Memorandum

To:	Garrett Crowe	**At:**	Baldasso Cortese
From:	Jim Antonopoulos	**At:**	SLR Consulting Australia Pty Ltd
Date:	13 September 2022	**Ref:**	640.30538.00000-M01-v0.2-20220913.docx
Subject:	Emmanuel College Warrnambool Year 9 Centre Acoustic Review		

Garrett

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Further to our acoustic workshop on 7 September we provide herein our review of the current architectural drawings and design for the Year 9 Centre at Emmanuel College

1 Introduction

The proposal comprises construction of a two level educational building incorporating:

- Gymnasium, Specialist Tech, Food Tech, Breakout and amenity/utility spaces on the lower ground
- GPLA's, Science Rooms, Breakout, Sick bay, interview / office / seminar rooms / small group, AV and Sound Labs, Staff work and lounge rooms, as well as amenities on the ground level.

2 Absorption Treatments

Acoustic absorption is important for teaching environments to ensure good speech intelligibility throughout the spaces and to control overall ambient noise levels. In addition, for open plan type designs (and where there are significant breakout spaces), provision of as much absorption as possible is the only way to achieve some form of acoustic separation between different areas, albeit it is nowhere near as effective as actual partitions.

In the sections below, the measure of absorption used for specifying materials is the Noise Reduction Coefficient (NRC) which has a range from 0 to 1. An NRC of 1 represents a highly absorptive material with 100% of the sound incident on it being absorbed. An NRC of 0.5 indicates that 50% of sound incident is absorbed and 50% is reflected. An NRC of 0 or close to zero represents a very reflective material that provides no useful absorption (eg. concrete or other flat hard surfaces etc).

Absorptive treatments are best applied to large available areas – ceiling and floors are often the most useful and cost effective areas to add absorption to, and can effectively be part of the base building materials. Dedicated acoustic absorptive panels can also be added to walls as necessary.

We provide below advice for the various internal finishes for the development that relate to absorption and reverberation control. See Error! Reference source not found. for a summary of the internal finishes review relating to each space.

2.1 Wall Panels and Absorption

Pinboard materials are proposed throughout various locations. Pinboard can offer useful absorption to spaces if appropriately selected.

As a general rule, the thicker the pinboard, the better its absorptive performance (although the composition and density is also important).

The proposed pinboard options include Autex and Woven Image 'Echopanel' options. These come in various thicknesses. It is recommended that not less than a 12 mm thick material be used as a minimum to general areas (ie all teaching spaces, breakout etc), and a thicker material to specific areas as called up. The following indicative absorption coefficients apply:

- 12-13.5 mm thick: NRC 0.4-0.5
- 25 mm thick: NRC 0.8

Acoustic pinboard (12mm min) is to be applied to all available surfaces in all teaching areas and breakout areas, as well as Staff Work areas.

It is also recommended that smaller type spaces like meeting, office, small group rooms, seminar include the pinboard to the equivalent of one wall.

The 25 mm thick panels should be used in the following areas:

- To one wall of the AV Room, and the other walls to have 12 mm thick standard product.
- To two perpendicular walls of the Sound Lab spaces (as a minimum).

2.2 Ceilings

It is understood that a combination of perforated plywood and perforated plasterboard ceilings are generally to be used throughout.

The following are suggested products to achieve reasonable absorption to all spaces where these are used.

Perforated Plasterboard Ceiling

- Recommend minimum NRC rating of 0.7 with >200mm ceiling cavity and insulation behind.
- 100 mm thick, high density 32 kg/m^3 insulation behind perf. plasterboard

The above NRC is typically achieved with perforated products that have at least a 16 % open area such as:

- Knauf Stratopanel, circle pattern '12/25 R' perforated plasterboard (18.1 % o.a. circular holes)
- Rigitone Matrix, 8 mm round perforated plasterboard (15.5 % o.a.)

The above ceilings provide a moderate to good level of acoustic absorption, in the order of NRC 0.7. The high density ceiling insulation provides improved absorption and also assists with controlling rain noise into the spaces, as well as any sound transmission across ceiling cavity zones.

The perforated plasterboard ceiling are nominated to all dedicated teaching spaces, as well as most meeting and work spaces. This should be maintained throughout all these areas.

NOTE: If any FCU's or ERV units are proposed they are best kept away from any perforated ceiling areas. Keep above amenity areas or small offices where set plasterboard could be allocated specifically (while providing additional room absorption via other means).

