampelite Wonderglas GC" (2400g/m^2), which is a premium grade glass reinforced polyester sheeting manufactured in accordance with AS/NZS 4256.3:1994. This product claims superior resistance to yellowing and other forms of degradation (25 year warranty).

The total skylight aperture for the skylights within the Covered Assembly Area is to be approximately 19.7 m^2 (eg four strip skylights being 7 metres long x 700 mm wide).

6.4 Sun Penetration

When direct sun falls into a space, it can result in a number of concerns, including:

- Solar gain, resulting in unwanted heat load.
- Visual discomfort where sun falls onto work surfaces. This is mainly a result of the significant contrast between the sun patch and the adjacent ambient light.
- Glare on visual display units such as computers and televisions (and white boards). This glare can be rogue reflections on the white board, or direct sun falling onto the white board.
- Extreme discomfort where direct sun shines into the eyes of an occupant.

To completely control all sun penetration, and therefore control glare, internal blinds are typically required for all light sensitive work areas. This is most relevant to Admin Offices, and Collegiate Rooms. It is generally accepted that the wide verandahs to Teaching Blocks will adequately control sun penetration into classrooms for the majority of school hours. For thermal purposes, if blinds are used the external face must be light in colour.

7. ACOUSTICS

7.1 Internal Walls

Section 5.14 of the P.S Brief includes minimum acoustic ratings and / or speech privacy requirements for wall separating the various spaces. Of particular note is the fact that walls separating spaces with perforated or metal strip ceilings must be constructed full height to roof over, to control room-to-room sound flanking via the ceiling space. Where this is not practical, an alternative is to use proprietary Audibar barrier backed acoustic ceilings.

The attached marked up plans (Appendix A) refer to Wall Types 1 to 4, depending on the required acoustic performance to meet the intent of the PS Brief. The Table below sets out acoustic performance and construction options for the various wall types.

Wall Type	Acoustic Performance	Lightweight Partition	Masonry / Concrete
Type W1 Blue	≥ R_w 42	1 layer 13mm plasterboard 76mm stud frame, 75mm insulation in cavity. 1 layer 13mm plasterboard	90mm masonry rendered both sides *OR* 110mm masonry (no render)
Type W2 Green	≥ R_w 46	2 layers 13mm plasterboard 76mm stud frame, 75mm insulation in cavity. 1 layer 13mm plasterboard	110mm masonry rendered both sides *OR* 150mm special performance brick (no render)
Type W3 Red	≥ R_w 50	2 layers 13mm plasterboard 76mm stud frame, 75mm insulation in cavity. 2 layers 13mm plasterboard	150mm special performance brick rendered both sides *OR* Cavity Masonry wall
Type W4 Yellow	Hydraulic / Discontinuous	Dual stud wall, consisting of: 2 layers 13 mm plasterboard 64 mm stud frame with, 75 mm insulation, 20 mm air-gap, 64 mm stud frame,	Cavity Masonry Wall, with resilient wall tiles (eg Matrix ties).

Table 2 – Acoustic Wall Types

Notes:

- It is essential that fibre insulation provided in stud-framed construction be specified to have density ≥10.8 kg/m^3. It is recommended that 75 mm glasswool partition batts are used. If polyester insulation is desired, utilise *Tontine Nova 75* insulation.
- Direct stick plasterboard on masonry walls is not an acoustic equivalent to render. A significant reduction is acoustic rating is likely to result where this lining is applied.
- Stud sizing is based upon acoustics and estimated partition height limits. This must be confirmed by structural and we must be advised before any changes are made.

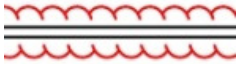
The minimum wall performance specified on the attached marked-up plans should provide an acceptable level of acoustic separation, provided the ambient noise level in each space complies with AS 2107:2016. If the actual ambient noise levels are too low (i.e. less than the *satisfactory* noise levels stipulated in AS 2107:2016), the specified performance for walls may not be adequate.

7.1.1 *Primary School Brief requirements for the Administration Block*

Section 5.14 of the Primary School Brief stipulates that *confidential* speech privacy shall be provided for the Principal's Office and the Interview Room. This requires a minimum R_w 46 wall construction between these rooms and the adjacent spaces, in addition to acoustically absorbent ceilings. A minimum of 110 mm masonry (rendered both sides) is required to achieve a sound reduction of R_w 46. Unfortunately 90 mm

masonry (rendered both sides) falls 3 R_w points short of the brief requirement. Therefore if the architect wishes to specify 90 mm masonry for the Principal's Office and Interview Room, the client shall be made aware of the deviation from the brief requirements.

7.2 Full-Height Walls



Many of the walls in this project need to be taken full-height right up to the underside of the roof sheeting above. This is required to control room-to-room noise transmission via the ceiling space.

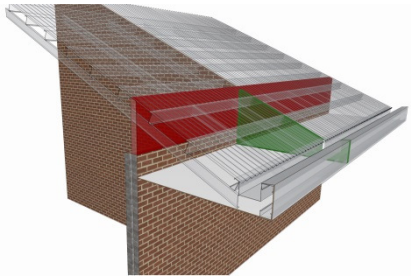
Full height walls are compulsory around spaces that contain perforated ceilings, given that perforated ceilings do not act as a barrier to noise transmission. The required full height walls are clouded in red on the attached plans. It is critical that an air-tight seal is achieved where the walls meet the underside of the roof sheeting / floor slab above:

- For stud framed walls, the plasterboard sheeting must push up against the Anticon roof insulation. The plasterboard sheeting must be cut around the purlins, with the resultant gaps sealed with a non-setting flexible sealant (similar to how a fire wall would be detailed).
- For masonry walls, stud framed construction can be used between the top of the masonry wall and the underside of the roof insulation to create full height walls. The stud framed construction must be as per the table of 'Wall Types' above, correlating with the colours on the marked-up plans.

It is important that the portions of full height wall above ceiling level are not compromised by mechanical and electrical services. Some issues to consider include:

- Avoid having mechanical ductwork penetrating full height walls. Where this is unavoidable, ensure an air-tight flexible seal is achieved around the duct at the wall penetration. This is often achieved by inserting high density fibreglass insulation into the small gap around the mechanical duct, then installing steel angles in front of the gaps to cover the insulation. Further information can be provided, if required.
- Avoid having cable trays passing through full height walls. Where this is unavoidable, special detailing is required to ensure an air-tight seal is achieved at the penetration. If cable trays must pass through full height walls, the best location for the penetration is above the door to the room in the ceiling space. We can provide a schematic detail for this penetration, if required.
- Cable trays must not pass through walls rated at or above Rw 50. Where this is unavoidable the cable tray must stop before the wall with cables being bundled, passed through conduits and sealed through the wall penetration. Conduits must not be more than 50mm individually.

