Sebastian Giglio Acoustic Consultant
B Eng (Hons) Mech
Building Acoustics ♦ Mechanical Services Noise ♦ Environmental Noise
PO Box 8400 Ph: (02) 8786 0912 Email: sgiglio@bigpond.net.au
Mt Pritchard NSW 2170 Fx: (02) 8786 0913 ABN 90 809 049 548

Rail Noise and Vibration Assessment - Proposed Residential Development Avon Road Pymble

Report prepared for:

JW Neale Pty Ltd (Receivers and Managers Appointed)
c/- PPB Advisory
Level 46, 19 Martin Place
Sydney NSW 2000

By email: Marchese Partners, psalotto@marchesepartners.com.au

Report Name:

Rail Noise and Vibration Assessment - Proposed Residential Development Avon Road Pymble

Prepared by:

Sebastian Giglio
B Eng (Hons) Mech

Date: 17 December 2012

Please note that this correspondence has only addressed the acoustical issues discussed. Other aspects of building design, such as fire-rating, structural and waterproofing considerations must be referred to others. Drawings shown are not for construction.

Table of Contents

1 INTRODUCTION

This Acoustic Report provides an assessment of rail noise impacts at the site of the proposed multi-building residential development at Avon Road Pymble. The Report has been prepared in order to address the indoor rail noise goals of the Infrastructure SEPP.

The following documents have been used in the preparation of the Report:

- Director General's Requirements (DGR) dated 11 February 2009, Y09/283
- NSW Department of Planning Infrastructure SEPP (State Environmental Planning Policy) 2007
- NSW Department of Planning *Development Near Rail Corridors and Busy Roads – Interim Guideline* (2008)
- Drawings prepared by Marchese Partners

Figure 1-1 shows an aerial photograph of the site and surrounds.

Potential acoustic issues that are covered in this report include:

- Indoor noise intrusion from rail passbys;
- Ground-induced vibration from rail passbys in the residential buildings.

Figure 1-1 Site Aerial Photo © Nearmap.com 2012

2 PROJECT/SITE DESCRIPTION

The site is described as Numbers 1, 1A 5A Avon Road, Numbers 4 and 8 Beechworth Road, Pymble (Lot 2 DP 205504, Lots 1 & 3 DP 403072, Lots 1 & 2 DP 583803). A site aerial view is shown in Figure 1-1, together with the site outline.

The project involves construction of four multi-storey residential buildings, described as Building 1 (4-6 storeys), Building 3 (6-7 storeys), Building 4 (6-9 storeys) and Building 5 (6-8 storeys). There is no Building 2 as this was part of an earlier scheme, since omitted. Land area is 2.5 hectares (23,677m^2). A total of 273 apartments are proposed.

The land is not a simple shape (refer to the Figure) but the north-eastern boundary of the site is bounded by the North Shore Railway Line. The site is located between Pymble and Turramurra railway stations. Approximately 220 passenger trains pass the site each weekday. No freight trains use this rail line.

3 NOISE CRITERIA

The NSW Department of Planning has produced a document titled *Development Near Rail Corridors And Busy Roads – Interim Guideline*. This document provides a central document for assessment of rail noise affecting residential land developments in NSW. In the past, a number of documents existed (and still exist) for this purpose: including Development Control Plans issued by Hornsby Council, North Sydney Council, various other Councils and Council bodies such as the Southern Sydney Regional Organisation of Council's (SSROC), as well as State Rail's publication *Interim Guidelines for Applicants – Consideration of Rail Noise and Vibration in the Planning Process*.

The noise criteria of all these separate documents is reasonably similar (as one would expect) with subtle differences. In general, the principle goal is based upon consideration of the total acoustic energy experienced by residential occupants indoors within habitable rooms of apartments and houses. Acoustic energy is additive logarithmically and appears to provide good correlation with subjective experience.

The Department of Planning goals for noise within residences are as follows:

- 35dBA $L_{Aeq(9\text{-}hours)}$ for bedrooms, during the period 10pm-7am;
- 40dBA $L_{Aeq(15\text{-}hours)}$ for other habitable rooms, during the period 7am-10pm;
- If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia.

The 10dBA allowance with doors/windows open is based on the widely accepted premise that a noise reduction of 10dBA can be achieved through an open window.

4 RAIL NOISE LEVELS

For much of the site, the railway line is in cutting. Therefore, the lowest levels of each building will be shielded from rail noise. However, the upper levels will have an "acoustic" direct line-of-sight of the railway line (the actual view may be obscured by trees and foliage but these provide scant acoustic shielding).