Perforated Plywood

As for the perforated plasterboard, a similar specification is recommended for the perforated plywood, however we note there appear to be less options available recently in Australia that may be able to achieve the specification below. Perforated plywood is also to be provided to the gymnasium to control reverberation

- Recommend minimum NRC rating of 0.7 with >200mm ceiling cavity and insulation behind. Some products may only achieve NRC 0.55-0.6 and this may be acceptable subject to review of test data.
- 100 mm thick, high density 32 kg/m^3 insulation behind perf. system.

The above NRC is typically achieved with perforated products that have at least a 16 % open area such as:

- Maxiply Vague Square (20 % o.a. circular holes)

The provided RCP's show the perforated plywood provided in raked ceilings in the gymnasium, main lobby, central breakout areas and corridors.

Specialist Tech Space

A specific acoustic ceiling is recommended for this space that provides both absorption and improved sound transmission to above.

The recommended system is as follows:

- Perforated plywood or similar (> 15% oa), suspended not less than 150 mm below soffit.
- 100 mm thick, high density 48 kg/m^3 insulation behind perf. system. This is a higher density insulation that provides improved sound transmission to above.

It is assumed the slab above is not less than 180 mm thick.

3 Wall Partitions

Noise transfer through partitions is controllable via appropriate selection of wall types and provision of appropriate detailing and noise control treatments to other paths of sound transfer, such above-ceiling paths, paths through ducts, junctions, glazed areas etc.

In the sections below we provide a review of the current design and recommendations for the above transmission paths.

Acoustic ratings of sound transmission are typically provided in terms of the 'weighted sound reduction index' Rw, or 'weighted level difference', Dw. These parameters, in dB, provide a measure of how much sound reduction a wall will provide for the typical human voice spectrum – the higher the Rw or Dw, the better the wall performance. The Rw is a measure of the specific wall or partition, as would be determined in a test laboratory. The Dw is the result obtained in the field, and can include the influence of other transmission paths (so the Dw is often not as good as the Rw).

Table 1 provides some indicative ratings used in various types of buildings and walls for general reference (not specific to schools).

Table 1 Indicative Acoustic Rating for Wall Partitions

Location	Typically applied Rw design ratings
Typical low privacy offices, and between classrooms with doors / glazing	Rw 25-30 dB
Medium privacy situations	Rw 30-40 dB
Between boardrooms, medical suites, traditional classrooms with dedicated walls	Rw 40-50 dB
Between classrooms and higher activity areas	Rw 45-55 dB
Apartment walls typically	Rw > 55 dB
Cinema walls	Rw > 70 dB

The sections below provide specific recommendations and discussion for partitions in the building. Refer also to **Appendix A** showing marked up architectural drawings.

3.1 Walls

The following general walls are nominated and shown on the markup attached. It is understood core filled blockwork walls will be used on the lower level and steel stud walls throughout elsewhere.

Wall Type	Description	Acoustic Rating Rw
T1	1x13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard each side of 92 mm 0.75 BMT stud, [118 mm overall]	35 dB
T2	1x13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard each side of 92 mm 0.75 BMT stud, 75mm thick 14kg/m3 glass fibre insulation to cavity [118 mm overall]	43-45 dB
T3	1x13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard to one side, 2 x 13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard to other side of 92 mm 0.75 BMT stud, 75mm thick 14kg/m3 glass fibre insulation to cavity [131 mm overall]	47-49 dB
T4	2x13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard to both sides of 92 mm 0.75 BMT stud, 75mm thick 14kg/m3 glass fibre insulation to cavity [144 mm overall]	50-53 dB
T5	Impact / hydraulic noise control wall: 1x13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard to one side, separate stud (or stag stud construction in 150 mm track), 2 x 13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard to other side of, wall, 2 x 75mm thick 14kg/m3 glass fibre insulation to cavity [190-225 mm overall depending on type of stud wall]	52-56 dB
T6	Cavity Slider Wall 1x13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard each side of separate 92 mm 0.75 BMT studs, cavity as required for slider, 75mm thick 14kg/m3 glass fibre insulation to each cavity. Note if a lining is required to the inside of the studs (to ensure insulation does not fall within cavity slider zone), provide wire, perforated pegboard, perforated plasterboard or other 'open' material to hold insulation in place. [approx. 310 mm overall with 100 mm cavity zone allowance]	>Rw 45 dB
T7	Core Filled blockwork wall (140mm or 190mm)	50-51 dB
T8	Core Filled blockwork wall + furring channel in Beta fix clip (or packed out) to form 50 mm cavity + 50mm thick 14kg/m3 glass fibre insulation to cavity and 2 x 13mm plasterboard to one side of wall only	62-65 dB
T9	Tech Room Wall – SPECIAL Core Filled blockwork wall + 64 (or 76) mm separate stud physically off wall to create 80 mm total cavity. High density rockwool or fibreglass insulation not less than 75mm thick, 48 kg/m^3 to wall cavity. Perforated plywood or 'pegboard' lining to face of studs.	>65 dB And NRC not less than 0.5

