BRONER CONSULTING

Acoustic Design Report

171 Swan Street Richmond

13th April 2017

Document history and status

Revision	Date	Description	By	Review	Approved
A	13/4/17	Design Report	N Broner		N Broner

Executive Summary

Broner Consulting Pty Ltd was engaged by Loop Architects to provide an acoustics design report for the proposed development at 171 Swan Street. The proposed development includes basement car parking and plant area, ground level retail, level 1 commercial and residential apartments from level 2 – 5.

Noise Level measurements were conducted at night time to characterise the background noise level in the area as well as during the daytime to characterise the tram and traffic noise levels.

Noise criteria for various occupancies were noted and the Sleep Disturbance criterion was also noted. Internal wall options were provided and glazing/sliding doors also provided to achieve the indoor noise criteria. Criteria for internal air conditioning noise levels were also provided and a Sound Power Level limit was set for the outside condensers. Due to the roof slab, no special recommendation was required for rain noise. General recommendations for hydraulic noise control were also provided. To minimize stacker noise emission, the rear car park area ceiling area should be acoustically lined.

Contents

Glossary

Term	Description
Noise Spectrum	The sound pressure level (or sound power level) as a function of frequency (eg octave band, 1/3 octave or narrow band). Generally used to identify noise sources or items contributing disproportionately to an overall noise level.
Ambient Noise Level	The prevailing noise level at a location due to all noise sources but excluding the noise from the specific noise source under consideration. Generally measured as a dB(A) noise level.
Background Noise Level	The lower ambient noise level, usually defined as the value of the time varying ambient noise level exceeded for 90% of the measurement time. Usually defined in the dB(A) scale - L_{A90}.
dB	Sound pressure levels are expressed in decibels as a ratio between the measured sound pressure level and the reference pressure. The reference pressure is $2x10^{-6}$ Pascal (Newtons per square meter).
dB(A)	The A-weighted sound pressure level in decibels, denoted dB(A) is the unit generally used for the measurement of environmental, transportation or industrial noise. The A-weighting scale approximates the sensitivity of the human ear when it is exposed to normal levels and correlates well with subjective perception. An increase or decrease in sound level of approximately 10 dB corresponds to a subjective doubling or halving in loudness. A change in sound level of 3dB is considered to be just noticeable.
Frequency	The rate of repetition of a sound wave. The unit of frequency is the Hertz (Hz), defined as one cycle per second. Human hearing at everyday sound pressure levels ranges approximately from 20 Hz to 20,000 Hz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands. For more detailed analysis each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.
L_{Fast}	The sound pressure level during the measurement period when using a Fast time response (0.125 seconds)
L_{eq}	The Equivalent Continuous Noise Level over the measurement time period eg over a 5 minute time period
Sound Level Meter	An instrument consisting of a microphone, amplifier and data analysis package for measuring and quantifying noise.
Rw	The Weighted Sound Reduction Index is a single-number quantity which characterises the airborne sound insulation of a material or building element such as a wall, window or door over a range of frequencies.
C_{tr}	An adjustment factor which is used to account for low frequency noise - typically the biggest problem with sound insulation. Ctr is always a negative number, so the Rw+Ctr will always be less than the Rw value.

1.0 Introduction

Broner Consulting Pty Ltd was engaged by Loop Architects to prepare an Acoustics Design Report for the proposed development at 171 Swan Street. The proposed development includes a basement car park and commercial tenancy, ground level retail, level 1 commercial and residential apartments from level 2 – 4.

The purpose is to provide noise attenuation measures to ensure the internal amenity of the residential building is not adversely affected by external noise sources (e.g. traffic and tram noise from Swan Street, mechanical plant equipment from nearby commercial uses, live music venues, etc.) and that the surrounding and proposed dwellings are not adversely impacted upon by mechanical plant equipment noise from the proposed development, including the garage entrance and car stackers.

This report presents our design recommendations for external and internal noise levels in accordance with the EPA Policy No N-1, the ABCB National Construction Code (BCA) requirements, AS2107 and sleep disturbance criteria.

2.0 Site Description

The proposed development at 171 Swan Street, Richmond, is in an area dominated by commercial and retail development. See Figure 1 below. The immediate area is zoned Commercial within Residential not too far away – see Figure 2.