It is also critical that all perimeter open eaves are closed off with a full height wall detail. This can either be achieved via the perimeter wall continuing up to the underside of the roof sheeting above (red area in the adjacent image), or by continuing the separating partition walls out to the edge of the eave lining (green area in adjacent image).



7.3 Operable Partitions

It must be recognised that operable partitions will not provide the same level of acoustic isolation as a permanent masonry or stud framed wall. Operable partitions provide flexibility of spaces, not 'sound proof' conditions.

7.3.1 *Classroom to Classroom*

In accordance with the PS Brief, operable partitions between Teaching Areas must be selected on the basis of at least R_w 43 design rating. This was the traditional rating of a suitably robust accordion type door. However with the change from accordion doors to panellised operable partitions, we believe that a rating of at least R_w 45 is a reasonable target and should be specified.

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7.3.2 *Library Block - Conference to Staff Room*

The operable wall between the Conference Room and Staff Room also needs to be specified with a minimum R_w 45 design rating, as per the current PS Brief. This is on the basis of providing a basic level of acoustic separation. However, we strongly recommend that an R_w 50 operable wall is provided between the Conference Room and Staff Room such that speech privacy is afforded.

7.3.3 *Covered Assembly Block - Music Classroom to Covered Area*

The operable wall between Music and Covered Assembly should be R_w 52, as both spaces may accommodate noise generating activities. Even this is not considered soundproof, but represents a practical level of noise control for this planning arrangement.

7.3.4 *Noise Flanking*

Given that perforated acoustic ceilings will be used in the various teaching spaces, conference room, etc, an 'acoustic septum' is required between the top of the operable room and the underside of the roof sheeting. This is necessary such that flanking noise transmission is sufficiently controlled. The acoustic septum is to consist of the following construction:

- Septum above R_w 43 operable wall – 1 layer of 13 mm plasterboard + 75 mm glasswool insulation + 1 layer of 13 mm plasterboard.
- Septum above R_w 45 operable wall – 2 layers of 13 mm plasterboard + 75 mm glasswool insulation + 1 layer of 13 mm plasterboard.
- Septum above R_w 52 operable wall – 2 layers of 13 mm plasterboard + 75 mm glasswool insulation + 2 layers of 13 mm plasterboard.

7.4 Internal doors

Acoustically, doors form the weakest link in a wall system. It follows that special attention to the performance and detailing of doors is required.

Where a basic level of noise control is required, doors should be provided with full perimeter rubber acoustic seals (frame seals and drop seals such as Raven RP10 & RP38). Acoustic seals will also be required for the meeting stile of double doors (e.g. Raven RP16 or RP71 seals). The door itself should be either 38 mm solid core or 10.38mm laminated glass in a high quality metal frame.

Note – A 38mm solid core door with seals will achieve a transmission loss performance of around R_w 28 to 30. This is noticeably lower performance than the wall types detailed in Section 7.1. As such, speech privacy is not possible even though an acoustically sealed door. Door grilles negate the acoustic performance of doors and must not be used in solid core doors. If 'Return Air' is required, it should be via acoustic air-transfer ducts, not door grilles.

The locations where it is recommended that acoustically sealed solid core or glazed doors be implemented are indicated on the attached marked-up plans (doors coloured in solid red).

7.5 Internal Glazing

Glazed areas in acoustic rated partition walls typically result in a significant acoustic weakness. Where internal glazing is required to spaces requiring speech privacy, the glass area must be minimised, and the performance of the glazing should generally be as close as possible to that of the partition wall. However, this typically requires acoustic double-glazed construction, since 6.38mm laminated glass in a solid frame only has a design rating of R_w 33 (whereas rendered single leaf 110mm masonry = R_w 47).

Acoustic double glazing typically has a large air-gap such as one layer of 10.38mm laminated glass, a minimum air space of 75mm and one layer of 6.38 laminated glass, in a solid frame. This construction should achieve approximately R_w 43 to 45 performance.

However, in our experience it is common for single glazing to be used in walls between spaces and corridors, where speech privacy is not a high priority, particularly where the wall is already downgraded by inclusion of a door (R_w 28 to 30). In the Administration building it is therefore likely to be adequate to use a single layer laminated glass from Manager Corp Services to Reception, and Medical to Corridor. Provided high privacy is not required between Interview and Reception, then we assume single glass will also continue to be used here. If higher speech privacy levels are required in this area then our recommendation is to remove the secondary door to the reception area and install the double glazing as described above. This could

alternatively be documented with one pane of 6.38mm laminated glass to one side of a suitable frame that can readily be upgrade to acoustic double glazing in the future by the addition of another layer of 10.38mm laminated glass.

One area for further detailed consideration is the window from Deputies to Medical Room. We would normally expect to see acoustic double glazing with > 70mm air gap in situations where speech privacy is important. If only single glazing is provided in this location then the Deputies will have to carefully manage voice levels when the Medical Room is occupied. This appears to be the status-quo in all recent Primary School projects, however steps could be taken to install a suitable frame that can be upgraded in the future as described above.

7.6 Ceilings

The attached acoustic marked-up plan (Appendix A) identifies the recommended ceilings for this project, based on the ceiling types below.

7.6.1 *Acoustically Absorbent Ceilings*

Acoustically absorbent ceilings are required for reverberation control in all multiple occupancy spaces and are annotated in blue on the attached marked-up floor plans. To be effective, at least 80% of the area over each room must be acoustically absorbent, allowing for some flush perimeter borders / bulkheads etc. if required. These ceilings must be specified to achieve a Noise Reduction Co-efficient of NRC 0.75 or better. For schools this is typically achieved by use of perforated metal strip ceilings to entire ceiling area, without closer strips. Examples of perforated metal strip systems include:

- Architectural Ceiling Systems — Ministrip (perforated)
Linear 5 (perforated)
- Acoustics Group — Paneline (perforated)
- Hunter Douglas — Luxalon 84B School Series (perforated)

Alternative acoustic ceilings may include:

- Perforated Coruline (ACS)
- High NRC Mineral Fibre Tile ceiling systems
- Perforated metal pan ceiling system
- Perforated plasterboard, such as Boral 12mm square pattern

If perforated plasterboard is to be used for selected feature areas, we strongly recommend it be specified as the Boral Echostop type with a ≥ 16% open area (eg 12 mm Square Holes). Unfortunately the standard CSR Gyprock Perforated Plasterboard with 6mm diameter perforations has only 8.2% open area, and achieves noticeably reduced acoustic absorption performance (in the order of NRC < 0.5). Note also that perforated plasterboard must not be spray painted, as this is highly likely to obscure the perforations and insulation overlay, significantly degrading its acoustic performance. This must be included in the project specifications.

