ACOUSTIC REPORT

FOR

148- 150 GREAT WESTERN HIGHWAY
WESTMEAD

EMF GRIFFITHS

Consulting Engineers

ST GEORGE COMMUNITY HOUSING

Client

HBO+EMTB

Architects

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SECTION 1.0 SITE DESCRIPTION

1.1 INTRODUCTION

EMF Griffiths have been commissioned to provide acoustic consultancy for the architectural and building services for the 148- 150 Great Western Highway Multi-Unit Residential Development, Westmead, NSW.

The multi-purpose development comprises of the following:-

Usage	Description
Apartments	Residential Apartments Levels on Ground Level to Level 6
Car Parking	Basement Level

Table 1: Project Breakdown

1.2 BACKGROUND

An acoustic assessment for noise intrusion to maintain appropriate levels of amenity for the building residents and users is required. The assessment is to include a review of building layout drawings, mechanical services, architectural schedules with respect to the acoustic requirements of the BCA section F5 and Australian Standard AS2107 and to propose acoustic design recommendations.

1.3 OBJECTIVES

Internal Acoustic Amenity study as follows:-

- Identification of target internal noise levels.
- Characterisation of noise emissions associated with the external mechanical plant and activities (e.g. waste and on site vehicle movements, outdoor space noise emissions from site occupants) associated with the development.
- Recommendations for appropriate noise amelioration measures to mitigate noise impact for the building residents and building users.
- Acoustic design in accordance with requirements of the Building Code of Australia.
- Acoustic Design of Noise Control Measures for Mechanical Ventilation. The noise emanating from the mechanical ventilation system shall be in accordance with the requirements of Appendix B of the Australia Standard AS 1055.2-1984 (Description and Measurement of Environmental Noise).

1.4 SUBJECT SITE - LOCATION AND DESCRIPTION

The site is located in Westmead, NSW. The site and location are shown in the image in Figure 1.

Figure 1: Aerial View of Subject Site

1.5 EXISTING NOISE AMENITY

Noise Levels were measured adjacent to the subject site (see Figure below) over the period Tuesday 19th August 2014 to Sunday 24th August 2014 to determine background noise levels around the subject site during daytime, evening and night time periods over the weekend and during week days.

Figure 2: Location of Noise Measurement Equipment (Aerial)

The operation of the sound level measuring equipment was field calibrated before and after the measurement and was found to be within 0.1 dB of the reference signal. All instrumentation used in this assessment hold a current calibration certificate from a certified NATA calibration laboratory. The Rion NL-21 Noise Logger was used to measure the ambient noise levels.

Ambient sound pressure levels were measured generally in accordance with Australian Standard AS1055.1:1997 - 'Acoustics-Description and measurement of environmental noise - Part 1: General procedures'. Ambient noise levels were recorded at 15 minute intervals over the 24 hour periods.

Note: There were periodic showers during the measurement data. The heavy Monday rain period has been excluded from the data.

The measured noise can be considered typical. There are a variety of noise sources currently at the development site including:-

- Traffic Noise from adjacent roads.
- Noise from buses at the adjacent bus stop.
- Typical suburban noises from residents using the external yards and cutting grass.

Noise events that were un-representative of the locality noise amenity have been excluded from the environmental noise calculations.

	Day	Temps		Rain	Wind	
		Min	Max		Dir	Speed
		°C	°C	mm	km/h	
19	Tues	12	17	48	SW	11
20	Wed	9	16	3	SSW	11
21	Thurs	7	18	2	NW	4
22	Fri	10	18	0	NW	2
23	Sat	7	18	3	SW	2
24	Sun		19	0	W	6

Table 2: Weather Summary during Noise Survey (Parramatta, Mason's Drive)

The 15 minute results for a typical 24 hour period are shown in Appendix A. The results are summarised below:-

	Period	Time	Noise Level dB(A)		
			L_{Aeq}	L_{A90}	L_{A10}
Weekday	Day	0700-1800	64	56	66
	Evening	1800-2200	63	55	65
	Night	2200-0700	59	48	61
Weekend	Day	0700-1800	63	52	65
	Evening	1800-2200	52	52	64
	Night	2200-0700	58	47	60

Table 3: Noise Survey Results (day-evening-night)

	L_{10} 18hr day 6am-12am	$L_{10\text{-}1hr}$ max 6am-10pm	Time for L_{10} 1hr max 6am - 10pm	L_{10} 1hr max 10pm-6am	Time for L_{10} 1hr max 10pm - 6am	L_{90} 18hr 6am-12am	L_{90} 8hr 10pm-6am	L_{eq} 18hr 6am-12am	L_{eq} 8hr 10pm-6am
Weekday	66	68	07.45	66	23.45	55	48	63	57
Weekend	64	70	15.45	64	22.45	52	46	61	56

Table 4: Noise Survey Results (day- night)

1.6 NOISE SOURCES

There are a variety of noise sources at the development including:-

- Noise transmitted by internal building services and pipework.
- Noise from waste vehicles and loading vehicles and passenger vehicles operating ground level.
- Noise from the operation of the passenger lift.
- Noise from passenger vehicles entering and leaving the car park.
- Noise due from users of the private outdoor areas.
- Noise from local roads and commercial activities at adjacent properties.

1.6.1 Mechanical Plant

External Noise Intrusion, generally from plant noise, is considered in this report. In most cases the transmission path will be via airborne noise. In some circumstances, regenerated noise as a result of vibration may also be an issue. Intrusive noise can generally be classified as either continuous or intermittent. Continuous noise, even though it might vary from time to time, is measured using a procedure to determine its equivalence over a representative time period.

The continuous measurement is normally expressed as L_{Aeq} whereas intermittent noise is measured as the arithmetic average of the maximum sound level readings expressed as $L_{Amax,avg}$. Note the units are not air conditioned. Mechanical Plant Equipment comprises continuous noise sources as follows:-

			L_W Sound Power (dB)								
	Frequency (Hz)		63	125	250	500	1k	2k	4k	8k	dB(A) @3m
Equipment	Operation Hours	No									
Car park exhaust	25% flow generally, 24/7	2	76	75	82	83	82	80	76	69	66
Toilet Exhaust fan	Switch controlled	Each SOU	-	51	63	54	54	54	49	40	40

***** C.M. Harris - Acoustical Measurements and Noise Control, 1991
**Manufacturers Data

Table 5: Sound Power and Number of Mechanical Plan

No air conditioning is being provided though provision is made for unit owners to install.

1.6.2 Waste and Car Park Vehicle Movements

The car parks are located in the basement car park and the associated noise sources are generally contained within the basement.