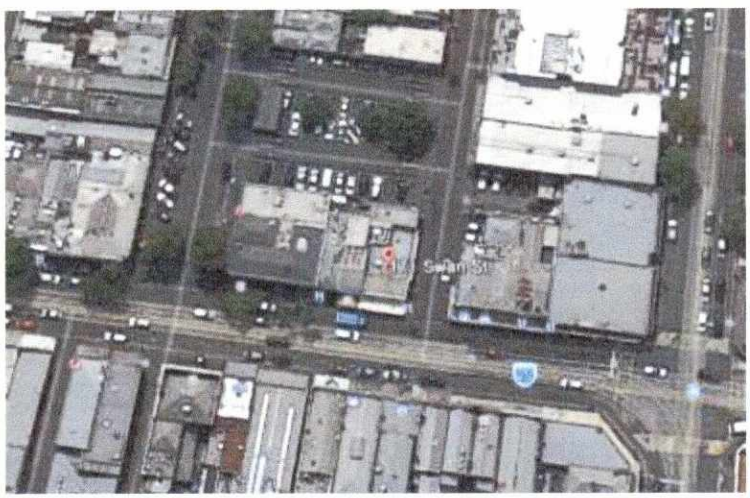


Figure 1 Plan showing 171 Swan Street and Environs

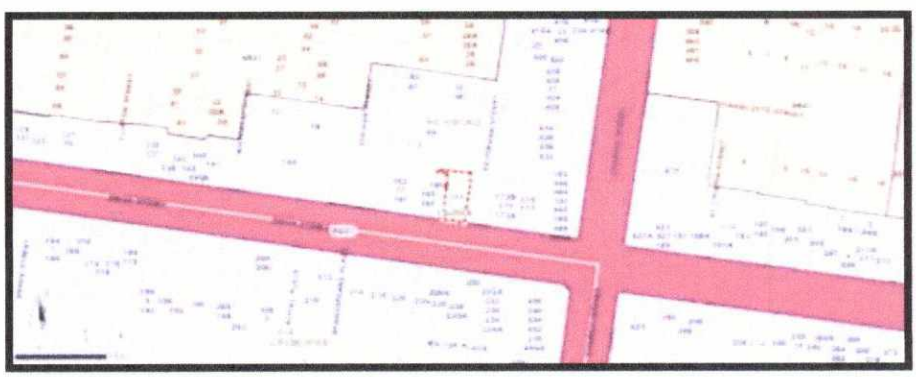


Figure 2 Zoning Map for the Area Around 171 Swan Street, Richmond

3.0 Noise Level Measurements

3.1. Ambient Noise Level

To derive the Noise Limit for noise emission from the proposed development, a Rion NL-001 noise logger was located on the roof of 171 Swan Street. The roof itself felt a little bit unstable so the logger was placed on the ductwork as shown in Figure 3 below.

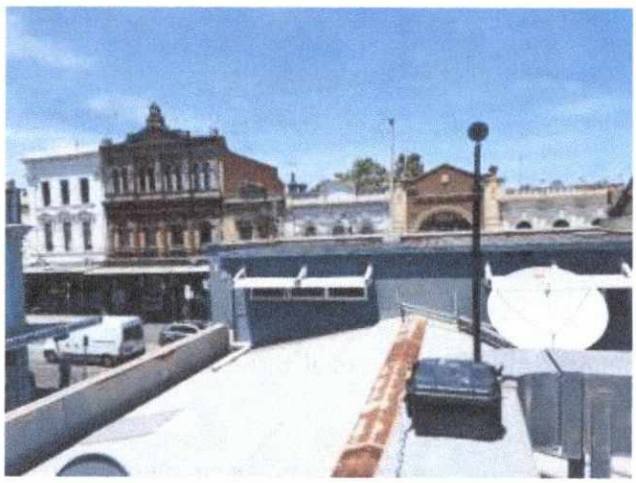


Figure 3 Location of the Noise Logger on the Roof of 171 Swan Street

At this location, the noise logger was somewhat shielded from the traffic noise on Swan Street. This means that the derived Noise Limit would be somewhat conservative. It also means that an allowance should be made with respect to the traffic noise intrusion level when considering the front façade design. Figure 4 below shows the diurnal noise level variation over time measured from 19 – 23 December 2016.

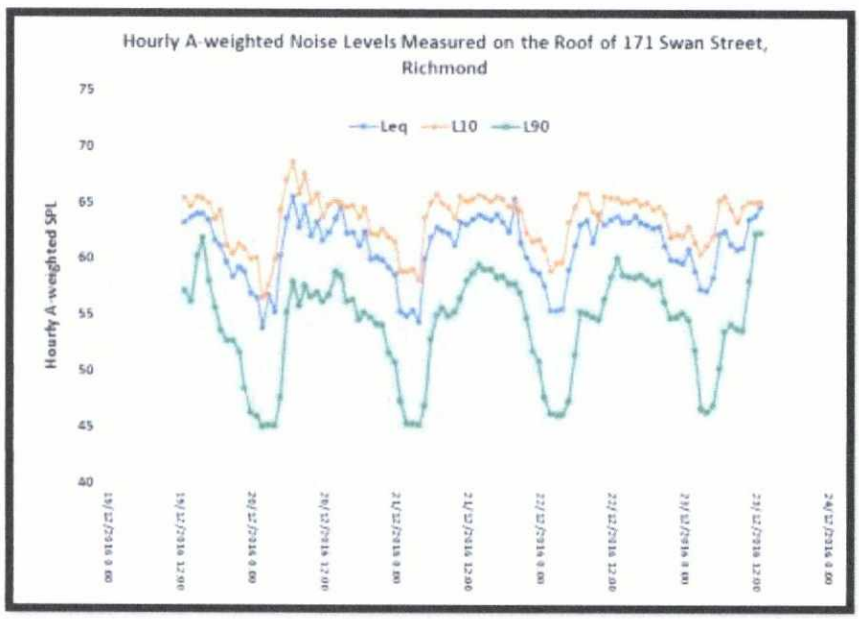


Figure 4 Hourly Noise Level Variation on the Roof of 171 Swan Street from 19 – 23 December 2016

3.1.1. Noise Limit

To derive the appropriate Noise Limit in accordance with the EPA Policy No N-1, the Influence Factor (IF) is first calculated based on the Zonings and the measured Period Background Noise Levels. Figure 5 shows the basis for the IF calculation.

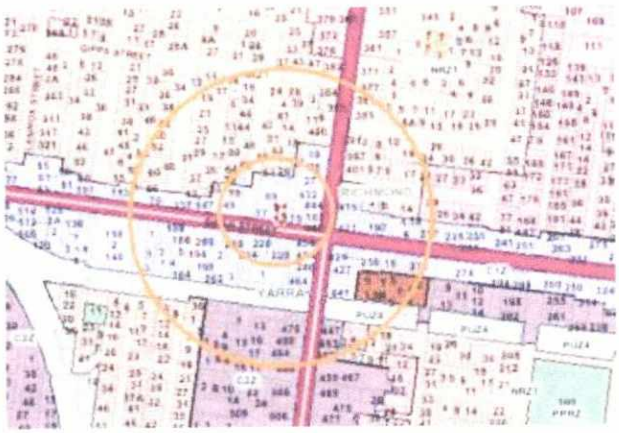


Figure 5 Circles Marked Up for Calculating the Influence Factor

The night time Noise Limit is the most stringent of all three time periods. The derived night time Noise Limit is 45 dBA.

This night time Noise Limit applies to noise emission for air conditioning condenser units at neighbouring residential locations.