Provide at least 75mm batts or blanket insulation directly over all acoustically absorbent ceilings, for acoustic performance. We understand that a common form of ceiling insulation over metal strip is fibre building blanket. This insulation must be specified to achieve at least NRC 0.80. This may be achieved by various thickness building blankets, being dependant on the material (fibreglass vs. polyester) and the insulation density etc.

Black scrim facing to insulation or separate scrim layer directly over metal strip or other perforated ceilings is typically required for aesthetic purposes.

7.6.2 *Flush Plasterboard Ceilings*

Plasterboard ceilings should be 13mm thickness, and effectively sealed to the perimeter walls of the space. For acoustic purposes at least 75mm insulation must be provided over.

7.6.3 *Covered Assembly and External Activity Areas*

Under the roof sheeting of the Covered Assembly and the External Activity areas, it is recommended that nominal 80mm thick perforated Anticon is provided. This must have a perforated foil face to ensure that both acoustic and thermal functions are provided. On some projects the addition of a breathable tear resistant shadecloth can then specified to be installed below the perforated Anticon face for durability. This is typically a client / architect directive to be specified.

7.6.4 *Music Room Ceiling*

The ceiling to the Music Room with carpet floor should be configured as approximately 50% acoustically absorbent ceiling area, and 50% reflective area. The reflective area (plasterboard) should be centred within the room dimensions, with the absorption ceiling located around the perimeter (eg perforated metal strip_. The perimeter of acoustic absorption is required for reverberation control, whilst the central plasterboard 'reflector' will provide useful acoustic feedback for musical activity.

Ideally, the central plasterboard ceiling shall not be parallel with the floor surface. It is recommended that the plasterboard ceiling is a minimum 7^{o} out-of-parallel with the floor surface. It is acceptable for the perimeter acoustically absorbent ceiling to be parallel with the floor.

In order to achieve compliance with the reverberation time criteria of AS 2107:2016, a minimum of 4.3 m^2 of acoustically absorbent panels are required on the walls. This can consist of 50 mm Autex Quietspace Panels or an alternative product achieving a Noise Reduction Coefficient (NRC) of 0.85.

It is also acceptable to have four acoustic panels, each 800 mm (wide) x 1370 mm (high) in accordance with 'Furniture Detail FD.07 Music Room – Acoustic Panel'. Please note that there is an error on this detail where it should say that the perforated timber is greater than 18% perforations, rather than less than 10% perforations.

7.7 Rain Noise

7.7.1 *Rain Noise Dampening*

It is essential that a minimum of 80mm thick Anticon blanket insulation be installed (without spacers) to the underside of all metal deck roofing over habitable rooms. This is required for rain noise dampening. Alternative foil only radiant insulation products will **not** fulfil this role.

Provision of 75 mm Anticon with insulated metal strip ceilings below is currently applied to all DET primary Schools. This does not prevent audible rain noise, but is considered adequate to reduce it to reasonable levels in general purpose learning environments.

Any rain water pipes that travel through the ceiling space above 'acoustic ceilings' should be wrapped in Pyrotek 4525 Acoustic Lagging, or equivalent.

7.7.2 *Roof Run-off*

All changes in roof level from high to low must be supplied with individual gutter systems and associated downpipes and spreaders, rather than allowing direct run-off. Without these, the 'waterfall effect' from roof run-off can generate noticeable noise intrusion.

7.8 Hydraulic Services

7.8.1 *Structure-borne noise from hydraulic services*

Structure-borne noise generated by water supply pipes, waste pipes, and hydraulic fittings can radiate noise into adjoining areas. The hydraulic fittings and lines must be carefully considered in terms of their impact on adjoining noise sensitive areas.

Where possible, hydraulic fittings such as cisterns and hand basins should not be mounted on walls that are common with adjacent noise sensitive spaces. Where this is not possible, the common wall will need to be as

per Wall Type W4. Review of the drawing indicates that location of cisterns on 'noise sensitive walls' has generally been avoided, except for:

Admin Block

AAT to Reception. Discontinuous Type W4 wall construction is recommended here to reduce structure-borne cistern flush and fill noise, even considering the expected low occurrence of simultaneous occupancy.

Teaching Block 1, 2 and 3

The AAT layouts have pan / cisterns directly on the wall common to Classrooms. It is recommended that acoustic resilient wall ties in these locations in order to minimise the structure-borne noise transmission through the wall from the cisterns.

7.8.2 *Fire Pumps*

Please refer to Section 2.4 of this report for the recommended acoustic specification for the diesel fire pumps.

7.9 Electrical Services

This section establishes general guidelines for within this project for the general installation of electrical equipment.

7.9.1 *Back to Back Power Points*

Standard electrical switch boxes must not be installed in a back-to-back arrangement within any of the acoustically rated walls (i.e. walls with an R_w rating greater than 40). If back-to-back switch boxes are unavoidable, then fire/acoustic rated switch boxes must be used, such as those manufactured by *Promat*, *Clipsal*, and *HPM*.

Standard electrical switchboxes can be used where they offset horizontally by a minimum of 300 mm as well as a vertical stud being located between the two boxes.

7.9.2 *Penetrations*

All electrical penetrations through walls are to be packed with fibreglass insulation fully sealed on both sides of the wall with acoustic sealant.

7.10 Mechanical Services

7.10.1 *Indoor Design Sound Levels - AS/NZS 2107:2016*

The duct-borne noise from the mechanical services shall comply with the design sound levels for the following spaces, as established in Australian Standard AS/NZS 2107:2016 *"Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors"*. Relevant design values are summarised below:

Type of Space	Design Sound Level range (L_{eq})
Corridors & Lobbies	40 to 50 dB(A)
Conference / Staff Room	40 to 45 dB(A)
Class Rooms and Activity Areas	35 to 45 dB(A)
Offices	40 to 45 dB(A)
Music Room	40 to 45 dB(A)
Resource Area	40 to 45 dB(A)
Toilets and Change Rooms	< 55 dB(A)

Table 3 – AS 2107-2016 Design Sound Levels

Design to control duct-borne Noise (Room Noise Levels) is responsibility of the Mechanical Services Design Consultant.

7.10.2 *Environmental Protection (Noise) Regulations 1997*

As per Section 2.3, the potential noise emissions from the mechanical services will be assessed during the Design Development stage in order to ensure compliance with the Environmental Protection (Noise) Regulations 1997.

7.11 Green Star Considerations

The following Green Star Credit Points (Green Star – Design & As Built V1.1) are directly relevant to Section 5.14 of the Standard Pattern Primary School Brief.

7.11.1 *IEQ-12 – Visual Comfort*

Four points are available under 'Visual Comfort' (Credit 12):

12.0 Glare Reduction (one point available) – Glare in the nominated area, from sunlight through all viewing façades, is reduced through a combination of blinds, screens, fixed devices, or other means.