Noise levels have been measured at two locations on the site, shown in Figure 1-1. The first location is at the nearest corner of Building 4 to the railway line. Measurements were carried out at 1.5m above the ground and this location was shielded from the rail tracks, although the top of the trains was visible.

The second measurement location was at the site boundary overlooking the tracks, approximately 13m from the nearest track. This was done in order to get a measurement that could be extrapolated to upper levels of apartment buildings, where there is little or no shielding of the tracks from the apartments.

Table 4-1 Summary of Noise Measurements at the Site, Carried Out on 21 November 2012

Time	Location	SEL Sound Level, dBA	L_{Amax} Sound Level, dBA	Log Average SEL
11:19am	1 (shielded)	69.6	61.1	
11:31am		73.7	64.9	
11:34am		73.3	65.7	
11:50am		68.0	60.7	
12:03pm		68.0	61.7	
12:07pm		72.4	63.9	
12:10pm		72.1	64.1	
				71.6 dBA
12:34pm	2 (not shielded)	86.7	79.1	
12:34pm		91.6	72.8	
12:47pm		88.5	81.4	
12:49pm		83.2	76.1	
1:03pm		81.4	74.5	
1:05pm		84.2	76.2	
1:17pm		85.0	77.8	
1:19pm		84.4	76.2	
1:33pm		90.4	84.1	

Time	Location	SEL Sound Level, dBA	L_{Amax} Sound Level, dBA	Log Average SEL
				86.0 dBA

The SEL noise level is a shorthand descriptor of the total energy of a noise event – in this case a train passby. In order to determine L_{Aeq} from SEL, the total energy of all train passbys is summed and logarithmically divided by the time taken (in this case, 9 hours or 15 hours); see the relation below. The result of these calculations is shown in Table 4-2. Note that the numbers of trains has been determined from City rail timetables – see Table 4-3.

- $L_{Aeq,15\text{-hours}}$ = SEL (train passby) + $10*\text{Log}_{10}$(number of trains in 15 hours) - $10*\text{Log}_{10}$(number of seconds in 15 hours)

Table 4-2 Summary of rail noise exposure (most exposed façade), dBA

Building	Distance from Centreline between Both Tracks	Shielding by Other Buildings	Bedrooms Rail Noise $L_{Aeq,9hrs}$	Other Habitable Rooms Rail Noise $L_{Aeq,15hrs}$
Microphone at Boundary	15m	NA	58	61
1	69m	Partial shielding	43	46
3	110m	Yes, well shielded	40	43
4	30m	None	54	57
5	22m	None	56	59

The calculated rail noise exposure in Table 4-2 above takes into account shielding by the embankment as a result of the trains being in cutting past the site. Building 1 and Building 3 require no special acoustic consideration to meet the indoor sound level goals for rail noise.

Table 4-3 Summary of Typical Weekday Rail Movements Passing the Site (both directions)

Time Period	Northbound	Southbound	Total (max)
Midnight-1am	5	0 (3 Friday nights only)	8
1-2am	1 (3 Fri nights only)	0	3
2-3am	0 (1 Fri nights only)	0	1
3-4am	0	0	0
4-5am	1	3	4
5-6am	1	4	5
6-7am	4	7	11
7-8am	7	9	16
8-9am	9	7	16
9-10am	8	5	13
10-11am	5	4	9
11am-midday	5	4	9
Midday-1pm	5	4	9
1-2pm	4	4	8
2-3pm	4	5	9
3-4pm	7	8	15

Time Period	Northbound	Southbound	Total (max)
4-5pm	7	11	18
5-6pm	8	8	16
6-7pm	6	6	12
7-8pm	6	4	10
8-9pm	4	4	8
9-10pm	4	4	8
10-11pm	4	4	8
11pm-Midnight	4	3 (4 Fri nights only))	8

Figure 4-1 Photographs of Noise Measurement Equipment on Site

5 RECOMMENDED NOISE CONTROL MEASURES

5.1 Façade Treatment

The following Table summarises the recommended construction recommendations for the façade of each building. Acoustic Treatment in this case is relatively modest - 4mm glass is sufficient to attenuate the rail noise for affected apartments. If thermal double-glazed windows are installed then the total glass thickness should be at least 8mm. Affected rooms will also require *alternative ventilation*. Options for alternative ventilation are outlined in the next Section of the Report.

Table 5-1 Summary of Acoustic Treatments to Facade

Building	Glazing - Bedroom and Living Room	Alternative Ventilation
1	Any	Not Required
3	Any	Not Required
4	Minimum 4mm for single glass	Yes, all floors
5	Minimum 4mm for single glass	Yes, all floors

5.2 Alternative Ventilation

The provision of alternative ventilation can be achieved in a number of ways. Some of these are described in principle below. A mechanical engineer should confirm that the final design complies with the requirements of the relevant ventilation Standard (typically 10litres/second of fresh air per person).

