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Hunter Medical Research Institute

Acoustics DA Report

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Arup
Arup Pty Ltd ABN 18 000 966 165

Arup
Level 17 1 Nicholson Street, Melbourne VIC 3000
Tel +61 3 9668 5500 Fax +61 3 9663 1546
www.arup.com/acoustics

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Contents

Appendices

Executive Summary

This report provides the acoustic assessment of the proposed Hunter Medical Research Institute for the purposes of the Development Application.

The proposed building location is within the existing John Hunter Hospital precinct, which itself is within a large reserve in Newcastle. As such, the building site is approximately 500 m from the nearest residential receivers.

Noise from operation and construction of the building is required to be addressed by the NSW DoP Director-General's requirements, and must comply with the requirements of;

- NSW DECC Industrial Noise Policy (INP)
- NSW DECC construction noise guidelines
- NSW DECC Environmental Criteria for Road Traffic Noise

This assessment concludes that the construction and operation of the Hunter Medical Research Institute will not have any significant impacts on the nearest noise sensitive receivers.

1 Introduction

The proposed HMRI building is a new medical research building located within the John Hunter Hospital precinct at New Lambton Heights in Newcastle, NSW. The building consists of two main wings, East and West, connected by a link (Pod) containing an open stair and lifts.

Arup Acoustics has been commissioned by S2F to provide acoustic engineering for the project and to prepare an Acoustic Assessment.

The NSW Department of Planning's Director-General's Environmental Assessment Requirements for the Hunter Medical Research Institute (dated 29/1/09) require that the Environmental Assessment address the following acoustic issues;

- Noise and vibration from construction
- Operational noise generated from plant and equipment.

The City of Newcastle (Letter dated 23/1/09) has also requested that traffic noise from Lookout Road from increased vehicles related to the development be addressed.

This assessment therefore:

- Identifies nearest sensitive receivers that will be affected by the proposed development.
- Sets the applicable acoustic criteria for the development.
- Assesses the predicted noise levels of the development against the relevant criteria and provides advice for noise mitigation where necessary.
- States whether or not the development is capable of complying with the applicable criteria and the relevant noise mitigation that may be necessary to achieve this.

A glossary of acoustic terminology is included in Appendix A for reference.

2 Site Environment

The proposed development site is shown in Figure 1 below. The site is related to and within the existing John Hunter Hospital precinct which is located within a large nature reserve. While the existing hospital itself is somewhat sensitive to noise from the proposed HMRI development, it also generates significant noise due to plant and equipment servicing the existing buildings.