12.1 Daylight (one or two points available) – 40% or 60% of the nominated area receives high levels of daylight.

12.2 Views (one point available) – 60% of the nominated area has a clear line of sight to a high quality internal or external view.

Compliance Comments

It is our opinion that for this project a total of three of the IEQ-12 credits could be claimed:

- Almost all external windows of the nominated area are shaded by wide verandahs which significantly control sun penetration (one point).
- 40% of the nominated area will have high levels of daylight due to use of solatube skylights (one point).
- 60% of the nominated area has a clear line of sight to an external view (one credit).

7.11.2 *IEQ-10 – Acoustic comfort*

Three points are available under 'Acoustic Comfort' (Credit 10):

10.1 Internal Noise Levels (one point available) – Internal ambient noise levels are suitable and relevant to the activity type of the room (compliance with AS 2107:2016).

10.2 Reverberation (one point available) – The nominated area has been built to reduce the persistence of sound to a level suitable to the activities of the space (compliance with AS 2107:2016)

10.3 Acoustic Separation (one point available) – Noise transmission between enclosed spaces has been addressed by the installation of partitions that achieve a weighted sound reduction index of R_w 45.

Compliance Comments

This project complies with two out of the three IEQ-10 credit points. Unfortunately the credit point for 10.3 'Acoustic Separation' cannot be claimed due to use of R_w 43 operable walls between class rooms.

Regards,

Benjamin Farrell
Director, M.A.A.S.

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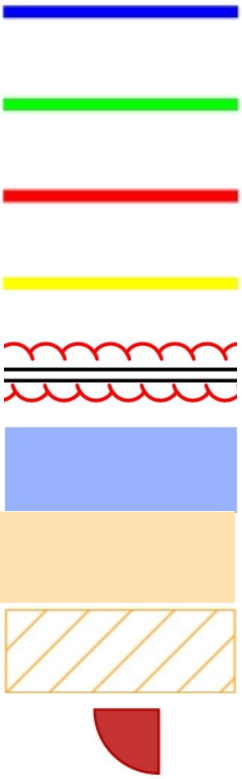
Member Firm – Association of Australian Acoustical Consultants

ATTACHMENTS

- APPENDIX A Acoustic marked-up plans
- APPENDIX B Alternative solution for the external R-values for walls.

APPENDIX A

LEGEND FOR ACOUSTIC MARKED-UP PLANS



Type W1 - ≥ R_w 42 Wall

Type W2 - ≥ R_w 46 Wall

Type W3 - ≥ R_w 50 Wall

Type W4 - Hydraulic Discontinuous Construction

Full Height Wall, Sealed to the Underside of the Roof Sheeting / Floor Slab Above

Acoustically Absorbent Ceiling (minimum NRC 0.75)

Perforated foil faced anticon insulation held to the underside of the roof sheeting.

Flush Plasterboard Ceiling with 75mm glasswool insulation minimum over

Solid Core Door with Full Perimeter Acoustic Seals. No door grills permitted

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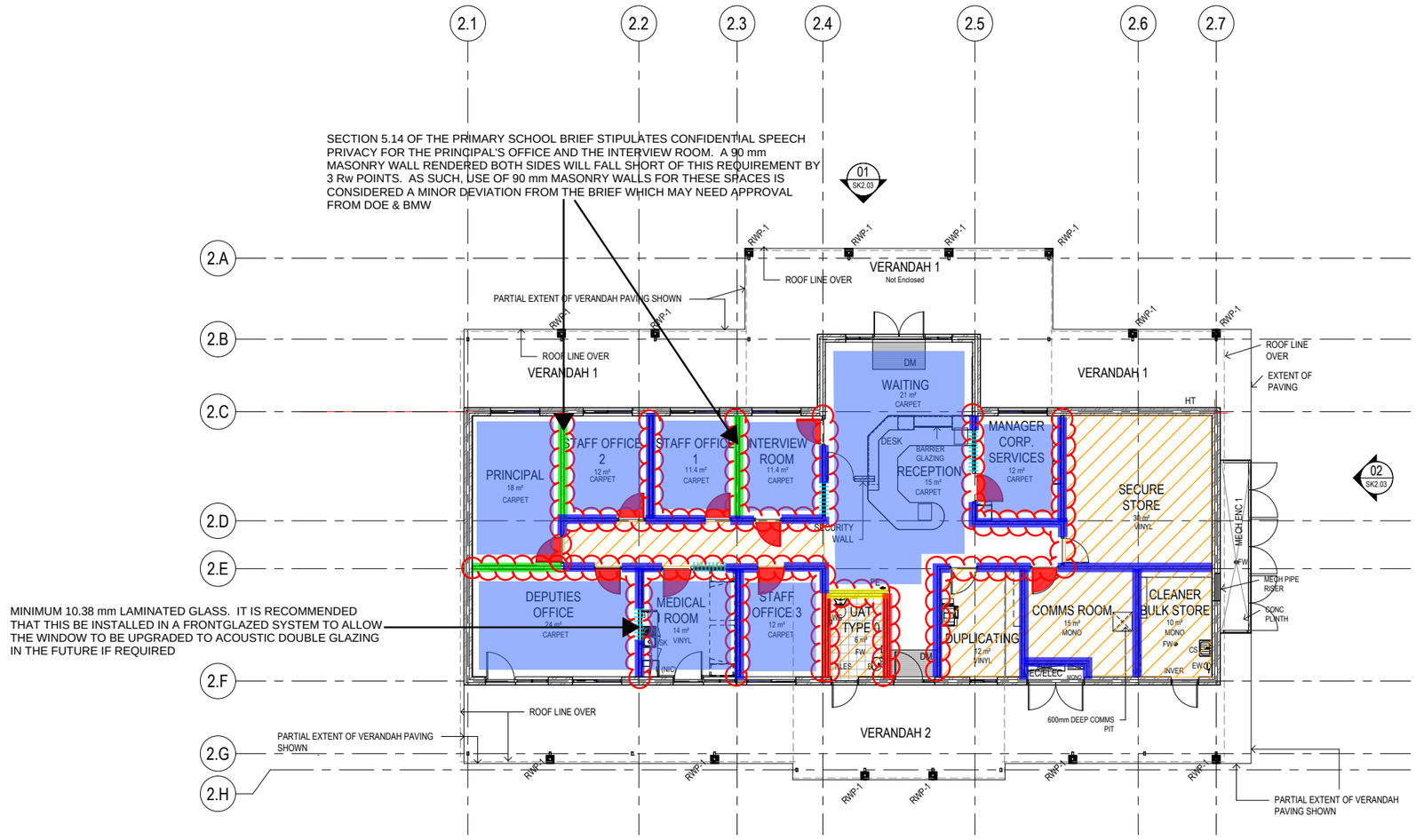
UNIT 3/2 HARDY ST SOUTH PERTH WA 6151 PH – (08) 9474 5966