Waste collection is by an 8.5m medium rigid rear loading waste truck accessing the basement waste storage area within the building envelope. The noise sources due to waste collection are intermittent and typical sound power levels from these events are shown below:-

Description	L_{Amax}
Waste Vehicle Movement* for ¼ hour between 7am and 8am	100dB(A)
Waste Vehicle Reversing Beeper** for ¼ hour between 7am and 8am	110dB(A)
Operation of Roller Shutter**** 2 movements per hour	90 dB(A)
Internal Car Movement (entering/leaving)*** 30 movements/hour between 6am-10am and 4pm-7pm and between 1 and 10 movements/hour at other times	94dB(A)

Table 6: Sound Power of Waste and Internal Car Park Movements

1.6.3 Common Area Use

The associated intermittent noise sources from use of private outdoor areas are detailed in the table below:-

Description	L_{Aeq}
People talking (loud conversation)*	70dB(A)

* Wolfgang Propst, 1994 Schriftenreihe: Sportanlagen und Sportgeräte (B2/94)

Table 7: Sound Power of Outdoor Area noise Sources

1.6.4 Traffic Noise

The traffic noise levels, were calculated using the noise calculation model SoundPLAN. Calculations are based on the procedures developed by the U.K. Department of Transport, Welsh Office, issued as "Calculation of Road Traffic Noise" in 1988 (CoRTN'88). The traffic flows are based on preliminary traffic data and **1.5%** growth **(as advised by project traffic engineer)** as follows:-

2012 Traffic Flow AADT	2024 Traffic Flow AADT	Heavy Vehicles (%)
36,500	40,242	5

Table 8: Traffic Flows

The predicted traffic flows were scaled down by a factor of 0.95, to represent the 95-percentile traffic flow in an 18-hour period between 6:00 a.m. and 12:00 midnight.

SECTION 2.0 ACOUSTIC DESIGN CRITERIA

2.1 DESIGN NOISE LEVELS AND REVERBERATION TARGETS

In NSW, noise pollution is regulated through the Protection of the Environment Operations Act 1997 (POEO Act). The POEO Act makes the Office of Environment and Heritage (OEH) the appropriate regulatory authority and therefore responsible for regulating noise from activities scheduled under the Act. The noise amenity at the site is to be governed by the Office of Environment and Heritage (OEH) policies and guidelines.

The Holroyd DCP and LEP incorporate the provisions in the State Environmental Planners Policies.

This includes acoustic privacy.

2.1.1 Noise Emission Criteria

The NSW Road Noise Policy establishes the target road traffic noise criteria as detailed below:-

Item	Sensitive Use Area	Descriptor	Noise Goal, dB(A)
Freeway/ arterial/ sub-arterial roads	Noise Sensitive Receiver on site	$L_{Aeq\ (15\text{-}hour)\ Day}$	55
Freeway/ arterial/ sub-arterial roads	Noise Sensitive Receiver on site	$L_{Aeq\ (9\text{-}hour)\ Night}$	50

Table 9: Road Noise Criteria

The State Environmental Planning Policy (Infrastructure) 2007-Reg/02 requires the following noise levels not to be exceeded:-

	L_{Aeq}
Bedroom (10pm-7am)	35dB(A)
Other areas (excluding garages, kitchens, bathrooms or hallways	40dB(A)

Table 10: SPP Intrusion Criteria

The design noise levels for the site under Australian Standard AS 2107.2000 are summarised below:-

Authority	Description	Applicable Area	Descriptor	Noise Goal, dB(A)
AS/NZS 2107:2000	Acoustic Quality Objective in dwelling during night (2200-0700)	Sleeping areas near major roads	$L_{Aeq\ (8\text{-}hour)}$	30-40
			$L_{Aeq\ (1\text{-}hour\ max)}$	45
	Acoustic Quality Objective	Enclosed Car Parks	L_{Aeq}	65
	Acoustic Quality Objective	Common Areas (lifts / foyers)	L_{Aeq}	55

Table 11: Design Noise Limits

2.2 ACOUSTIC SEPARATION TARGETS

The design criteria for the apartments are governed by the provisions of the acoustic requirements of BCA 2014 section F5.1 to F5.6 for a Class 2 building. The deemed to satisfy provisions for parts F5.3 to F5.5 are detailed below:-

BCA Clause	Item	Criteria
F5.3	Determination of impact sound insulation rating for walls.	A wall in a building required to have an impact sound insulation rating must be discontinuous construction. Discontinuous construction means a wall having a minimum 20mm cavity between 2 separate leaves, and (i) For masonry, where wall tiles are required to connect leaves, the ties are of the resilient type; and (ii) For other than masonry, there is no mechanical linkage between leaves except at the periphery.
F5.4 (a) (i)	Sound insulation of floors between units.	A floor separating sole occupancy units must have an $R_W + C_{tr}$ (airborne) of not less than 50 and an $L_{n,w} + C_I$ (impact) of not more than 62.
F5.4 (a) (ii)	Sound insulation of floors between units and stairways, public corridors, public lobbies or the like.	A floor separating sole occupancy units from stairways, public corridors, public lobbies, lift shaft or the like must have an $R_W + C_{tr}$ (airborne) of not less than 50 and a $L_{n,w+Cl}$ (impact) of not more than 62.
F5.5 (a) (i) & (ii)	Sound Insulation of walls between units	A wall must have an $R_W + C_{tr}$ (airborne) of not less than 50 if it separates sole occupancy units; A wall must have an R_W (airborne) of not less than 50 if it separates a sole occupancy unit from a plant room, lift shaft, stairway, public corridor, hallway or the like.
F5.5 (a) (iii)	Sound insulation of walls between a bathroom, sanitary compartment, laundry or kitchen and a bedroom or habitable room in adjoining SOU. Wall between SOU and a plant room or lift shaft	Walls must be of discontinuous construction (e.g. 20mm unconnected cavity, no linkage between leaves other than at periphery)
F5.5 (b)	Doors to apartments from public corridors.	Doors to the apartments are to achieve an R_w of not less than 30.
F5.5 (e)	Sound insulation of walls with floors above	Wall to continue to the underside of the floor above or to have a ceiling that provides the sound insulation required for the wall.
F5.5 (f)	Sound insulation of walls with roofs above	Wall to continue to the underside of the roof above or to have a ceiling that provides the sound insulation required for the wall.
F5.6	Sound Insulation Rating of Services	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 by construction with an $R_w + C_{tr}$ (airborne) not less than:- (i) 40 if the adjacent room is a habitable room (other than a kitchen); or (ii) 25 of the adjacent room is a kitchen or non-habitable room. (iii) If a storm water pipe passes through a sole-occupancy unit it must be separated in accordance with (i) and (ii).
F5.7	Sound Isolation of Pumps	Flexible couplings to be used at the point of connection between the service pipes in the build and any circulating or other pump.

Table 12: BCA 2014 Acoustic Design Criteria

All forms of construction detailed in table 12 must be installed as follows:-

(a) Masonry – Units must be laid with all joints filled solid, including those between the masonry and any adjoining construction.

(b) Concrete slabs – Joints between concrete slabs or panels and any adjoining construction must be filled solid.