3.2. Traffic Noise Level

The traffic noise level was measured at 1m from the facade and at 6m back from the facade to obtain an indication of the incident traffic noise levels – see Figures 6 and 7 which show the measurement setup . This was for the purpose of determining the glazing design required to achieve compliance with Standards.

Figure 6 Measurement Location at 1 metre from the Facade

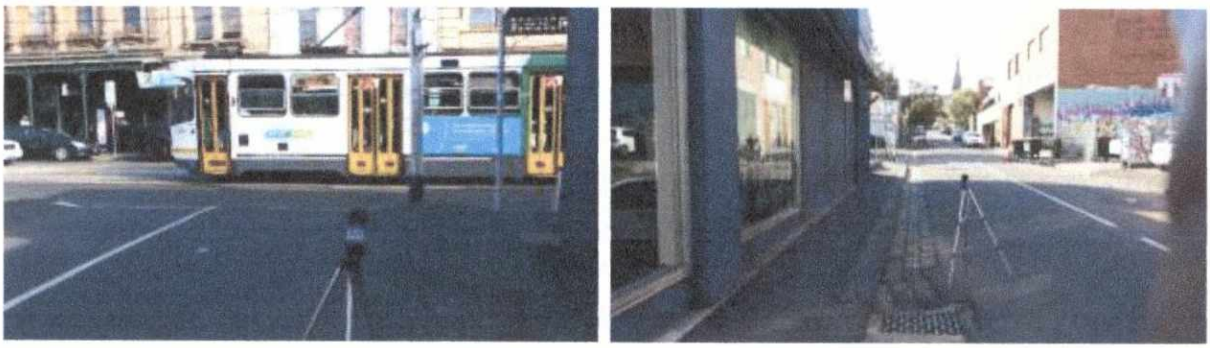


Figure 7 Measurement Location 6m back from the Facade

Figure 8 and 9 show the traffic noise level versus time traces at 1m and 6m from the curb respectively. Trams, trucks and motorbikes caused the greatest increase in noise levels with trams going away from the city (closest line) generating the highest noise level (up to 85 $L_{Aeq,1s}$).

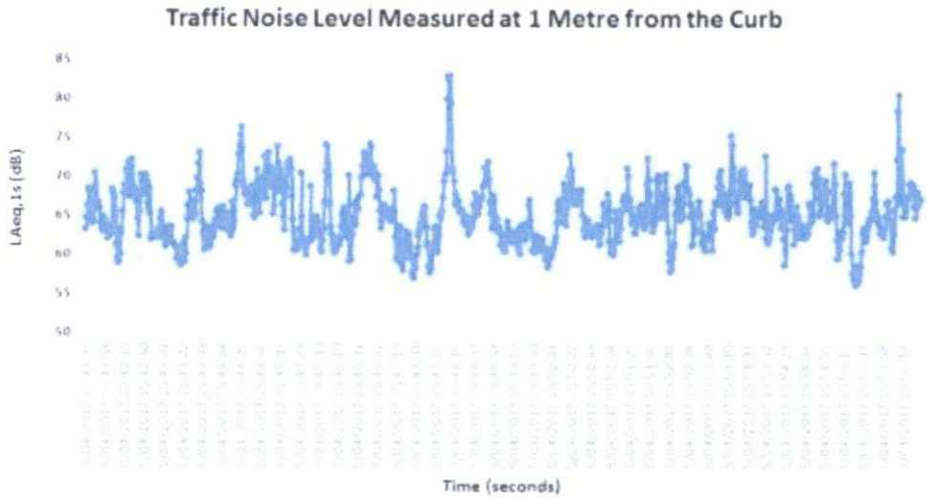


Figure 8 Traffic Noise Level Versus Time at 1m from the Curb

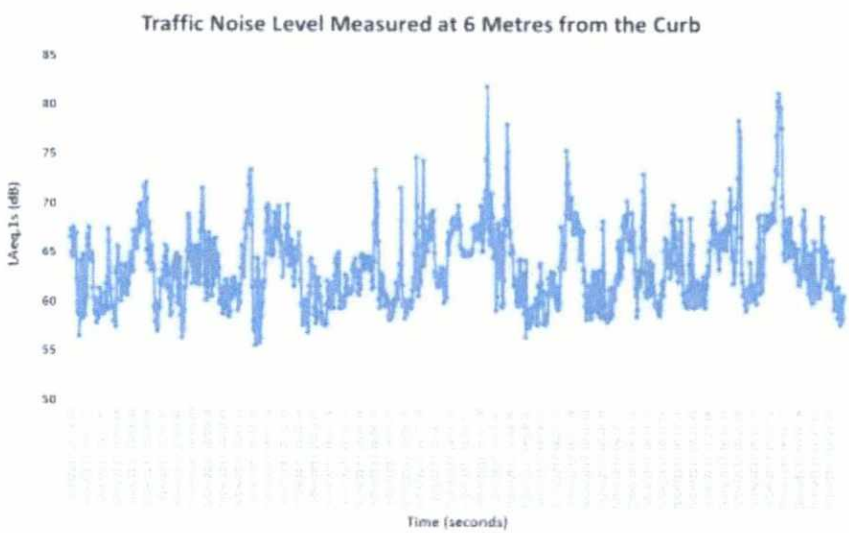


Figure 9 Traffic Noise Level Versus Time at 6m from the Curb

4.0 Criteria

4.1. AS2107:2016

AS2107:2016 "Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors" recommends acoustic design sound levels for various occupied spaces due to background steady noise sources such as air conditioning and distant traffic. The recommended design levels are for ensuring a healthy, comfortable and productive environment for the occupants and the users.

The relevant criteria for the proposed development are shown in Table 1 below excerpted from Table 1 of the Standard.