3.2 Cavity Walls for Sliders

Cavity wall sliders will require a twin stud wall arrangement. This is an appropriate construction for these locations and the wall will achieve above Rw 45 dB.

Note if a lining is required to the inside of the studs (to ensure insulation does not fall within cavity slider zone), provide wire, perforated pegboard, perforated plasterboard or other 'open' material to hold insulation in place.

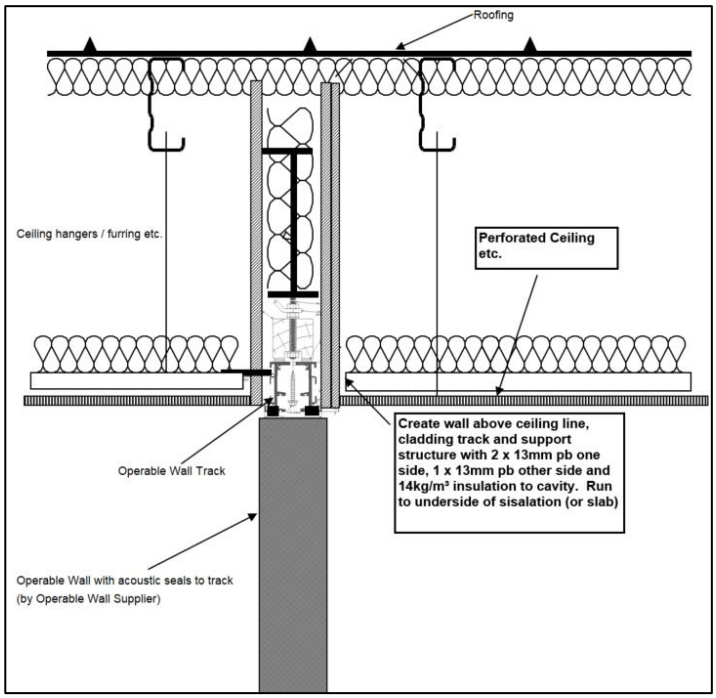
3.3 Operable Wall – Presentation Space

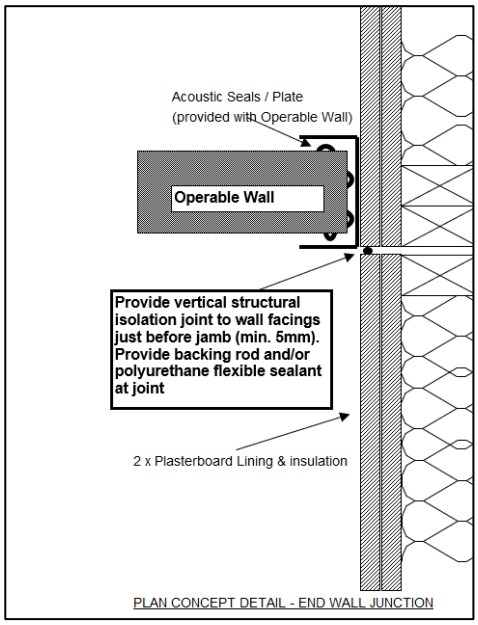
An operable wall is nominated between the Gym and the ground floor presentation space. Operable walls are notorious for performing poorly and being difficult to effectively seal.

A reputable make of operable wall should be nominated (eg. Lotus or Glyde) with a laboratory rating of not less than Rw=45 dB.

We note that the head, bottom and perimeter sealing details should be provided by the supplier of the operable wall and are critical to implement if aiming to achieve a field rating close to that of the laboratory rating.