(c) Sheeting materials:-

(i) If one layer is required on both sides of a wall, it must be fastened to the studs with joints staggered on opposite sides; and

(ii) If two layers are required the second layer must be fastened over the first layer so that the joints do not coincide with those of the first layer; and

(iii) Joints between sheets or between sheets and any adjoining construction must be taped and filled solid.

(d) Timber or steel-framed construction – perimeter framing members must be securely fixed to the adjoining structure:-

(i) Bedded in resilient compound; or

(ii) The joints must be caulked so that there are no voids between the framing members and the adjoining structure.

(e) Services:-

(i) Services must not be chased into concrete or masonry elements.

(ii) A door or panel required to have a certain $R_w + C_{tr}$ that provides access to a duct, pipe or other services must:-

- Not open into any habitable room (other than a kitchen); and
- Be firmly fixed so as to overlap the frame or rebate of the frame by not let than 10mm, be fitted with a sealing gasket along all edges and be constructed of:-

a. Wood, particleboard or blockboard not less than 33mm thick; or

b. Compressed fibre reinforced cement sheeting not less than 9mm thick;

c. Other suitable material with a mass per unit area not less than 24.2 kg/m^2.

(iii) A water supply pipe must:-

- Only be installed in the cavity of discontinuous construction; and
- In the case of pipe that serves only one sole-occupancy unit, not be fixed to the wall leaf on the side adjoining any other sole-occupancy unit and have a clearance not less than 10mm to the other wall leaf.

(iv) Electrical outlets must be offset from each other:-

- In masonry walling, not less than 100mm; and
- In timber or steel framed walling, not less than 300mm.

2.3 SERVICES ACOUSTIC TARGETS

Hydraulic and Mechanical Services Risers to be acoustically treated give $L_{Amax,avg}$ 50.

NR levels are as below for noise levels due to operation of building services:-

Use Area	Noise Goal, NR
Bedroom	35
Living Room	45
Kitchen	45
Bathroom	45
Lounge	45

Table 13: Recommended Service Acoustic Targets

SECTION 3.0 RECOMMENDATIONS

3.1 FACADE TREATMENTS

Glazing treatments have been recommended based on the noise calculated at each facade and the noise target within the spaces affected by facade performance.

The Traffic Noise Results are presented below:-

Location	Façade Noise Level dB(A)			
	North	East	South	West
Ground	44	68	75	71
Level1	44	70	76	71
Level2	44	72	76	73
Level3	44	71	76	73
Level 4	44	71	75	73
Level 5	44	71	75	72
Level 6	44	71	73	72

Table 14: Calculated Façade Noise Levels due to Traffic

Please refer to mark up plan drawings in Appendices for the glazing and wall performance requirements. The following construction elements are recommended as per the original site noise survey:-

Wall Location	Proposed Minimum Construction	Acoustic Requirement
External Walls	110mm brick veneer, 92mm studs and internal 13mm plasterboard lining.	R_w >50
Roof	Refer table 17	R_w+C_{tr}>39
Glazing –Southern Façade Bedroom	DGU comprising two panes of 5mm thick glass minimum with 100mm air gap and full acoustic seals.	R_w>43
Glazing – Southern Façade Living Rooms – East and West facades	14.38mm float with full acoustic seals	R_w>38
Glazing – Northern Facade – Southern Façade Bathroom/ Ensuite / Laundries/ kitchens – Eastern and Western Facade	6.38mm float with acoustic seals	R_w>32
– Northern Façade Bathroom/ Ensuite /laundries/ kitchens	6mm Float in standard frames	R_w>28

Table 15: Weighted Sound Reduction Index of Recommended Building Elements

3.2 ACOUSTIC SEPARATION TREATMENTS

Based on space types identified in the layouts the following constructions are recommended (refer marked up layout drawings in Appendices) for adequate acoustic separation for elements within the building:-

Clause	Item	Proposed Minimum Construction
F5.4	Sound Insulation of floors between units	Refer table 12 and Appendix A
F5.5 (a) (i) & (ii)	Sound Insulation of walls between units and between units and plant rooms, stairways, public corridors, hallways or the like.	Refer table 12 and Appendix A
F5.5 (a) (iii)	Walls between a bathroom, sanitary compartment, laundry or kitchen and a bedroom or habitable room in adjoining room or SOU from a plant room or lift shaft	Refer table 12 and Appendix A
F5.5 (b)	Doors to apartments from public corridors.	Single leaf door with acoustic perimeter seal and tread seal to Rw 30 rating.
F5.5 (e)	Sound Insulation of walls with floors above	Wall to continue to the underside of the floor above or to have a ceiling that provides the sound of insulation required for the wall. Or Between bathrooms and habitable room in sole occupancy units and between bedrooms and public areas:- (a) Concrete slab soffit with 200mm minimum cavity depth. (b) 30mm plasterboard barrier with 50mm Glasswool seal. (c) One layer of 13mm fibre-protective grade plasterboard. (d) Wall with required sound rating, to underside of ceiling
F5.5 (f)	Sound Insulation of walls with roofs above	Wall between units to continue to the underside of the roof. Wall between units and public corridors to continue to the underside of the roof above or to have a ceiling that provides the sound insulation required for the wall.
F5.6	Sound Insulation Rating of Services	Services in Ceiling/Floor/Wall Cavities, Kitchens and Non Habitable Areas:- Where lagged (e.g. CSR Acoustilag 45 or equivalent) duct, soil, waste or water supply pipes are located in the ceiling space and pass through more than on sole occupancy unit:- - Acoustically sealed ceiling penetrations with surface mounted fittings at to be used or acoustically treated recessed light fittings - Ceiling to comprise minimum single layer of 13mm plasterboard. - Risers to comprise minimum layer of 13mm plasterboard. - Where lagged stormwater pipes pass through ceiling cavities of sole occupancy units ceilings to comprise minimum single layer of 13mm plasterboard. - Unlagged pipes in risers to comprise minimum outer layer of 13mm plasterboard with 75mm thick, 11kg/m3 glass wool insulation in riser cavity. Habitable Areas:- Where lagged (e.g. CSR Acoustilag 45 or equivalent) duct, soil, waste or water supply pipes are located in the ceiling space and pass through more than one sole occupancy unit - Acoustic sealed ceiling penetrations with surface mounted fittings are to be used or acoustically treated recessed light fittings. - Ceilings to comprise minimum layer of 13mm plasterboard with 90mm t hick, 10.5kg/m3 glass- wool insulation blanket.

Clause	Item	Proposed Minimum Construction
		- Where lagged stormwater pipes pass through sole occupancy units ceiling cavities, ceilings to comprise minimum layer of 13mm plasterboard with minimum 90mm thick, 10.5kg/m3 glass wool insulation blanket. - Unlagged pipes in risers to comprise minimum outer layer of 13mm plasterboard with 75mm thick, 11 kg/m3 glass wool insulation blanket in wall cavity and 13mm plasterboard inner layer and 50mm, 11 kg/m3 glass wood insulation in riser cavity.
F5.7	Sound Isolation of Pumps	Flexible couplings to be used at the point of connection between the service pipes in a building and any circulating or other pump.