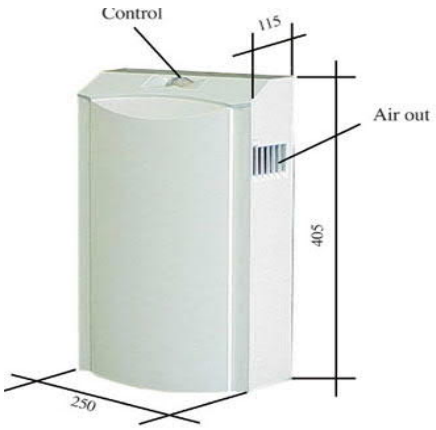
Option 1

Fully ducted air-conditioning with provision included of Outside Air. Many domestic air-conditioning systems do not include outside air by default – it must be specified at the time of tendering/ordering.

Option 2

Proprietary wall-mounted ventilation system, such as Aeropac. Aeropac units are approximately $800 each (per habitable room or per group of rooms – refer to the Mechanical Consultant). Available from Acoustica, ph: 1300 722 825.

Figure 5-1 Example of proprietary wall-mounted ventilation unit that provides air filtering as well as noise control (Aeropac)



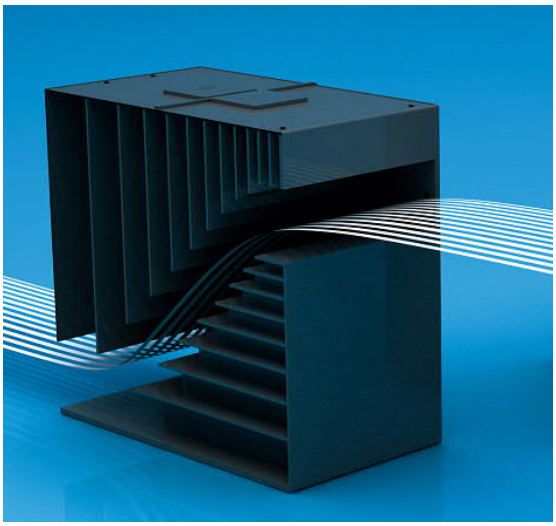
In all cases a Mechanical Engineer must certify that the ventilation requirements have been met.

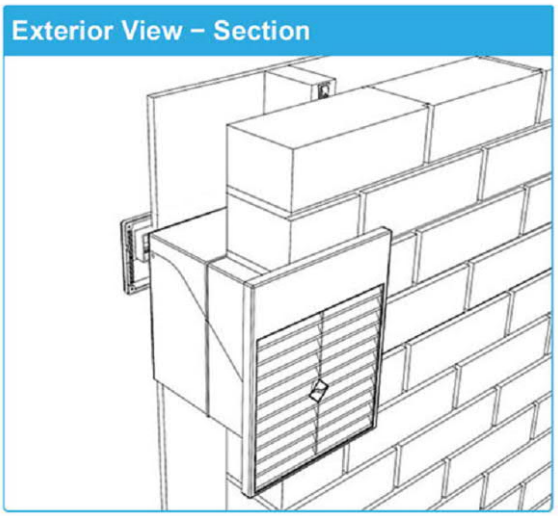
Option 3

Provision of an attenuated air inlet in an external faced and an oversized exhaust fan in the ensuite or bathroom. Having the oversized exhaust fan can promote cross-flow ventilation in the apartment.

Attenuated air inlet could be a proprietary unit such as "Silenceair".

Figure 5-2 SilenceAir external ventilation bricks





Silenceair units are approximately $160-180 each, plus the cost of upgraded toilet/laundry exhaust fans. Available from www.silenceair.com

Note that if a passive acoustically treated air inlet is installed, such as SilenceAir, then an additional fan is required in order to provide cross-flow ventilation; this is often achieved by an oversize toilet/laundry exhaust fan.

Option 4

Similar to Option 3 but with an alternative attenuated air inlet provided by the Builder. This could consist of a simple external air grille in the brick wall, connected to a 1.2m long internally insulated plasterboard bulkhead.