In addition, perimeter ceiling and wall details are also critical. The following provides concept details for operable wall head and perimeter treatments.



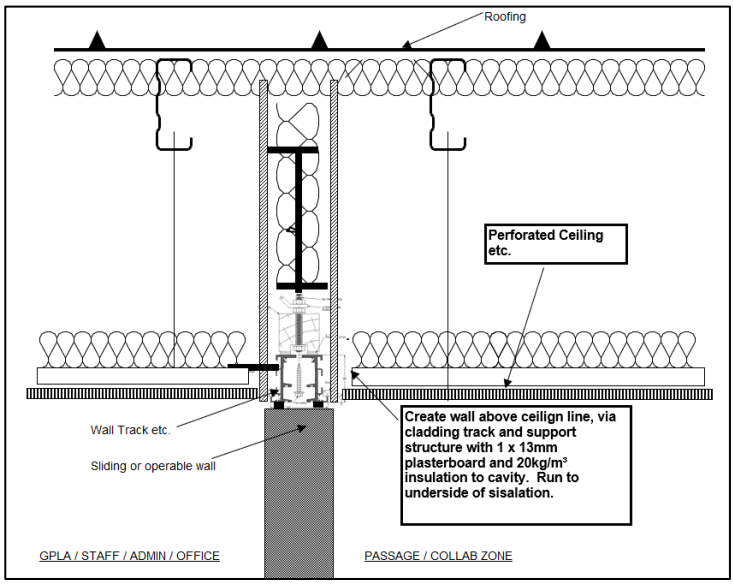


3.4 Sliding Doors

Sliding doors are nominated throughout. Sliding doors are historically difficult to seal but proprietary products are now more readily available that achieve reasonable acoustic performance.

Acceptable acoustically rated sliding doors are available from Lotus and Glyde and should be selected to achieve not less than Rw 30 dB. The doors are to be installed in accordance with the manufacturer's recommendations with effective sealing and detailing at the top, bottom and perimeter.

Note that the area above the sliding doors (ie effectively the separating wall between all rooms and the passageway / breakout zones) need to include partition constructed slab to slab in the case of the ground floor, and to the underside of the roof structure / pushed against sisalation on the upper floor. The concept is shown below. The wall section above the ceiling line only needs 1 layer of plasterboard to each side of the frame (and insulation in the cavity) as opposed to the walls that separate the main teaching spaces.



3.5 Glazing

Generally, all internal glass should be not less than 10 mm thick laminated or toughened glass. This will achieve Rw 33-35 dB which is comparable (and usually better than) entry doors.

Internal glazing should be avoided between individual teaching spaces. None are noted in the drawings but if they are adopted a moderate upgrade to Rw 40 dB can be obtained with a small cavity double glazed unit such as 6 mm glass, 12 mm air, 10.38 mm laminated glass ('6/12/10.38'). Otherwise, a 50 mm air cavity glazing system would be required to achieve ratings closer to Rw 45 dB.

The external glazing for the lower ground Specialist Tech Room should include a higher specification of glass to minimise noise to outside (nearby residential uses). It is recommended that either a 12.5 mm VLAM hushglass be used, or a thermal double glazed type unit (IGU) comprising 6 mm glass / 12 mm air cavity / 10.38 mm laminated glass. The door system should include appropriate air-tight perimeter seals.

Skylights and windows within 15 m of any rooftop plant (fans, condenser units etc.) areas should be either 10.38 mm laminated glass or IGU type glazing with 6 mm / 12 mm gap / 10.38 mm as a minimum.

All other external glass to architects' and energy report requirements.

3.6 Internal Doors

Acoustic rated doors comprising minimum 40 mm thick solid core timber (6 mm glass viewing panes acceptable) with Rw 30 dB rated perimeter and automatic door bottom seals are recommended for the following locations (refer also to attached markup).

- Reflective Space
- Offices
- Small Group
- Seminar Rooms
- Staff Lounge and Staff Work
- Soundlab* NOTE – if recordings / casting is to occur here and minimal sound disturbance is necessary, it is unlikely that a single door will be sufficient to the AV room (assuming the AV room will operate at the same time). An airlock arrangement would be required for this to be effectively isolated. Proprietary acoustic doors with ratings of up to Rw 45 dB are also available but a particularly costly.