Table 16: Recommended Acoustic Separation Construction Performance

Slab/ Roof Location	Proposed Minimum Construction	Acoustic Requirement
Habitable Area with suspended ceiling with habitable carpeted area above	200mm concrete slab with carpet	$R_w+C_{tr}>50$ $L_{n,w}+C_I<62$
Habitable Area with suspended ceiling with external tiled balcony area above	200mm concrete slab with 3mm impactamat under tile or equivalent	$R_w+C_{tr}>50$ $L_{n,w}+C_I<62$
Habitable kitchen area with suspended ceiling and habitable tiled / kitchen area above	200mm concrete slab with 5mm impactamat under tile or equivalent. Acoustic insulation in ceiling above.	$R_w+C_{tr}>50$ $L_{n,w}+C_I<62$
Bathroom with suspended ceiling and tiled bathroom above	200mm concrete slab with 3mm impactamat under tile or equivalent	$R_w+C_{tr}>50$ $L_{n,w}+C_I<62$
Bathroom with suspended ceiling and tiled kitchen above	200mm concrete slab with 3mm impactamat under tile or equivalent	$R_w+C_{tr}>50$ $L_{n,w}+C_I<62$
Areas which only have partially overlap and have Bedroom with painted slab soffit and Tiled laundry above.	200mm concrete slab with 5mm impactamat under tile or equivalent.	$R_w+C_{tr}>50$ $L_{n,w}+C_I<62$
Roof	Colorbond steel roof with Anticon 55 on purlins and 2 x 13 fire-rated plasterboard ceiling below and 7kg/m2 /140mm glass wool blanket in cavity.	$R_w+C_{tr}>39$ Rain Noise & Roof top plant noise mitigation.
Undercroft/Basement Sofit	200mm slab	None

Table 17: Recommended Acoustic Separation Construction Performance for Floors/ Roof

Wall Location	Proposed Minimum Construction	Acoustic Requirement
Between livings areas / bedrooms of adjacent units	13mm plasterboard/ Furring channels on bettafix clips (40mm cavity) with TSB2 50mm Tontine insulation (or equivalent) in cavity / 150mm concrete filled blockwork wall	$R_w+C_{tr}>50$
Between kitchens or bedrooms, bathrooms and living areas of adjacent units	13mm plasterboard/ Furring channels on bettafix clips (40mm cavity) with TSB2 50mm Tontine insulation (or equivalent) in cavity / 150mm concrete filled blockwork wall	$R_w+C_{tr}>50$ Discontinuous
Between lift shaft and SOU's	190mm Core Filled Concrete Block work / 20mm air gap / 76mm stud with 70mm glass wool insulation 9kg/m^3 sound screen/ 2 x 13mm plasterboard	$R_w+C_{tr}>50$ Discontinuous

Wall Location	Proposed Minimum Construction	Acoustic Requirement
Public Corridor Walls to Kitchens / Bathrooms	Plasterboard or FC sheet / Furring Channel / 150mm AFS Walling /Furring Channels/ 13mm Plasterboard 9mm FC sheet.	R_w>50
Intratenancy walls between wet areas and other habitable spaces	13mm plasterboard, 14kg/m³ glasswool batts in cavity, 9mm FC sheet.	R_w>45
Intratenancy walls generally	13mm plasterboard, 14kg/m³ glasswool batts in cavity, 13mm plasterboard,	R_w>35
Doors to Apartments	35mm Solid Core Doors with acoustic seals in fully caulked frame	R_w>30

Table 18: Recommended Minimum Acoustic Separation Construction Performance for Internal Walls/Doors

Note:-

1. All wall, floor and door systems types to be tested in accordance with AS1276 & AS1191 or ISO 717.1 & ISO 717.2
2. All acoustic separation systems installed in accordance with manufacturers recommend installation details.

3.3 SERVICES TREATMENTS

All mechanical and hydraulic services installations shall comply with the following requirements to ensure that noise and vibration from the plant is reduced to a minimum:-

(a) All rotary machinery shall be accurately balanced both statically and dynamically and shall be free from vibration at all operating speeds and during starting and stopping.

(b) Centrifugal and reciprocating rotating equipment shall be mounted on vibration absorbing mountings.

(c) All connections to rotating machinery, or assemblies containing machinery shall be rendered flexible by vibration hangers supporting ducting and piping systems, flexible connections between ductwork and fans, and in critical installations with flexible hose between pipes and pumps. If flexible hose is not installed, adequate provision shall be made to take up vibration in bends and pipe runs.

(d) Acoustic lining and/or attenuators shall be applied to critical sections of ducts and air handling units unless otherwise specified.

(e) Acoustic seals shall be provided where all pipes, ducts and conduits penetrate plantrooms or acoustic walls.

(f) Duct connections to vibrating mechanical plant shall be isolated by flexible PVC connections not less than 100mm long when fully stretched out.

Neoprene type mounts may be used for all static deflections up to and including 9mm however above that, combined springs and neoprene pads shall be used. Isolation efficiency and static deflection shall not be less than the following:-

Element	Requirement	Typical Construction
Treatment of mechanical services ductwork	NR 35 in bedrooms NR 45 in all other areas	Internally and externally lined ductwork and attenuators as detailed in mechanical specification.
Risers (general)	Resultant $L_{Amax, avg}$ < 50dB(A)	Un-lagged pipes in risers to comprise minimum outer layer of 13mm plasterboard with 75mm thick, 11 kg/m^3 glass wool insulation blanket in wall cavity and 13mm plasterboard inner layer and 50mm, 11 kg/m^3 glass wool insulation in riser cavity. Lagged pipe risers to comprise outer layer of 13mm plasterboard with 75mm thick, 11 kg/m^3 glass wool insulation blanket

Element	Requirement	Typical Construction
Car park exhaust, kitchen exhaust ,	R_{w+Ctr} 40	2 x 16 mm fire-rated plasterboard, 50 mm /11 kg/m^3 glass wool insulation in 50mm cavity, 75mm power panel.
Pumps	Flexible couplings to be used at the point of connection between the service pipes in a building and any circulating or other pump.	Install flexible coupling

Table 19: Recommended Services Performance

Pipe penetrations to use resilient mount with false flanges sealed with flexible mastic to maintain acoustic rating of wall. Internal stormwater pipes to be treated with 20dB insertion loss pipe lining (e.g. 25mm pipe lagging with mass loaded vinyl outer layer) with ceiling insulation below.

3.4 LIFT CORE TREATMENTS

Recommend bedroom areas adjacent to lift cores are avoided; in particular no bed heads to be located against lift core walls.