Table 1 DESIGN SOUND LEVELS FOR DIFFERENT AREAS OF OCCUPANCY IN BUILDINGS

Type of occupancy/activity	Design sound level ($L_{Aeq,t}$) range
OFFICE BUILDINGS	
Board and conference rooms	30 to 40
Corridors and lobbies	45 to 50
Executive office	35 to 40
General office areas	40 to 45
Meeting room (small)	40 to 45
Open plan office	40 to 45
Reception areas	40 to 45
Toilets	45 to55
Undercover carparks	< 65
SHOP BUILDINGS	
Small Retail Stores	< 50
Show Rooms	< 50
RESIDENTIAL BUILDINGS Houses and apartments in inner city areas or entertainment districts or near major roads	
Apartment common areas (e.g. foyer, lift lobby)	45 to 50
Living areas	35 to 45
Sleeping areas (night time)	35 to 40
Work areas	35 to 45

4.2. Sleep Disturbance

The potential impact on sleep of residents due to road traffic and trams on Swan Street needs to be considered. There is no sleep criterion approach in Victoria. However, the NSW Road Traffic Noise Policy (March 2011) reviewed sleep disturbance criteria and concluded that:

"From the research on sleep disturbance to date it can be concluded that:

- maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep
- one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly".

The LAmax descriptor is used to measure and quantify maximum noise level events. The LAmax is the maximum fast time weighted sound level of an event measured with a sound level meter satisfying AS IEC 61672.1-2004.

4.3. Sound Insulation

The ABCB National Construction Code (BCA) specifies in Section F5 the insulation for walls, floors and services for different adjacencies. Table 2 below indicates the sound insulation requirements relevant to the apartments.

Table 2 Sound Insulation Requirements for Apartments

WALLS

AREA	ADJOINING AREA	BCA Requirement
Habitable	Habitable	Rw + Ctr 50
Habitable room (other than Kitchen)	Bathroom, sanitary compartment, laundry or Kitchen	Rw + Ctr 50 discontinuous
Any Room in Apartment	Corridor, Stairway, Lobby	Rw 50
Any Room in Apartment	Lift shaft, plant room	Rw 50 discontinuous

FLOORS

Apartment	Sound Insulation Requirement
Floor separating sole occupancy units or a sole occupancy unit from plant room, lift shaft, stairway, public corridor or lobby	Rw + Ctr not less than 50 Lnw + Ci not more than 62

DOORS

Apartment	Sound Insulation Requirement
A door in wall that separates an apartment from a stairway, public corridor, public lobby	Door Assembly not less than Rw 30

SERVICES

Apartment	Sound Insulation Requirement
If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one sole occupancy unit, the duct or pipe must be separated from the rooms of any sole occupancy unit	Rw + Ctr not less than: 40 if the adjacent room is a habitable room (other than a Kitchen) or 25 if the adjacent room is a Kitchen or non habitable room
If a storm water pipe passes through a sole occupancy unit	As Above

5.0 Design Recommendations

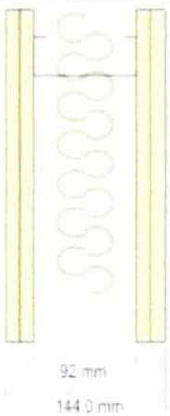
5.1. Sound Insulation

There are many options for compliance with respect to Sound Insulation. We show below indicative solutions but many others can be considered.

5.1.1. Wall Options Rw + Ctr 50

CSR 048 	*Both Sides* • 2 x 13mm GYPROCK SOUNDCHEK plasterboard.	(a) Nil	49/43
		(b) 50 GW Partition 11kg	57/49
		(c) 75 GW Partition 11kg	58/**50**
		(d) TSB3/ASB3 Polyester	56/**50**
		(e) 60 Soundscreen™ 2.0 batts	58/49
		WALL THICKNESS mm	144

System Reference:	
Lining Side One:	
Plate Size(mm):	
Framing:	
Insulation:	
Lining Side Two:	
FRL - LB:	
FRL - NLB:	
Acoustic Ratings:	
Nom Wall Width (mm):	
Acoustic Basis:	
FRL Basis:	



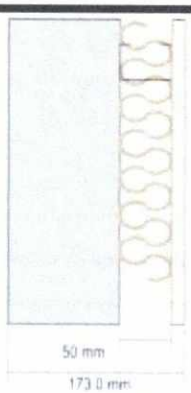
Rw 59 dB
C -3 dB
C_{tr} -8 dB
D_{nTw} 61 dB

System description

Panel 1: 2 x 13.0 mm CSR Gyprock 13mm Soundchek plasterboard (ρ 1000 kg/m3, E 3.8GPa, η 0.01)

Cavity: Steel stud (0.55mm). Stud spacing 600 mm. Infill: Earthwool 11kg/m³ 50mm Acoustic Wall Batt. Thickness: 50 mm. (ρ 11 kg/m3, Rf 9000 Pa.s/m2.)
Panel 2: + 2 x 13.0 mm CSR Gyprock 13mm Soundchek plasterboard (ρ 1000 kg/m3, E 3.8GPa, η 0.01)

CSR 739				
	*Masonry Side* • 1 x 13mm GYPROCK plasterboard CD *Stud Side* • 1 x 10mm GYPROCK plasterboard CD.	(a) 75 GW Partition 11kg	60/**51**	62/**54**
		(b) 90 Gold Batts™ 2.0	61/**52**	63/**55**
		(c) TSB4/ASB4 Polyester	59/**50**	61/**53**
		ADDITIONAL WALL THICKNESS mm	104	132

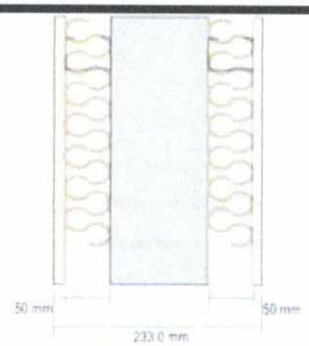


Rw 59 dB
C -2 dB
C_{tr} -8 dB
D_{nTw} 61 dB

System description

Panel 1 : 1 x 110.0 mm Solid Conc Blocks (ρ:2100 kg/m3,E:20GPa,η:0.04)