APPENDIX A
ACOUSTIC MARKED-UP PLANS



1 A2.05 GROUND FLOOR
SCALE 1 : 100

NOTE:
50mm SETDOWN TO ALL TOILET AREAS

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SCALE 1:100 @ A1

NORTH

DATE	ISSUE	DESCRIPTION
02/05/2019	P2	ISSUED TO BMW
13/03/2019	P1	ISSUED TO QS

PRELIMINARY — ISSUE P2

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Department of **Finance**
Building Management and Works

PROJECT.
SUNNINGDALE PRIMARY SCHOOL
LOT 9766 SUNNINGDALE ROAD, YANCHEP
ADMINISTRATION

FLOOR PLAN

DRAWN: TG		DESIGNED: EIW	
CHECKED: AD		PRINCIPAL:	
APPROVED:			
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BMW PROJECT No:		EIW PROJECT No: 1820	
BMW FILE No:		EIW FILE No: SDP SK2.01 P5	

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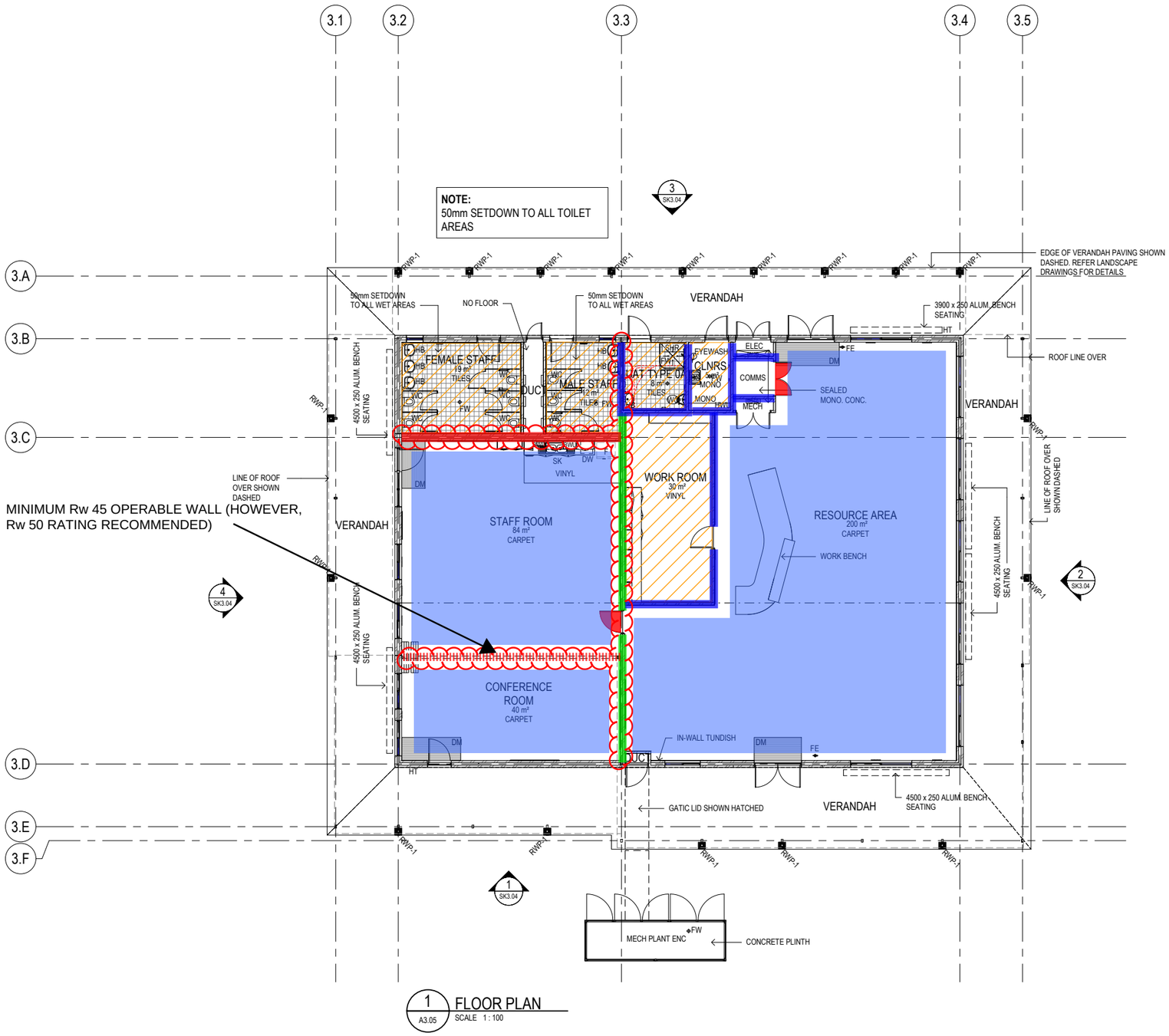

1 FLOOR PLAN
A3.05 SCALE 1 : 100

0 1000 5000 mm
SCALE 1:100 @ A 1

NORTH

DATE	ISSUE	DESCRIPTION
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13/03/2019	P1	ISSUED TO QS

PRELIMINARY ISSUE: P2

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PROJECT.
SUNNINGDALE PRIMARY SCHOOL
LOT 9766 SUNNINGDALE ROAD, YANCHEP
LIBRARY

FLOOR PLAN

DRAWN: AT		DESIGNED: EIW	
CHECKED: AD		PRINCIPAL:	
APPROVED:			
SCALE: 1 : 100		DATE: JANUARY 2019	DRAWING No: SK3.01
BMW PROJECT No:		EIW PROJECT No: 1820	
BMW FILE No:		EIW FILE No: SDP SK3.01 P5	