Recommend noise control measures for minimising lift core noise is:-

1. Maximise stiffness of lift cores to minimum vibration levels. Minimum 150mm thick in-situ concrete or 190mm thick core filled wall.
2. Locate lift rail mounts on stiffest part of lift core structure: i.e. where shaft wall and floor slabs meet Fixings to be located on the centre line of the floor slab.
3. Discontinuous wall and ceiling construction Typical Construction types are detailed below:-

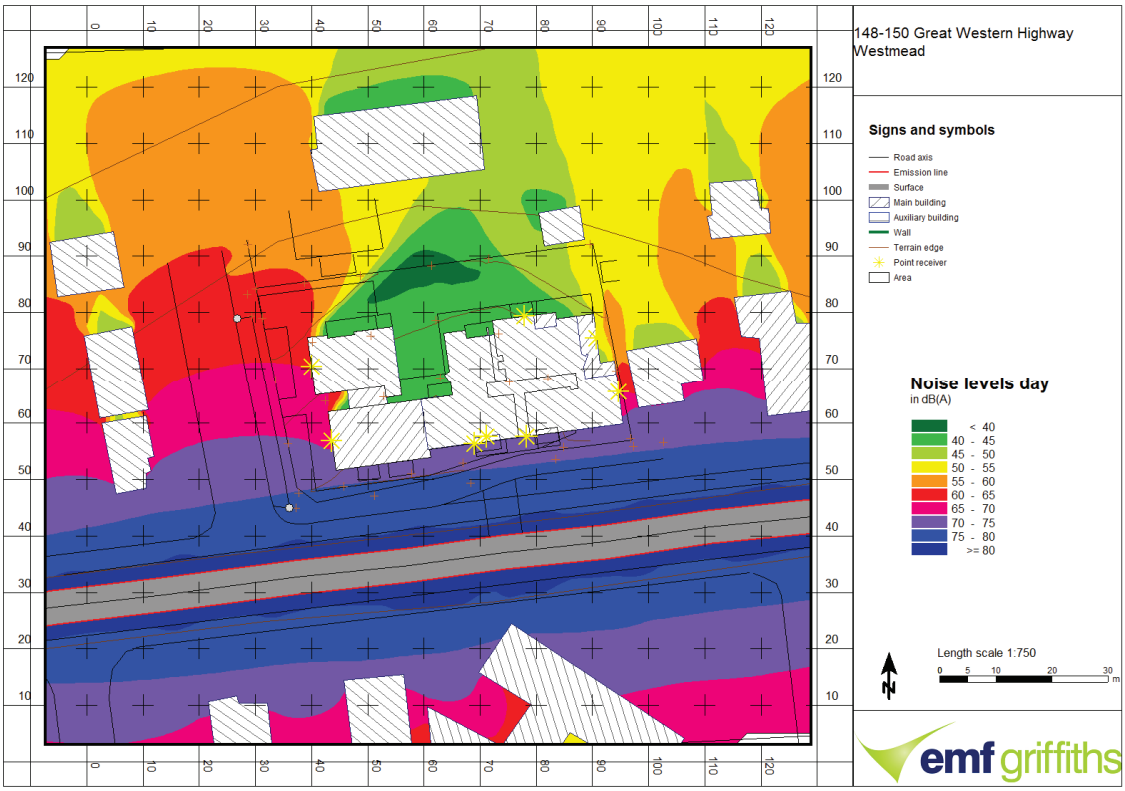
Item	Typical Construction
Ceiling	Isolation mounted with insulated (75mm acoustic insulation) and suspended plasterboard. No down lights.
Wall	Two layers of 13mm fire rated plasterboard on 76mm steel studs with 40mm gap to shaft wall. 75mm insulation in cavity.

Table 20: Proposed Construction for Apartments adjacent to lift cores

SECTION 4 CONCLUSION

The noise levels within the apartments are acceptable provided the services and architectural design incorporates the attenuation measures as specified in this report or equivalent.

APPENDIX A - NOISE MAPS


148-150 Great Western Highway
Westmead
Signs and symbols
Road axis
Emission line
Surface
Main building
Auxiliary building
Wall
Terrain edge
Point receiver
Area
Noise levels day
in dB(A)
< 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
65 - 70
70 - 75
75 - 80
>= 80
Length scale 1:750
0 5 10 20 30 m
N
emf griffiths