Cavity : Steel stud (0.55mm); Stud spacing 600 mm ; Infill: Earthwool 11kg/m³ 50mm Acoustic Wall Batt Thickness 50 mm (ρ:11 kg/m3, Rf:9000 Pa.s/m2)
Panel 2 : 1 x 13.0 mm CSR Gyprock 13mm standard plasterboard (ρ:650 kg/m3,E:1.9GPa,η:0.01)



Rw 65 dB
C -7 dB
C_{tr} -15 dB
D_{nTw} 67 dB

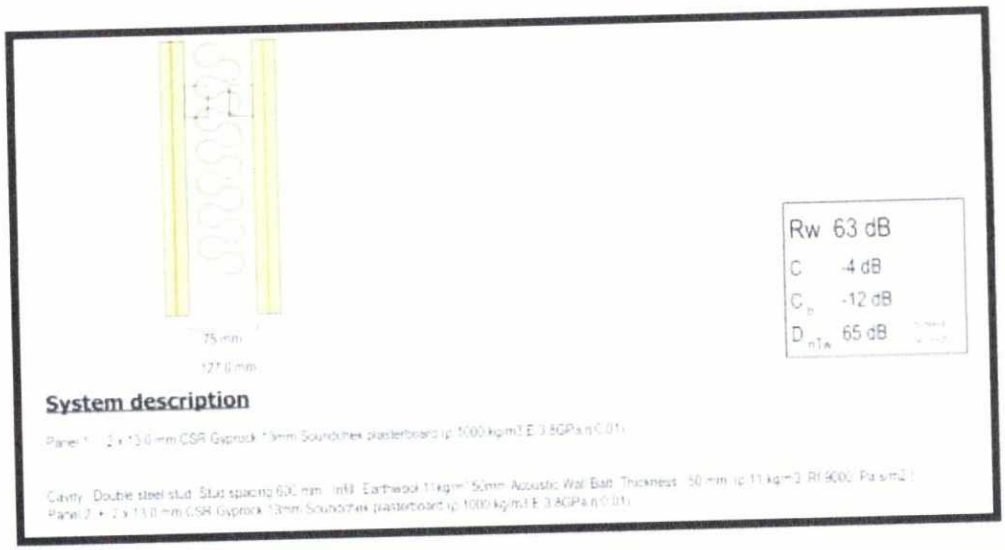
System description

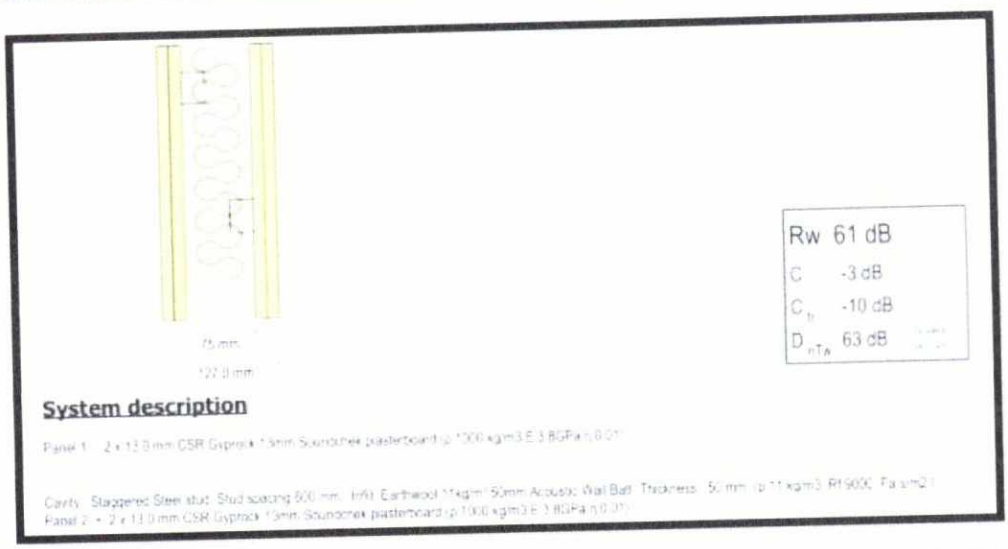
Panel 1 : 1 x 13.0 mm CSR Gyprock 13mm standard plasterboard (ρ:650 kg/m3,E:1.9GPa,η:0.01)

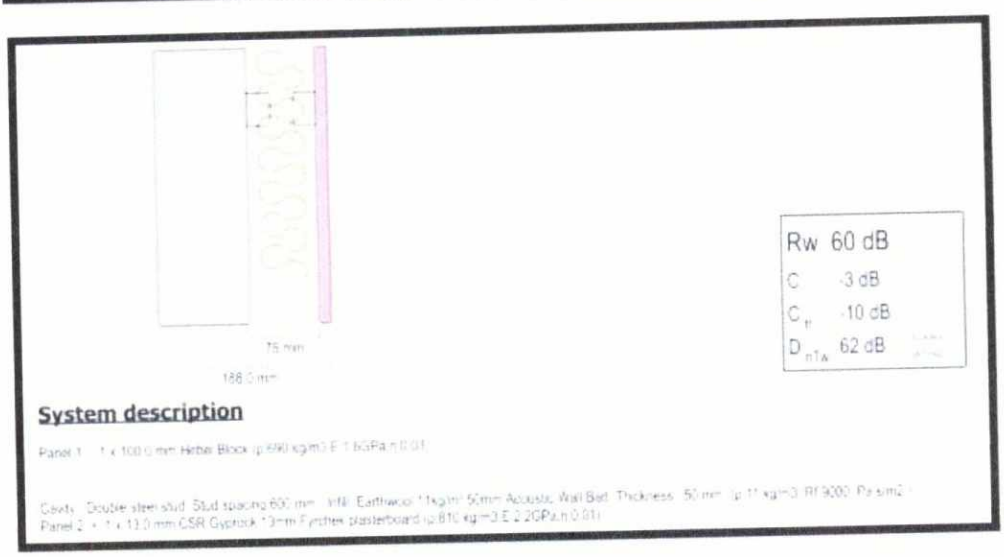
Cavity : Steel stud (0.55mm); Stud spacing 600 mm ; Infill: Earthwool 11kg/m³ 50mm Acoustic Wall Batt Thickness 50 mm (ρ:11 kg/m3, Rf:9000 Pa.s/m2)
Panel 2 : 1 x 110.0 mm Solid Conc Blocks (ρ:2100 kg/m3,E:20GPa,η:0.04)