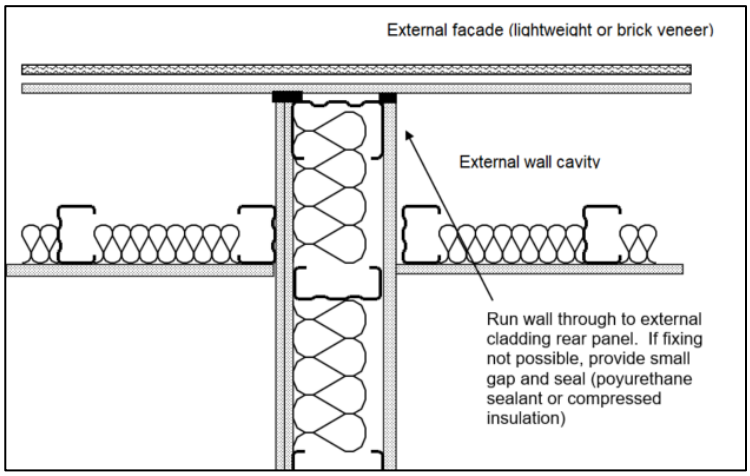
Various seal options are available from Kilargo and Raven that achieve Rw 30 dB ratings.

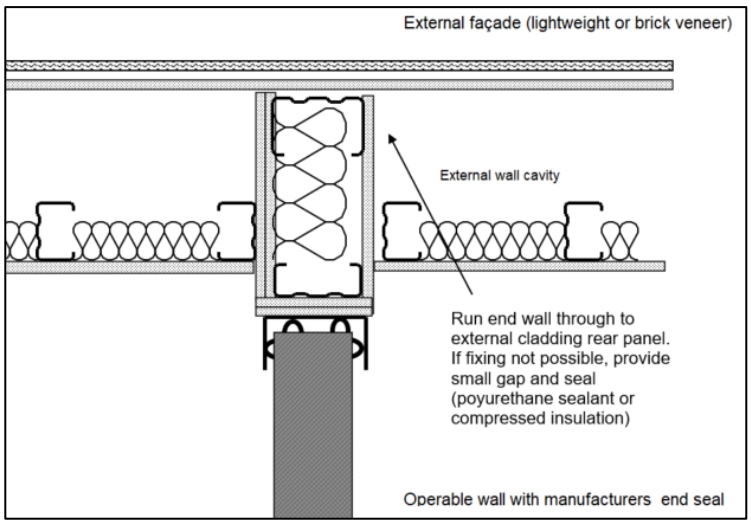
3.7 External Façade Junctions

Ensure all partitions penetrate the façade glazing framework.

As a rule any separating wall that meets with the external walls will require the separating wall to continue through the external wall inner linings, and seal as practicable to the external façade element.

The images below show conceptually how this can be achieved (for lightweight external walls).





External Glazed Junctions

All separating walls should generally run through or intersect a column at the façade. Intersection to window mullions should be avoided. If this cannot be avoided, specific detailing will be required (this does not appear to be an issue on this project generally).

3.8 Above Ceiling Treatment of Walls

All walls (except T1 walls or walls that have plasterboard ceilings to both sides of the wall) are required to run above the ceiling line to the underside of the roof or soffit. These walls should incorporate the following:

- Wall frames and linings should be taken up and sealed to the underside of the roofing and structure as practicable i.e.:
  - Where the top of the wall meets with deck roofing, basic compression of roof sisalation / insulation should provide a sufficient 'air tight' path for the sound transmission.
  - For junctions to steel or timber structure, cut around and provide a practical means of sealing, such as packing of high density insulation (>60 kg/m³) or provision of expanding foam (although expanding foam should be kept to a minimum area).

- For the lower floor, slab to slab construction should be adopted with standard flexible sealant (polyurethane) to be used.

4 Roof / Ceiling and Rain Noise

Achieving sound reduction from rain noise (or other external environmental noise ingress) via the roof / ceiling can be challenging in situations where perforated or very lightweight ceilings are nominated for the purposes of room absorption. While the perforated ceilings allow for the sound in the room to penetrate the ceiling cavity and be absorbed, they also allow more rain / external noise to enter rooms via the perforations.

The following roof / ceiling system is proposed / recommended:

- Roof deck.
- Ashgrid roof spacer with CSR Bradford 140-150 mm Anticon (medium duty foil with glass fibre insulation)
- Bulk ceiling insulation eg 100 mm thick, 32 kg/m^3 (as nominated above perf ceilings etc.).
- Perforated plasterboard or plywood.