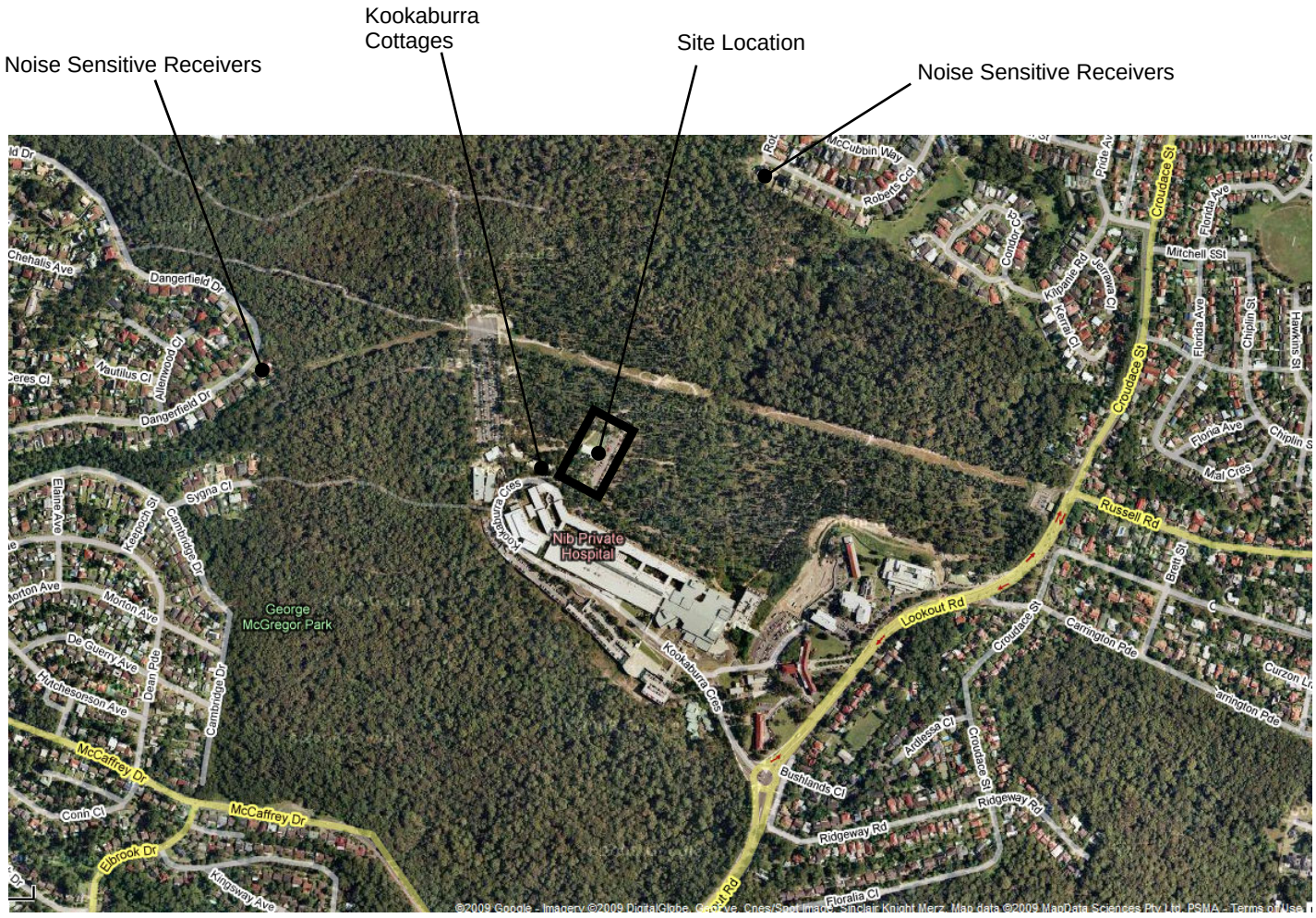

Figure 1: HMRI site location.

There are several short-term residential buildings (Kookaburra Cottages) which are used for short term accommodation for families of patients and are associated with the hospital precinct. These are located to the between 20-50 m west of the development site.

The nearest residential noise sensitive receivers that are not associated with the development are located at Roberts Circuit and Dangerfield Drive, approximately 500 m from the development site.

Since these noise sensitive receivers are located such a long way from the site, it is the local requirements for noise control to the adjacent hospital, Kookaburra Cottages and the building itself that are critical, and will determine the noise control requirements for the building services equipment and construction activities. In designing the noise control to ensure reasonable amenity at these nearby locations, industrial noise levels at the residential receivers are predicted to be inaudible above typical background noise levels in suburban environments.

Therefore, a detailed noise survey has not been undertaken on site, and criteria for the non-associated residential receivers are based on the lowest practical limit, on the basis that this will be readily achievable.

3 Noise Criteria

Noise criteria for the HMRI development have been determined from several relevant sources, including legislation, EPA policy, relevant Australian Standards and guidelines.

- NSW Environmental Protection Authority (EPA) Industrial Noise Policy (INP), 2000.
- NSW EPA Environmental Criteria for Road Traffic Noise (ECRTN), 1999.
- NSW EPA Environmental Noise Control Manual construction noise guidance, 1996.
- Australian Standards as appropriate.

These guidelines have been followed in determining the acoustic criteria for the HMRI.

3.1 Industrial Noise Criteria

The New South Wales environmental noise policy relating to industrial noise is the *New South Wales Environment Protection Authority (EPA) Industrial Noise Policy* (INP), dated January 2000. Noise emission from plant and equipment on the subject site is required to comply with the noise limits assessed in accordance with the INP. The overall aim is to allow the need for industrial activity to be balanced with the desire for quiet in the community.

The objective of the INP is to protect residential areas from noise generated by commercial, industrial or trade premises. Noise limits are based on land use in the area and existing background levels. Compliance is achieved if the adjusted L_{eq} noise level at any residence affected by noise from the facility is below the noise limit. The adjusted L_{eq} is determined by applying corrections for such noise characteristics as duration, intermittency, tonality and impulsiveness.