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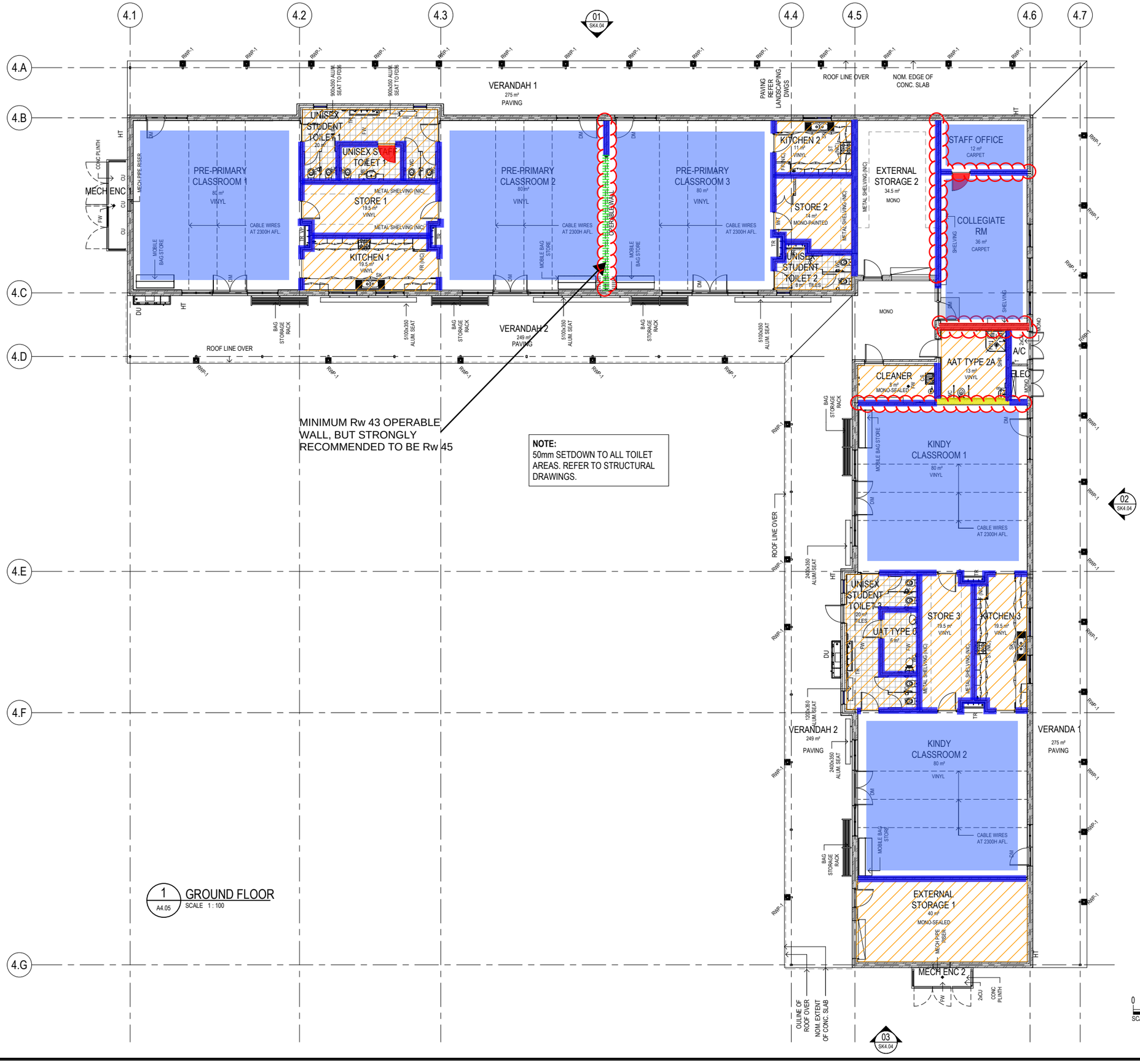

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SCALE 1 : 100

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13/03/2019	P1	ISSUED TO QS

PRELIMINARY — ISSUE: P2

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PROJECT.
SUNNINGDALE PRIMARY SCHOOL
LOT 9766 SUNNINGDALE ROAD, YANCHEP
TEACHING BLOCK 1

FLOOR PLAN

DRAWN: TG		DESIGNED: EIW	
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APPROVED:			
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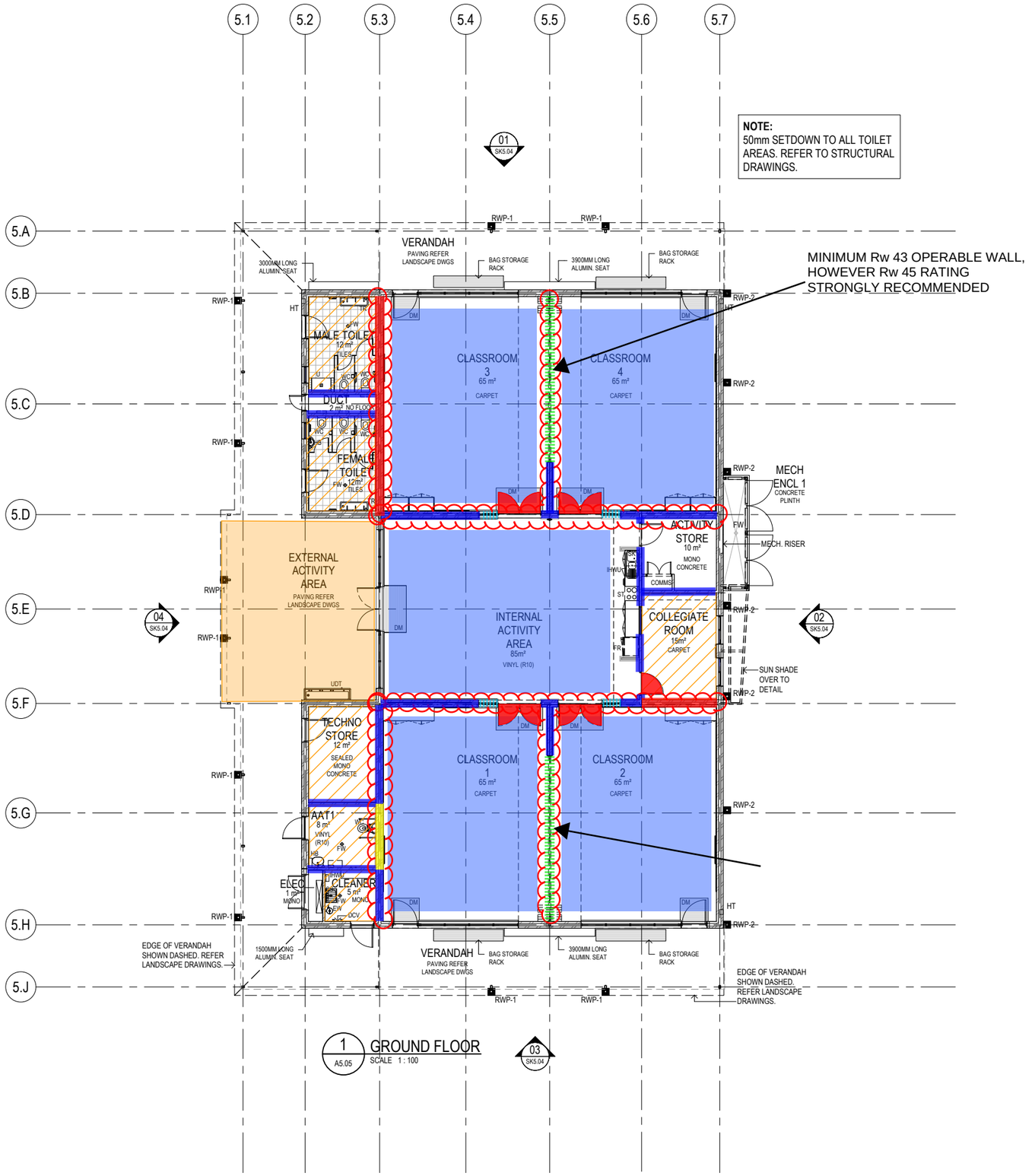