The above system incorporates significant insulation, however, rain noise control will be limited due to the perforated ceiling linings. This is likely to only be an issue during heavier rainfall, and provision of further acoustic treatments to address this is often not considered feasible (i.e. it would mean designing for less than a 10% occurrence in a year). However, if the school has a particular concern in relation to rain noise, further treatment could be considered (eg. provision of additional mass layer such as 19 mm chipboard under metal deck roofing).

5 Mechanical

A separate acoustic review will be provided for mechanical services once the design is progressed. The following provides some preliminary guidance.

- The Specialist Tech room is likely to have a dust extraction system -these can be particularly noise and this may need an acoustic enclosure given the proximity of nearby residential uses. Provide details when available.
- Breakout noise from ducted AC units within the building (FCU's / ERV's etc.) can cause noise impacts to occupants due to the large extent of perforated ceilings. Such units should ideally be located in dedicated plasterboard bulkheads or kept over specific spaces where plasterboard ceilings can be nominated (ideally over utility areas / stores / toilets etc.). It is also possible to contain such units above offices / meeting rooms and to provide upgrades to the ceilings over these spaces specifically.
- An external plant area is noted adjacent to a residential boundary. This will require specific review once mechanical equipment selections are available.
- Cassette style or wall mounted AC units should be selected for lowest noise levels. Noise levels to teaching areas should ideally be kept to below 40 dBA with the units operating.
- Any roof plant platforms should be constructed well away from the roof structure - ie supported off structural elements with the platform at least 300 mm above (and not in contact with) the metal deck roof. The platform itself should be of solid floor construction with a solid floor mass barrier. We would allow for 2 layers of 12 mm compressed fibre cement sheet.

- All plant equipment must be installed on appropriate vibration isolation mounts which achieve not less than 95% isolation efficiency. Typically this can be achieved via pad mounts for condenser units.