Cavity : Steel stud (0.55mm); Stud spacing 600 mm ; Infill: Earthwool 11kg/m³ 50mm Acoustic Wall Batt Thickness 50 mm (ρ:11 kg/m3, Rf:9000 Pa.s/m2)
Panel 3 : 1 x 10.0 mm mm Plasterboard (ρ:710 kg/m3,E:2GPa,η:0.01)

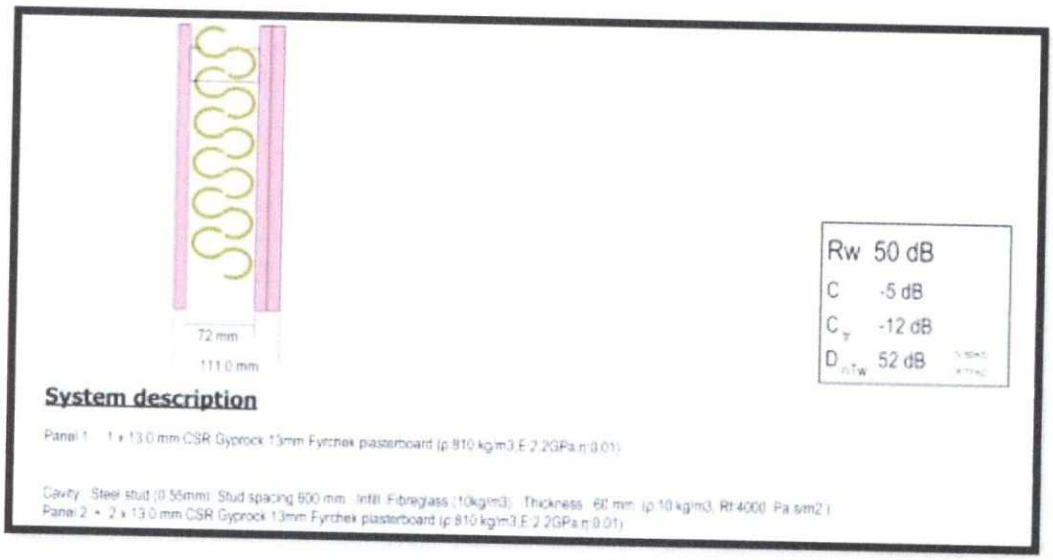
5.1.2. Rw + Ctr 50 discontinuous

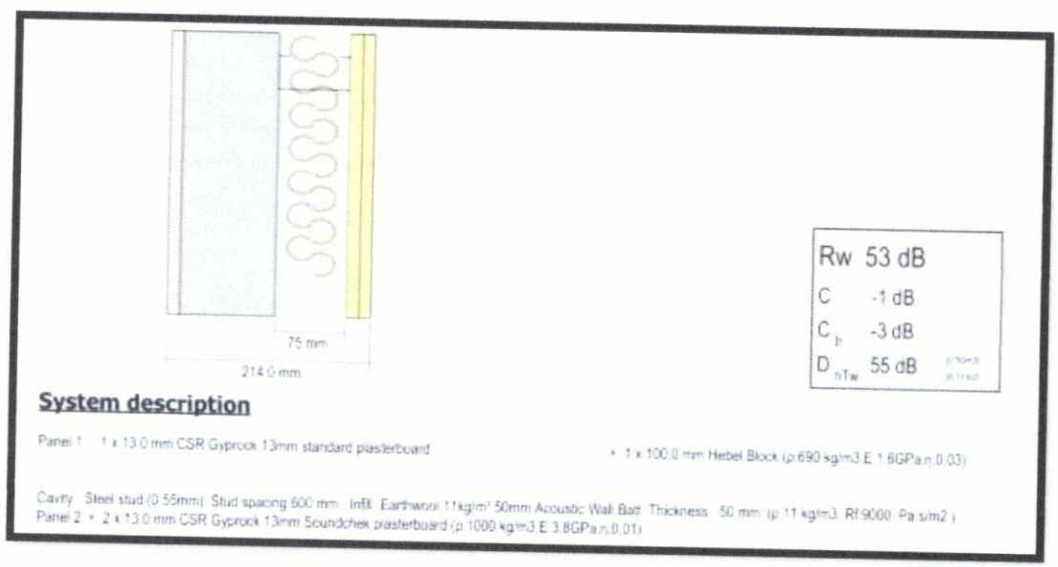






5.1.3. Wall Options Rw 50



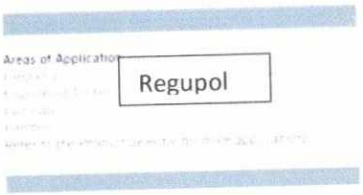


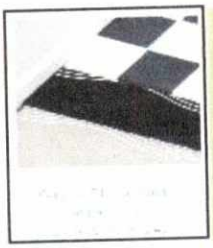
5.1.4. Floor/Ceiling Systems

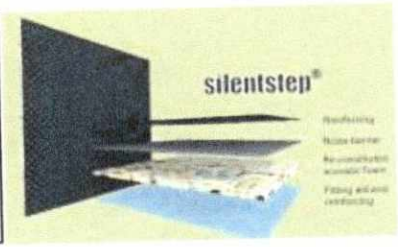
The floor coverings in this instance will be carpet in the bedrooms, tiles in the bathrooms and T&G timber floorboards in the living areas.

As 200mm concrete slabs are proposed for use as the floors, it will only be necessary to use underlay under the carpet.