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SCALE 1:100 @ A1

NORTH

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13/03/2019	P1	ISSUED TO QS
DATE	ISSUE	DESCRIPTION

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PROJECT.
SUNNINGDALE PRIMARY SCHOOL
LOTS 9766 SUNNINGDALE ROAD, YANCHEP
TEACHING BLOCKS 2 & 3

FLOOR PLAN

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CHECKED: AD		PRINCIPAL:	
APPROVED:			
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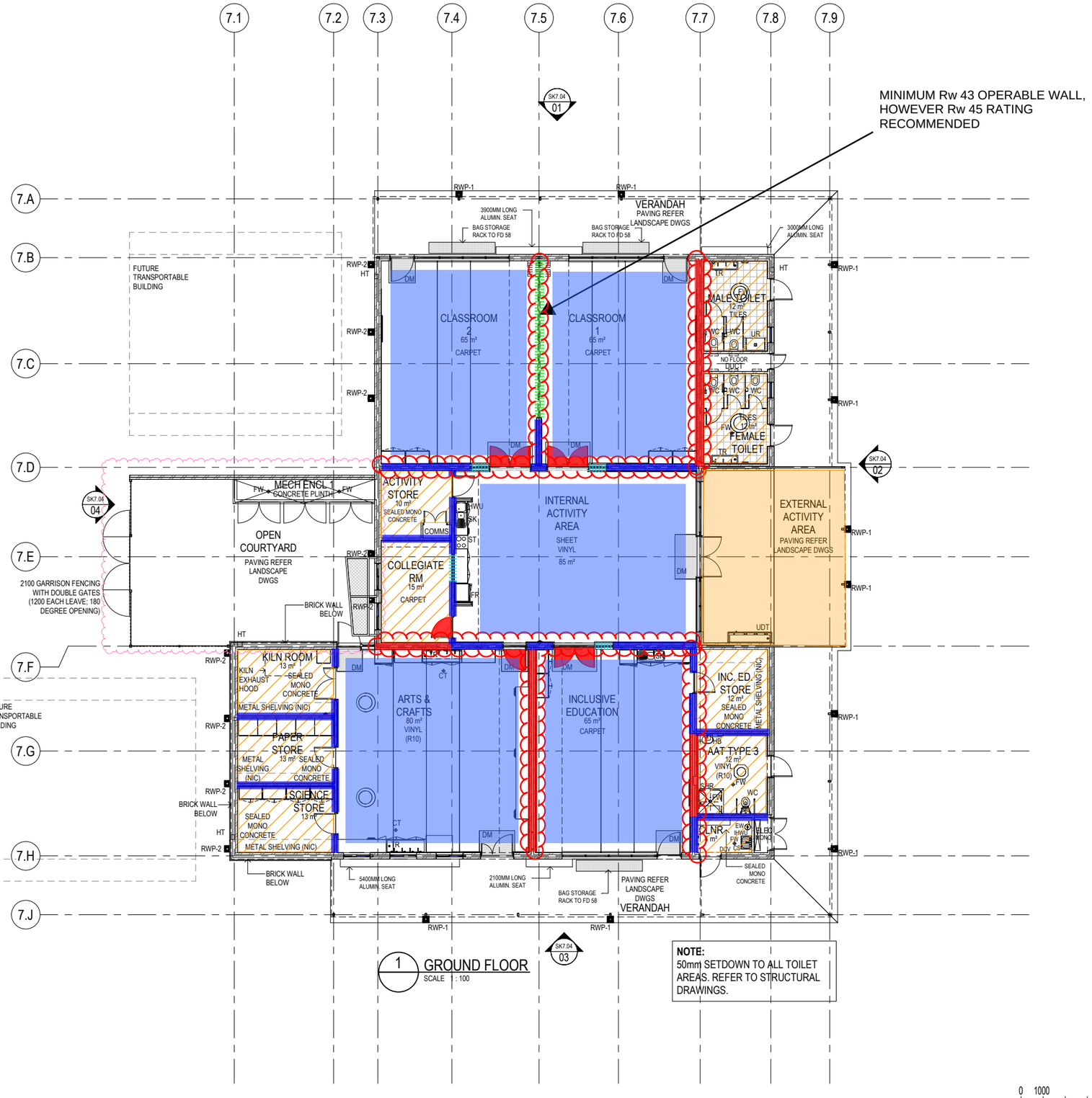

1 GROUND FLOOR
SCALE 1 : 100

NOTE:
50mm SETDOWN TO ALL TOILET AREAS. REFER TO STRUCTURAL DRAWINGS.

0 1000 5000 mm
SCALE 1:100 @ A 1

NORTH

DATE	ISSUE	DESCRIPTION
13/05/2019	P4	REVISED COURTYARD LAYOUT
03/05/2019	P3	ISSUED TO CONSULTANTS
02/05/2019	P2	ISSUED TO BMW
13/03/2019	P1	ISSUED TO QS

PRELIMINARY — ISSUE P4

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PROJECT.
SUNNINGDALE PRIMARY SCHOOL
LOT 9766 SUNNINGDALE ROAD, YANCHEP
TEACHING BLOCK 4