APPENDIX B - FAÇADE TYPES

Typical Floor

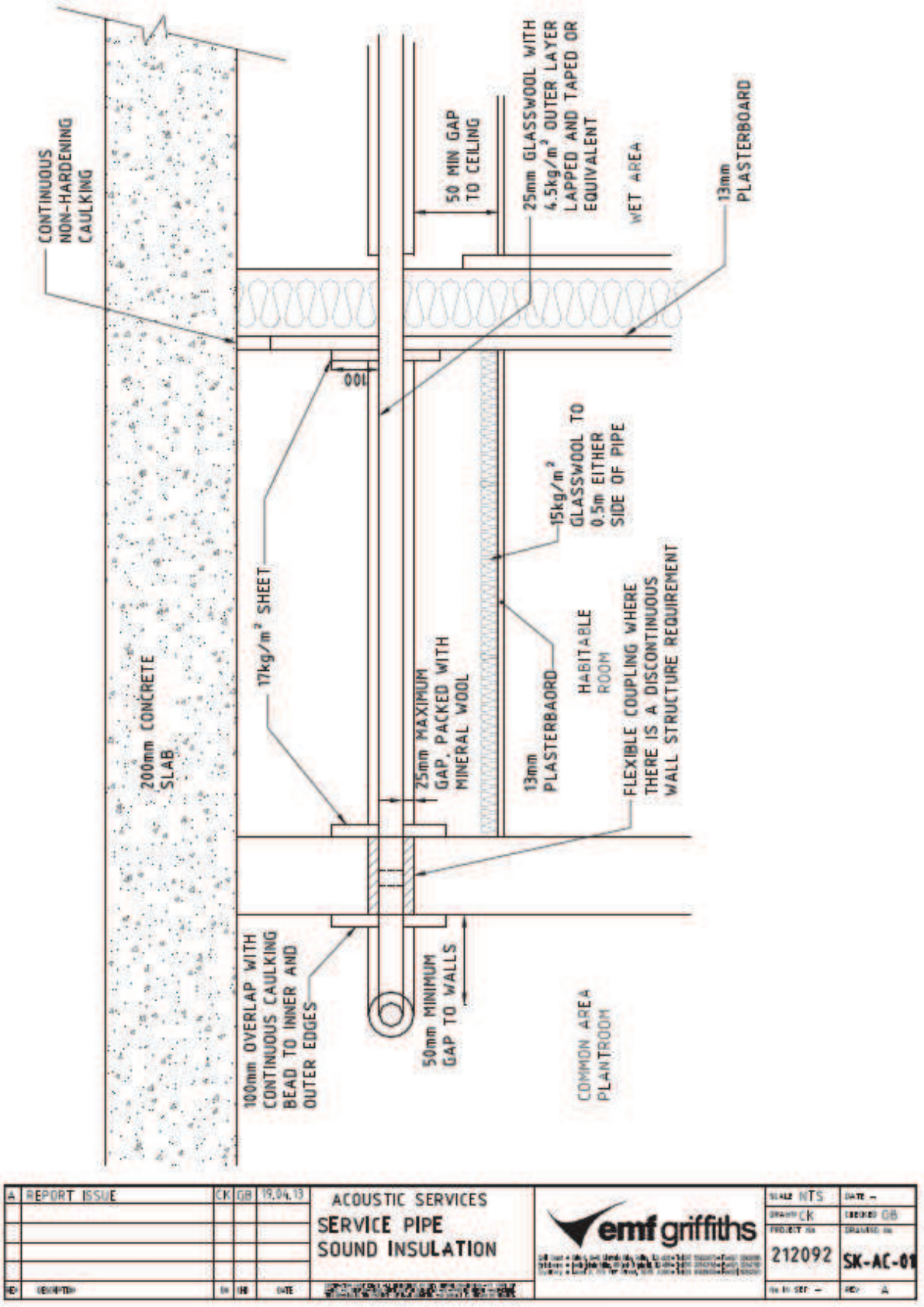
Facade

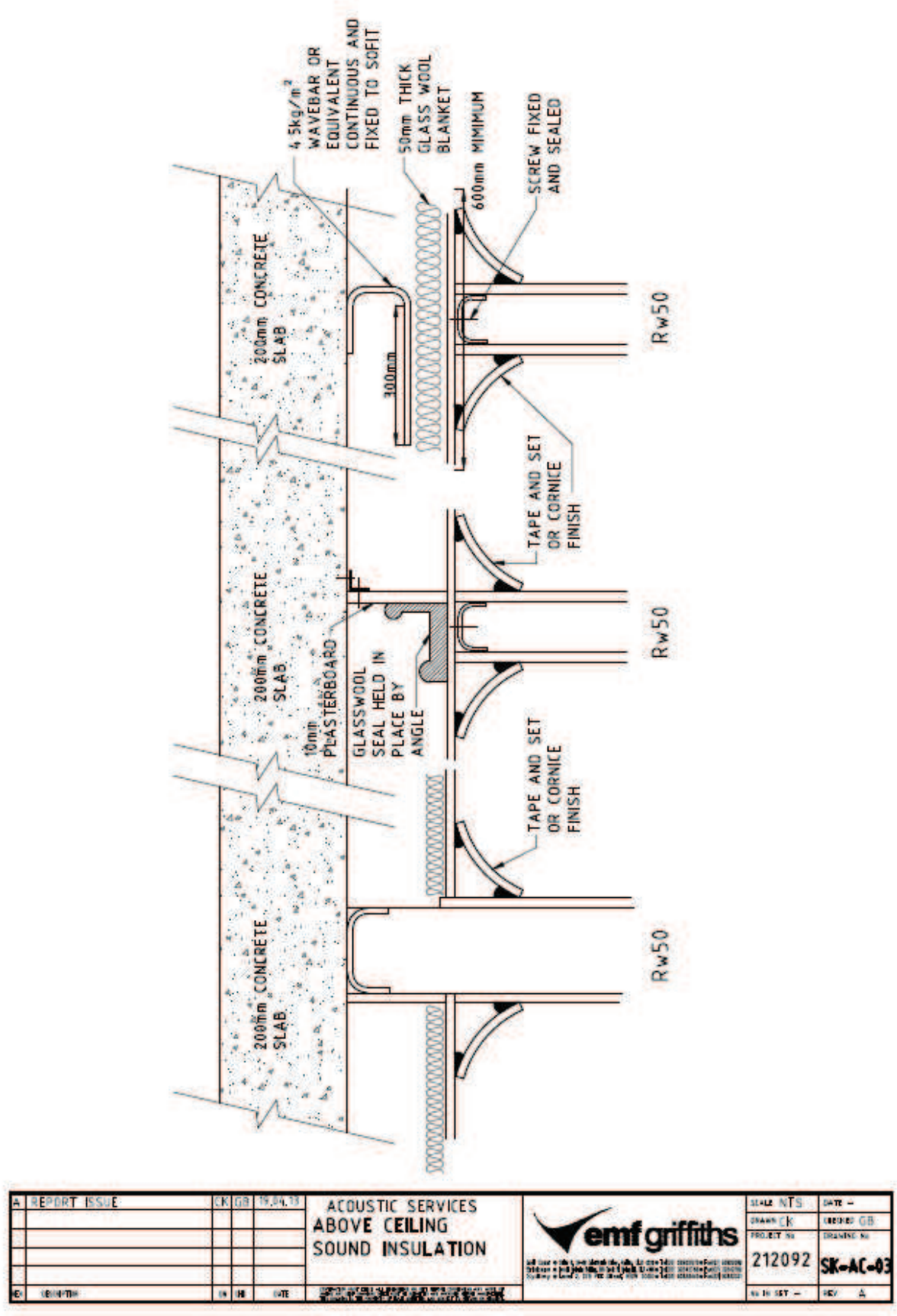
Rw >50

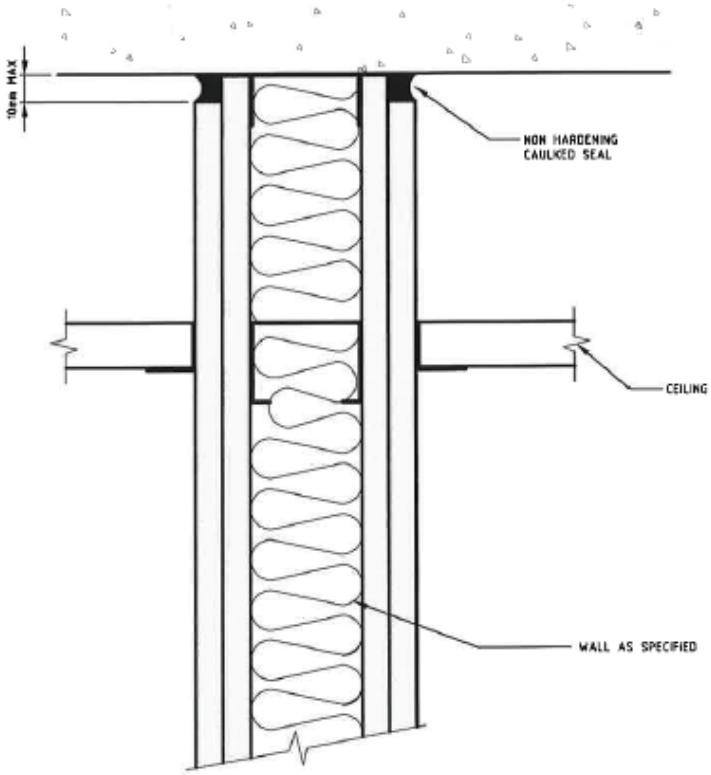
Glazing

Rw 28
Rw 32
Rw 38
Rw43

APPENDIX C - DETAIL SECTIONS


CONTINUOUS NON-HARDENING CAULKING
200mm CONCRETE SLAB
17kg/m² SHEET
100
50 MIN GAP TO CEILING
25mm GLASSWOOL WITH 4.5kg/m³ OUTER LAYER LAPPED AND TAPED OR EQUIVALENT
WET AREA
13mm PLASTERBOARD
15kg/m² GLASSWOOL TO 0.5m EITHER SIDE OF PIPE
25mm MAXIMUM GAP. PACKED WITH MINERAL WOOL
13mm PLASTERBAORD
HABITABLE ROOM
FLEXIBLE COUPLING WHERE THERE IS A DISCONTINUOUS WALL STRUCTURE REQUIREMENT
100mm OVERLAP WITH CONTINUOUS CAULKING BEAD TO INNER AND OUTER EDGES
50mm MINIMUM GAP TO WALLS
COMMON AREA PLANTROOM
A REPORT ISSUE CK GB 19.04.13
ACOUSTIC SERVICES
SERVICE PIPE SOUND INSULATION
emf griffiths
SCALE NTS