Regupol 4515 9mm can used as an underlay under the ceramic tile flooring and Regupol 6010 10mm can be used under the T&G timber with plywood. Other underlays that can be considered are Embelton Impactamat 800 (5mm thick) or Pyrotek Silentstep 10mm. The suppliers should be consulted to obtain the optimum installation information.

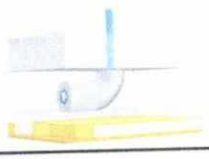






5.1.5. Services

Services running in ceiling voids should be enclosed as for example as below:

CSR SS12 	• 1 x 13mm GYPROCK SOUNDCHEK plasterboard	(a) Nil	Nil	0	27
		(b) Nil	Acoustilag™ 45	0	41
		(c) 75 GW Partition – 11kg	Acoustilag™ 45	5	43

CSR SS42	INNER LAYER • 2 x 13mm GYPROCK FYRCHEK OUTER LAYER/CEILING • 2 x 13mm GYPROCK Plasterboard CD	(a) 50 GW Partition – 11kg	Nil	53/44
		(b) TSB4 Polyester	Nil	53/46

Piping can be lagged with Pyrotek Soundlag 4525C or Rehau piping can be used.

5.1.6. Doors

To comply with the Rw 30 requirement for an apartment door, a solid core door 40mm thickness with door seals is required. A Spence Sontron 40SC-1 with perimeter and floor seals and threshold plate or equivalent will be acceptable.

5.2. Façade Glazing

We have based our analysis on the assumption that the façade structure will be constructed from 20mm precast concrete.

For the retail and commercial office, use Capral XO 6.38 laminated or equivalent.

Figures 10 – 13 show the façade glazing requirements. Capral or equivalent acoustic performance should be used. Where no glazing is specified, then any glazing option can be used to suit.