FLOOR PLAN

DRAWN: TG		DESIGNED: EIW	
CHECKED: AD		PRINCIPAL:	
APPROVED:			
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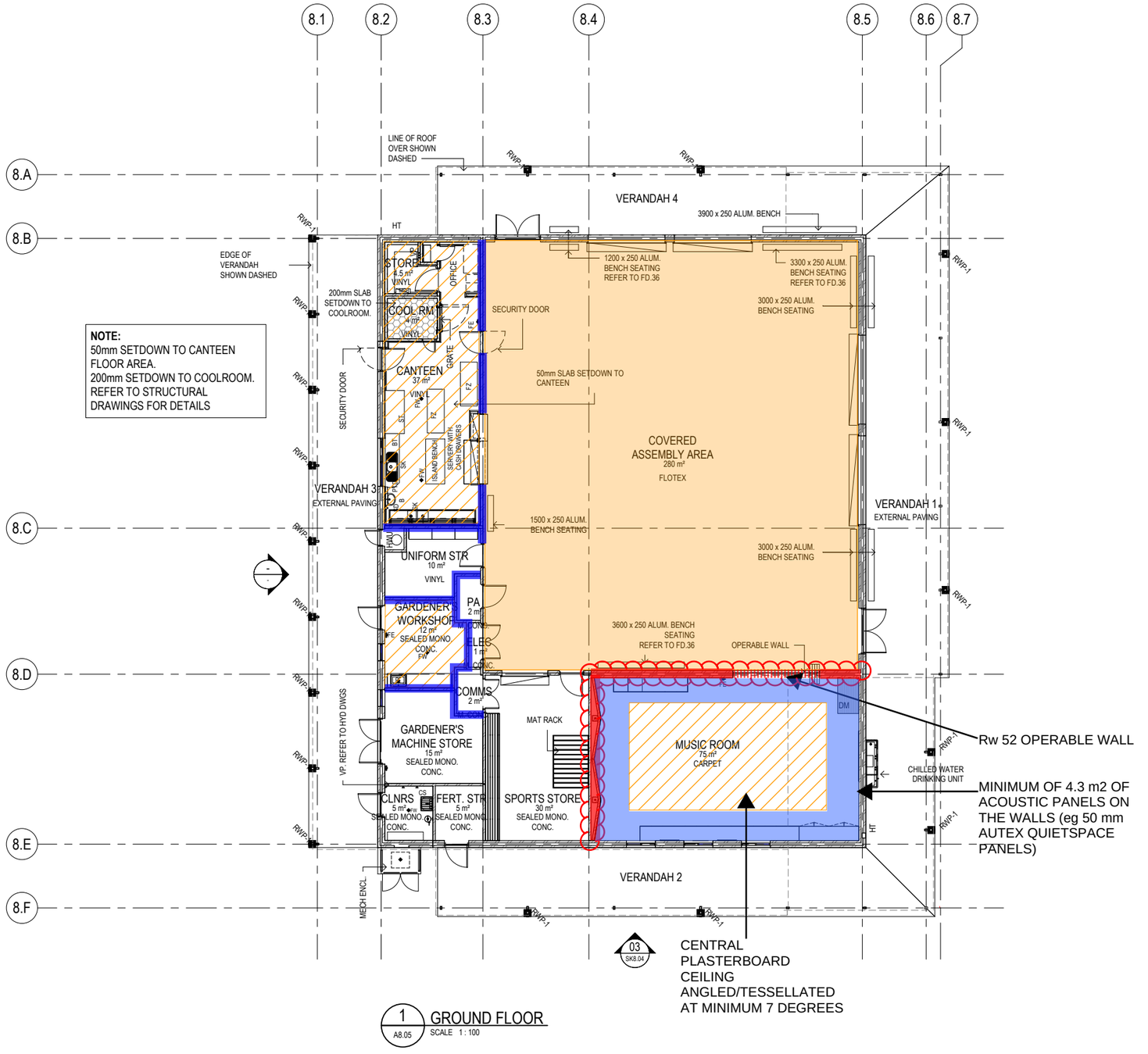

1 A8.05 GROUND FLOOR
SCALE 1 : 100

0 1000 5000 mm
SCALE 1:100 @ A 1

NORTH

DATE	ISSUE	DESCRIPTION
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02/05/2019	P2	ISSUED TO BMW
13/03/2019	P1	ISSUED TO QS

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PROJECT.
SUNNINGDALE PRIMARY SCHOOL
LOT 9766 SUNNINGDALE ROAD, YANCHEP
COVERED ASSEMBLY

FLOOR PLAN

DRAWN: TG		DESIGNED: EIW	
CHECKED: AD		PRINCIPAL:	
APPROVED:			
SCALE: 1 : 100		DATE: JANUARY 2019	DRAWING No: SK8.01
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PROJECT: Sunningdale Primary School
PROJECT No.: 18028

TASK: SECTION J 2016 INSULATION CONSOLIDATION

ADMINISTRATION BLOCK

	Area m2	D-T-S values	Area factor
R1.8 Cavity Masonry	127.46	1.8	1.0
R2.3 Cavity Masonry	48.20	2.3	0.5
R1.8 Steel framed	48.20	1.8	0.4
R2.8 Steel framed	6.35	2.8	0.08
Total Area	230.21		
Average R-value			***1.93***

	Area m2	**Alternative value**	Area factor
R1.8 Cavity Masonry	127.46	1.8	1.0
R2.3 Cavity Masonry	48.2	1.8	0.4
R1.8 Steel framed	48.2	2.8	0.6
R2.8 Steel framed	6.35	2.8	0.08
Total Area	230.21		
Average R-value			***2.04***

TEACHING BLOCK 2 & 3

	Area m2	D-T-S values	Area factor
R1.8 Cavity Masonry	53.40	1.8	0.5
R2.3 Cavity Masonry	40.55	2.3	0.5
R1.8 Steel framed	32.20	1.8	0.3
R2.8 Steel framed	57.93	2.8	0.88
Total Area	184.082		
Average R-value			***2.22***

	Area m2	**Alternative value**	Area factor
R1.8 Cavity Masonry	53.398	1.8	0.5
R2.3 Cavity Masonry	40.55	1.8	0.4
R1.8 Steel framed	32.2	2.8	0.5
R2.8 Steel framed	57.934	2.8	0.88
Total Area	184.082		
Average R-value			***2.29***

TEACHING BLOCK 4

	Area m2	D-T-S values	Area factor
R1.8 Cavity Masonry	67.38	1.8	0.6
R2.3 Cavity Masonry	55.35	2.3	0.6
R1.8 Steel framed	50.95	1.8	0.4
R2.8 Steel framed	46.09	2.8	0.59
Total Area	219.78		
Average R-value			***2.14***

	Area m2	**Alternative value**	Area factor
R1.8 Cavity Masonry	67.38	1.8	0.6
R2.3 Cavity Masonry	55.35	1.8	0.5
R1.8 Steel framed	50.95	2.8	0.6
R2.8 Steel framed	46.09	2.8	0.59
Total Area	219.78		
Average R-value			***2.24***

TEACHING BLOCK 1 - PRE-PRIMARY SECTION

	Area m2	D-T-S values	Area factor
R1.8 Cavity Masonry	138.93	1.8	0.9
R2.3 Cavity Masonry	20.69	2.3	0.2
R1.8 Steel framed	45.15	1.8	0.3
R2.8 Steel framed	75.79	2.8	0.76
Total Area	280.55		
Average R-value			***2.11***

	Area m2	**Alternative value**	Area factor
R1.8 Cavity Masonry	138.93	1.8	0.9
R2.3 Cavity Masonry	20.69	1.8	0.1
R2.8 Steel framed	45.15	2.8	0.5
R2.8 Steel framed	75.79	2.8	0.76
Total Area	280.55		
Average R-value			***2.23***