DRAWN CK
CHECKED GB
PROJECT No 212092
DRAWING No SK-AC-01
REV A

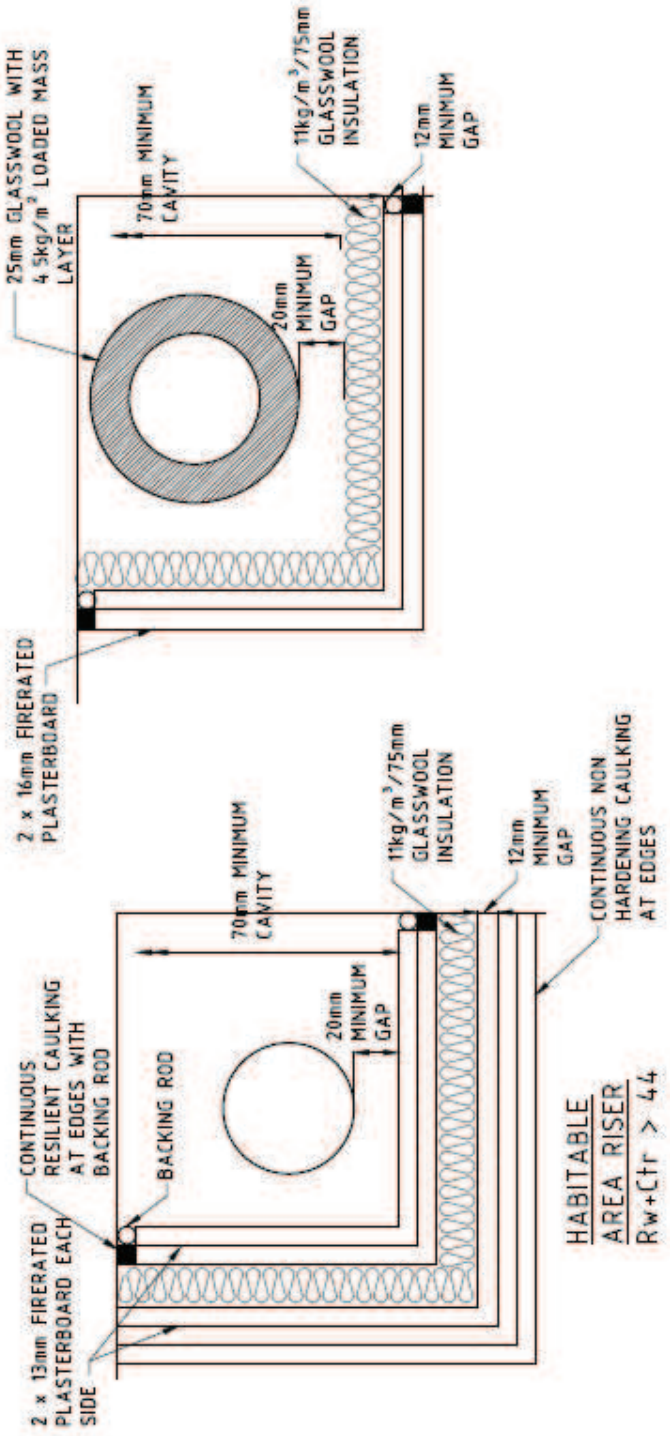

4.5kg/m² WAVEBAR OR EQUIVALENT CONTINUOUS AND FIXED TO SOFIT
50mm THICK GLASS WOOL BLANKET
600mm MIMIMUM
SCREW FIXED AND SEALED
200mm CONCRETE SLAB
100mm
Rw50
TAPE AND SET OR CORNICE FINISH
10mm PLASTERBOARD
GLASSWOOL SEAL HELD IN PLACE BY ANGLE
Rw50
TAPE AND SET OR CORNICE FINISH
Rw50
A REPORT ISSUE CK GB 19.04.13
ACOUSTIC SERVICES
ABOVE CEILING
SOUND INSULATION
emf griffiths
SCALE NTS
DRAWN CK
CHECKED GB
PROJECT No 212092
DRAWING No SK-AC-03
REV A



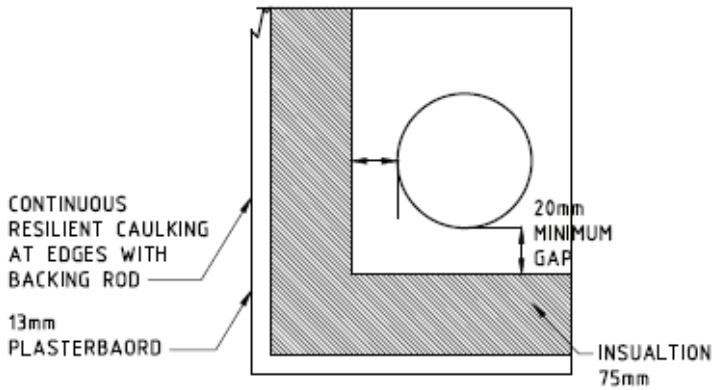
SECTION

A	PRELIMINARY ISSUE	CK	GB	xx.xx.14	ACOUSTIC SERVICES FULL HEIGHT PARTITION	emf griffiths	SCALE NTS / DATE –
							DRAWN CK / CHECKED GB
							PROJECT No 211647 / DRAWING No SK-AC-02
							No IN SET – / REV A
REV	DESCRIPTION	BY	CHK	DATE			