Figure 10 Glazing/Sliding Doors For Level 2

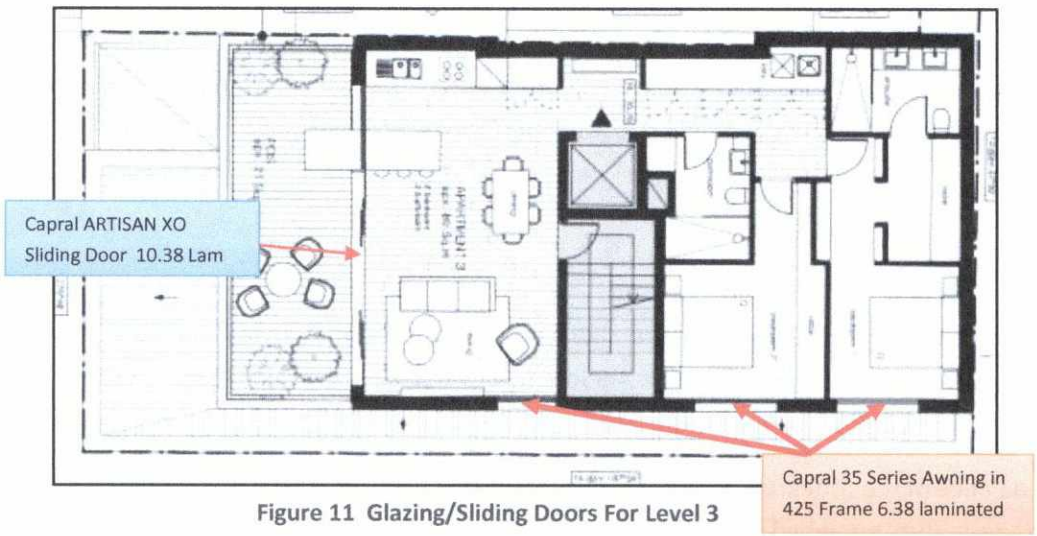


Figure 11 Glazing/Sliding Doors For Level 3

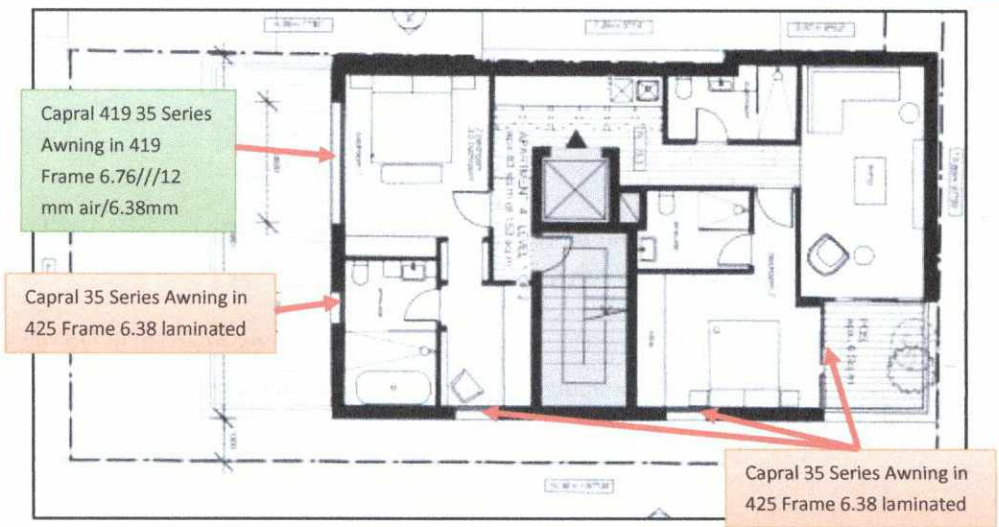


Figure 12 Glazing/Sliding Doors For Level 4

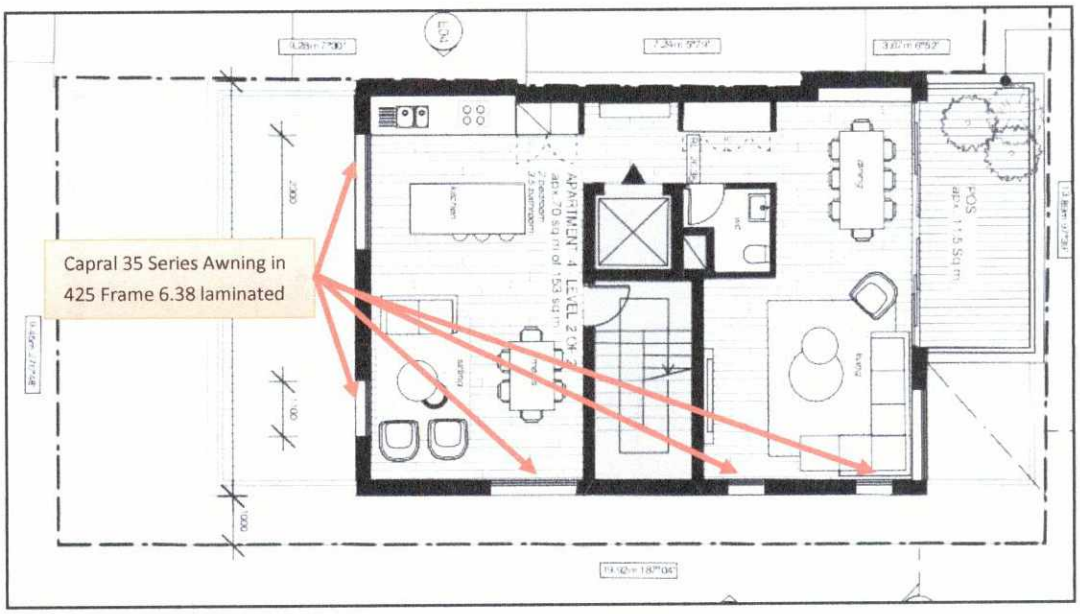


Figure 13 Glazing/Sliding Doors For Level 5

We have given glazing/sliding door recommendations based on the Capral range of products. Alternatives are acceptable as long as they have a similar acoustic performance.

5.3. Rain Noise

The plant area is to be a 200mm structural slab with a vapour retarder, rigid insulations and a waterproofing membrane with a slope of min 1:50 over. A 350mm floor thickness is available for addition structure and insulation as required for thermal purposes.

For the balance of the roof areas which has roof sheeting alone, there will be a 200mm structural slab with timber framing to support the ribbed roof decking above with a min 2° pitch. Insulation over slab may be required for thermal purposes only.

5.4. Mechanical Services

Fan coil units and split ducted units should be chosen to ensure that so that the noise level in each room will comply with the requirements of AS2107:2016 for the various occupancies.

Where ducts are used for supply air, internal acoustic lining may be necessary to achieve the internal noise levels. FCU exhaust may require lined ducting or acoustic insulation in the ceiling void to ensure that the exhaust noise level is not excessive.

5.5. Condenser Noise Emission

External Condenser units are planned for some balconies and the noise emission at the nearest residential neighbours will need to comply with the Night Time Noise Limit of 45 dBA.

For the balcony on the south side of Level 3, the Outdoor Unit Sound Power Level must be less than 70 dBA and should be located on the south western corner of the balcony.

For the balconies on the north eastern side on Levels 2 and 4, the Outdoor Unit Sound Power Level must be less than 64 dBA and placed on the north eastern side (adjacent to the parapet which should be 100mm higher than the top of the condenser unit.

5.6. Hydraulic Noise Control

Typical sources of hydraulic noises include fitting noises, filling noise, draining noises, inlet noises and impact noises. To minimise airborne and structure borne noise transmitted by hydraulic services, the following general guidelines should be followed:

- Good space planning is imperative.
- No direct rigid contact should occur between piping and surrounding structures or wall materials. Use flexible caulking or mastic to fill oversize penetrations.
- Use a minimum of 6 - 12 mm neoprene rubber to isolate any clamps or fixtures from the piping.
- Size pipes for maximum flow velocities of 1.8 m/sec maximum.
- Regulate maximum water pressure to 3.5kg/sq cm in main risers and lines, and 2.5kg/sq cm in distribution branches.
- Select quiet fixtures.
- Use cast iron pipe for waste/drain lines.
- Install tubs and showers on 2.5cm thick glass fibrepads and coat the back of the tub/shower enclosure with a mastic damping material.
- Incorporate flexible connections between piping systems and noise producing equipment, such as booster pumps, dishwashers, garbage disposals, etc.
- Acoustically lag piping with Pyrotek Acoustic Lag 4525 or use Rehua Rapiano Plus

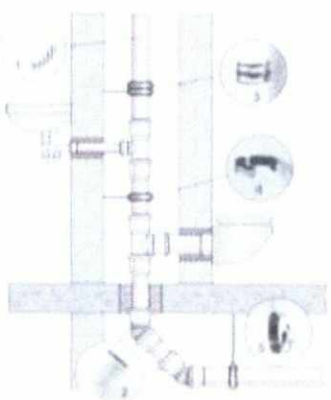


Figure 14 Hydraulic Noise Treatments

5.7. Car Stacker Noise

Car stackers create a tonal noise during their operation and when the lift hits the stops. The maximum level is LAmax 80 dBA at 6 metres when the stops are hit. We recommend that, in this instance, the ceiling of the car parking area be lined with 50mm Reapor from Pyrotek or equivalent.

6.0 Summary

Broner Consulting Pty Ltd was engaged by Loop Architects to provide an acoustics design report for the proposed development at 171 Swan Street. The proposed development includes basement car parking and plant area, ground level retail, level 1 commercial and residential apartments from level 2 – 5.

Noise Level measurements were conducted at night time to characterise the background noise level in the area as well as during the daytime to characterise the tram and traffic noise levels.

Noise criteria for various occupancies were noted and the Sleep Disturbance criterion was also noted. Internal wall options were provided and glazing/sliding doors also provided to achieve the indoor noise criteria. Criteria for internal air conditioning noise levels were also provided and a Sound Power Level limit was set for the outside condensers. Due to the roof slab, no special recommendation was required for rain noise. General recommendations for hydraulic noise control were also provided. To minimize stacker noise emission, the rear car park area ceiling area should be acoustically lined.

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