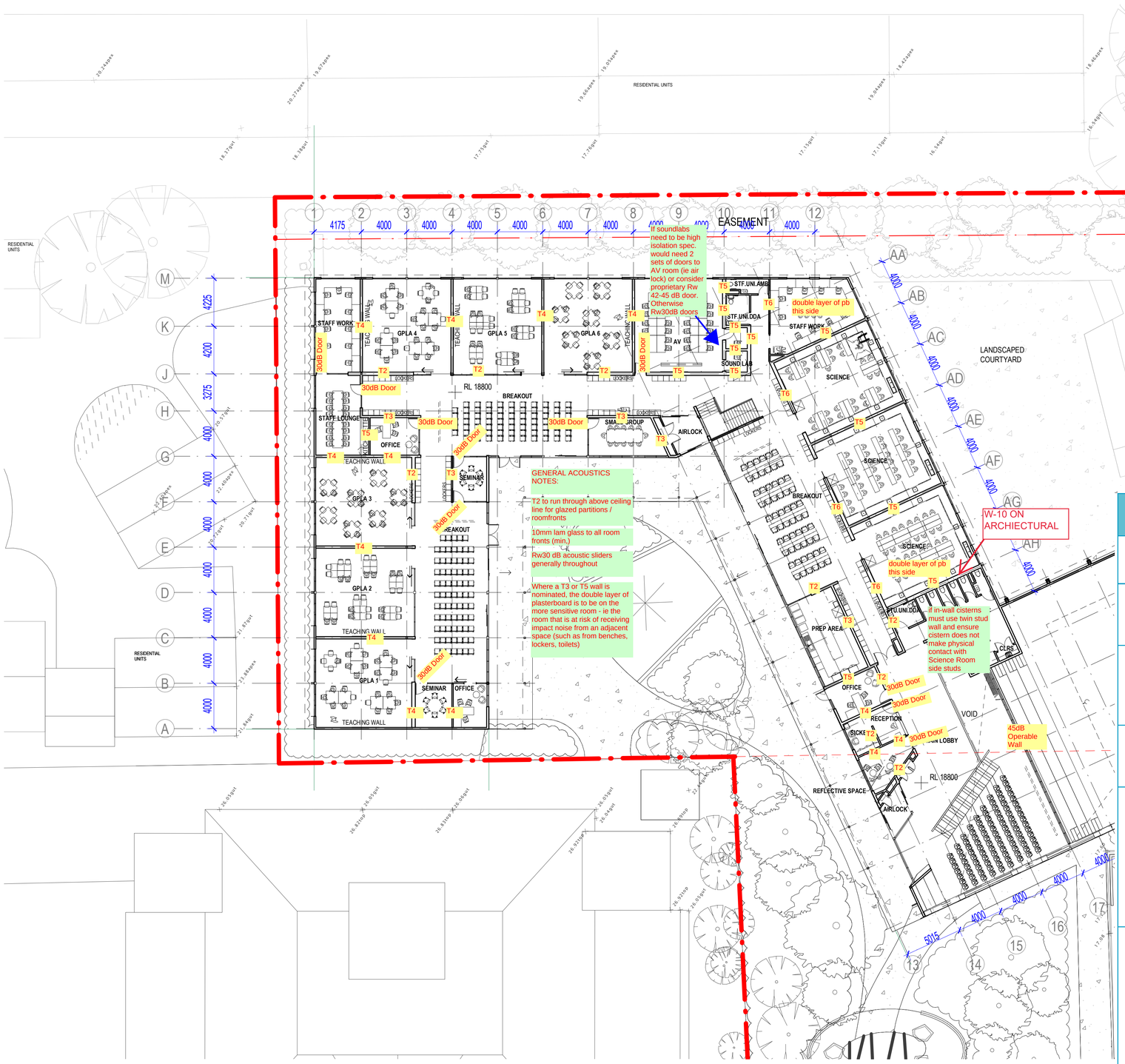
Yours sincerely

Technical Director – Acoustics

SLR Consulting Australia Pty Ltd

Checked/
Authorised by: DW

Attachment A: Architectural Markups



SLR Markup

13-Sep-2022

Wall Type	Description	Acoustic Rating Rw
T1	1x13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard each side of 92 mm 0.75 BMT stud, [118 mm overall]	35 dB
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T4	2x13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard to both sides of 92 mm 0.75 BMT stud, 75mm thick 14kg/m3 glass fibre insulation to cavity [144 mm overall]	50-53 dB
T5	Impact / hydraulic noise control wall: 1x13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard to one side, separate stud (or stag stud construction in 150 mm track), 2 x 13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard to other side of, wall, 2 x 75mm thick 14kg/m3 glass fibre insulation to cavity [190-225 mm overall depending on type of stud wall]	52-56 dB
T6	Cavity Slider Wall 1x13 mm standard (min. 8.5 kg/m2) or impact resistant plasterboard each side of separate 92 mm 0.75 BMT studs, cavity as required for slider, 75mm thick 14kg/m3 glass fibre insulation to each cavity. Note if a lining is required to the inside of the studs (to ensure insulation does not fall within cavity slider zone), provide wire, perforated pegboard, perforated plasterboard or other 'open' material to hold insulation in place. [approx. 310 mm overall with 100 mm cavity zone allowance]	>Rw 45 dB