Riser Details



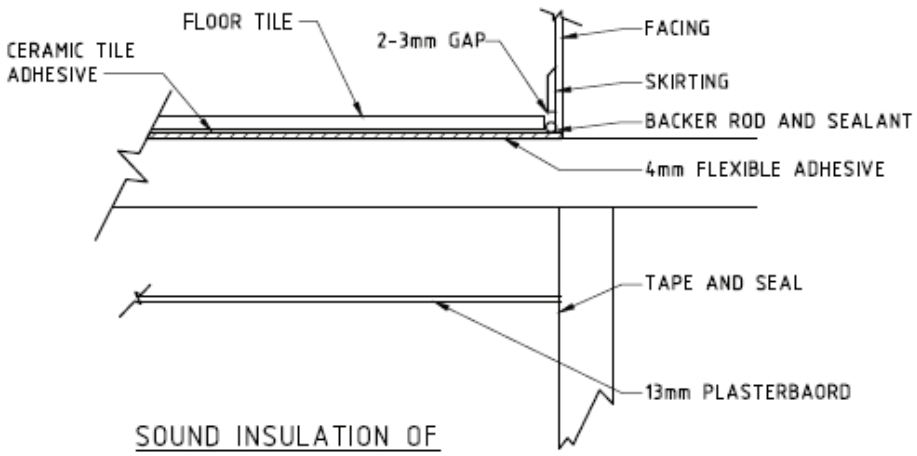
A	REPORT ISSUE	CK	GB	19.04.13	ACOUSTIC SERVICES RISER SOUND INSULATION	emf griffiths	SCALE NTS; DRAWN CK; CHECKED GB; PROJECT No 212092; DRAWING No SK-AC-05; DATE –; REV A



NON-HABITABLE
AREA RISER
Rw+Ctr > 25

A	REPORT ISSUE	CK	GB	19.04.13	ACOUSTIC SERVICES NON-HABITABLE AREA RISER	emf griffiths	SCALE NTS / DATE –
							DRAWN CK / CHECKED GB
							PROJECT No 212092 / DRAWING No SK-AC-10
							No IN SET – / REV A
REV	DESCRIPTION	BY	CHK	DATE			

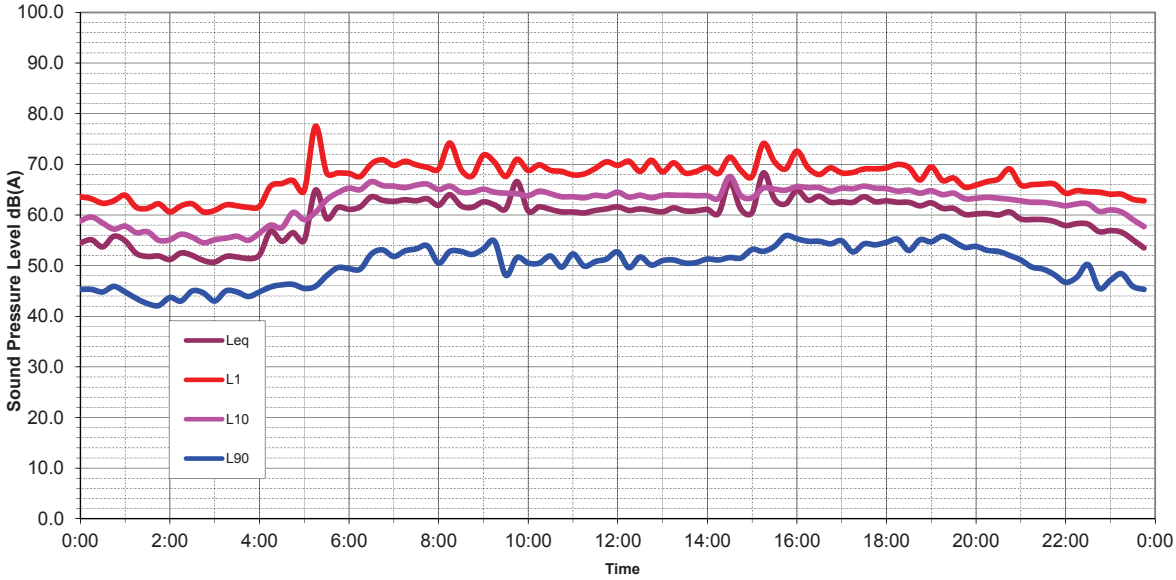
Tiled/ Wet Floor Details



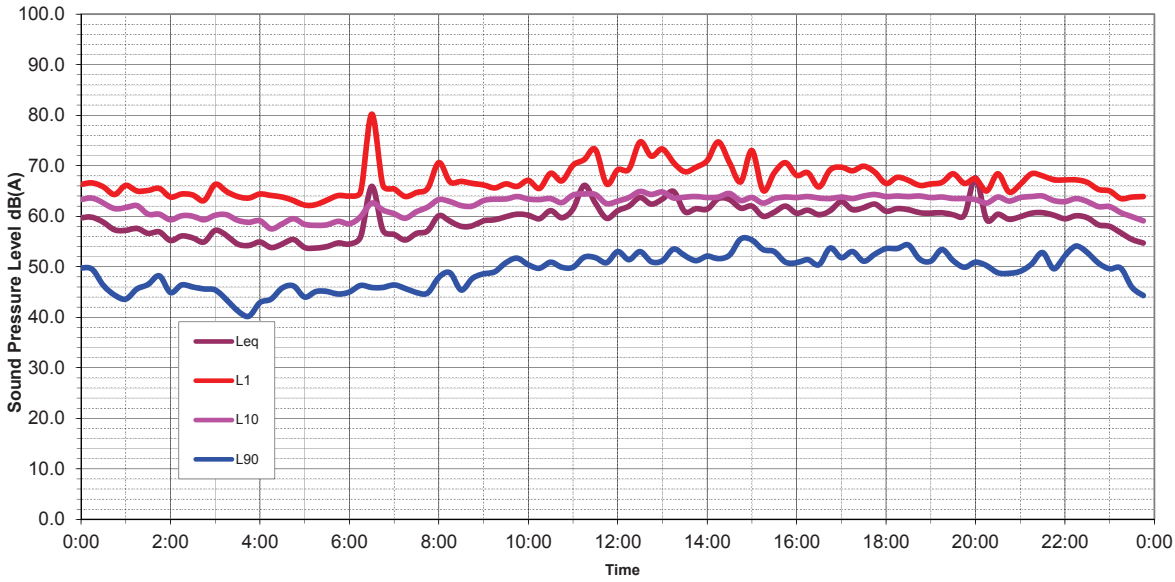
A	REPORT ISSUE	CK	GB	19.04.13	ACOUSTIC SERVICES INSULATION OF FLOORS BETWEEN UNIT, WET AREAS	emf griffiths	SCALE NTS / DATE – / DRAWN CK / CHECKED GB / PROJECT No 212092 / DRAWING No SK-AC-11 / No IN SET – / REV A
REV	DESCRIPTION	DR	CHD	DATE			

APPENDIX D - NOISE SURVEY RESULTS

Typical Weekday Noise Levels


Sound Pressure Level dB(A)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time
Leq
L1
L10
L90

Typical Weekend Noise Levels


100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Sound Pressure Level dB(A)
Leq
L1
L10
L90
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time