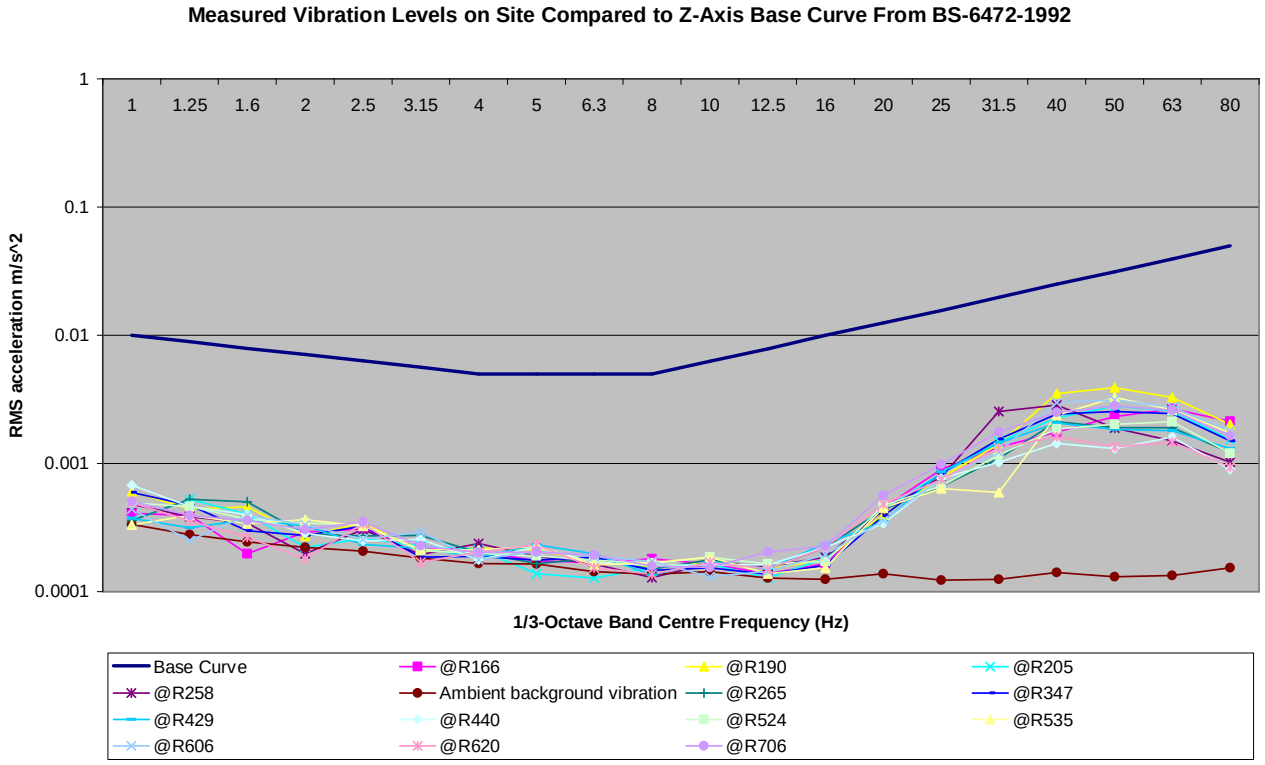
In all cases, a mechanical engineer should confirm that the design complies with the ventilation regulations.

6 RAILWAY VIBRATION

Figure 6-1 shows the graphical results of vibration measurements carried out at the site of Building 4. The allowable level of vibration is based on an "energy dose", similarly to the case of noise. The thick blue line in the graph represents the level of *continuous* vibration that is acceptable for a residence during night-time. Rail-generated vibration is not continuous and so the total energy dose would be lower than represented by the measured data.

Since the rail vibration measurements from each train passby are well below the allowable level of *continuous* vibration, no further investigation is required and vibration levels will comply with the allowable levels.

Figure 6-1 Summary of Measured Vibration



The vibration measurement equipment is shown in Figure 6-2. Equipment consisted of:

- Aluminium ground spike, buried 30cm into the ground;
- Dytran 3185D accelerometer (S/N: 2566);
- Svantek 949 Sound and Vibration Analyser (S/N: 8197).

Figure 6-2 Photograph of Vibration Measurement Setup

7 CONCLUSION

This Acoustic Report has investigated the implications for rail noise for the new residential buildings proposed for the development at Avon Road, Pymble. It has been found that apartments for Building 4 and Building 5 will require alternative ventilation in order that occupants can keep the windows closed if they so desire. The actual glazing requirements are relatively modest. A number of possible systems for alternative ventilation were presented in the Report.

Measurements of rail vibration also indicated relatively low impact and no special considerations are contemplated.

In conclusion it has been found that rail noise levels are not particularly high at the site and that the NSW Department of Planning, as well as the Director General's Requirements, can be met in a relatively straightforward manner.