1 / 008 GROUND FLOOR PLAN

SCALE - 1 : 200

ADVERTISED PLAN

Revision	Description	Date

PRELIMINARY
NOT FOR CONSTRUCTION

CLIENT
EMMANUEL COLLEGE

PROJECT TITLE
EDMUND RICE YEAR 9 CENTRE

ADDRESS
140 BOTANIC ROAD, WARRNAMBOOL, VICTORIA 3280

DRAWING TITLE
GROUND FLOOR PLAN

NORTH | CHECKED | DRAWN | DATE | SCALE @ A1: 1 : 200

PROJECT NO. 20210078 | DRAWING NO. SD-101 | REVISION

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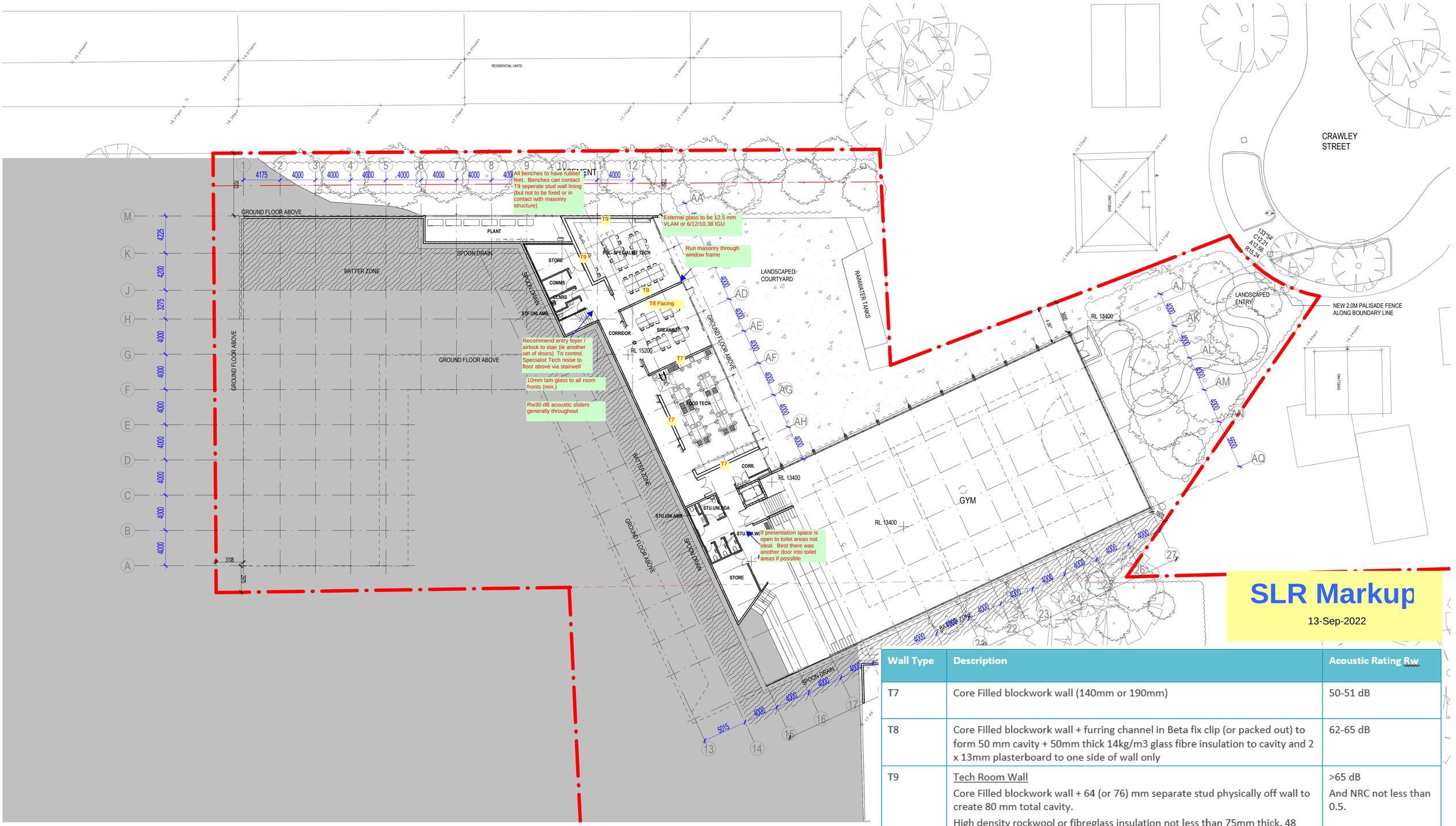

SLR Markup

13-Sep-2022

Wall Type	Description	Acoustic Rating Rw
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T9	<u>Tech Room Wall</u> Core Filled blockwork wall + 64 (or 76) mm separate stud physically off wall to create 80 mm total cavity. High density rockwool or fibreglass insulation not less than 75mm thick, 48 kg/m^3 to wall cavity. Perforated plywood or 'pegboard' lining to face of studs.	>65 dB And NRC not less than 0.5.

1 / 008 LOWER GROUND FLOOR PLAN

SCALE - 1 : 200

ADVERTISED PLAN

Revision	Description	Date

PRELIMINARY
NOT FOR CONSTRUCTION

CLIENT: EMMANUEL COLLEGE

PROJECT TITLE: EDMUND RICE YEAR 9 CENTRE

ADDRESS: 140 BOTANIC ROAD, WARRNAMBOOL, VICTORIA 3280

DRAWING TITLE: LOWER GROUND FLOOR PLAN

NORTH | CHECKED | DRAWN | DATE | SCALE @ A1: 1 : 200

PROJECT NO.: 20210078 | DRAWING NO.: SD-100 | REVISION

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