The assessment of noise emission under the INP is based on the calculation of a noise limit at a receiver position, taking into account the land use in the surrounding area and the background noise level.

The INP separates the day into three different time periods – day, evening and night, as detailed below in Table 1.

Table 1: INP Time Periods

Period	Day of Week	Time period
Day	Monday-Saturday	0700-1800hrs
	Sunday, Public Holidays	0800-1800hrs
Evening	Monday-Sunday	1800-2200hrs
Night	Monday-Saturday	2200-0700hrs
	Sunday, Public Holidays	2200-0800hrs

Typically, for industrial sources such as the HMRI facilities that are required to operate 24hrs/day, the night-time period is the most sensitive, and the night-time limits will be the most onerous.

The INP provides guidance on acceptable noise levels from the introduction of new industrial noise sources to an area. The assessment procedure for industrial noise sources has two components:

- Controlling intrusive noise impacts in the short term for residences.
- Maintaining overall noise level amenity for particular land uses such as residences.

Both of these components result in noise criteria that should not be exceeded in order to avoid any adverse noise impacts on the affected areas. Both criteria should be taken into account when assessing the noise impact of industrial source(s) associated with the proposed development, and where the intrusiveness and the amenity criterion differ, the lower of the noise criteria is adopted as the project-specific noise criterion.

These criteria will be used to assess noise breakout from plantrooms and roof top plant noise from the proposed development.

3.1.1 Amenity Criterion

Criteria for the protection of amenity are given for various types of receiver and different times of the day. The amenity criterion is set so that the L_{Aeq} noise level from the industrial noise source does not increase the total industrial noise levels at the receiver above the acceptable noise level (ANL) for that receiver.

The criteria relate only to industrial-type noise and do not include road, rail or community noise. The criteria are set based on how close the existing L_{Aeq} industrial noise levels are to the ANL, using the adjustment factors given in Table 2.2 of the INP to account for existing level of industrial noise.

A summary of the amenity noise criteria for noise sensitive receivers for the development are given in Table 2.

Table 2: Amenity Noise Criteria, L_{Aeq}, dB re 20μPa.

Type of Receiver	**Recommended LAeq Noise Level, dB(A)**	
	Acceptable	Recommended Maximum
Suburban Residence, Night-time *	40	45

* Night Periods for INP: Monday – Saturday 2200-0700hrs ; Sunday, Public Holidays 2200-0800hrs

3.1.2 Intrusiveness Criterion

The intrusiveness criterion require the equivalent continuous noise level, L_{eq}, of the source to be no more than 5 dB above the background noise level, and is summarised as:

$L_{Aeq\ (15\ min)} \leq L_{A90\ (15\ min)}$ background Level + 5 dB

However, since the nearest residential receivers are located approximately 500 m from the development site, noise from the development at these locations is not predicted to be significant, and detailed noise surveys have not been undertaken. Rather the lowest typical night-time ambient noise level for this type of location (approximately 25 dB(A)) has been used as the basis of developing a conservative criteria.

This would result in an **intrusiveness limit of 30 dB$L_{Aeq,15min}$**.

3.1.3 Project Specific Noise Criteria

From the amenity and intrusiveness criteria, the more stringent of the two is applied to determine project specific criteria for the development.

In this case a project specific noise limit of **30 dB$L_{Aeq,15min}$** has been adopted.

3.2 Emergency Generator Noise Criteria

The NSW Environmental Protection Authority (EPA) Environmental Noise Control Manual (ENCM) sets the guidelines for emergency generators, which are used in the event of power shortages, in order to minimise disturbance to the community.

For residential receivers, daytime and evening:

From 7am to 10pm any day of the week, the L_{A10} sound pressure level should not exceed the L_{A90} background level by more than 10 dB(A) at the boundary of any nearby affected residence, and in any case the L_{A10} level at the residential boundary should not exceed 55 dB(A).

Night time:

From 10pm to 7am the L_{A10} level at should not exceed the L_{A90} background level by more than 5 dB(A) at the boundary of any nearby affected residence, and in any case the L_{A10} level at the residential boundary should not exceed 45 dB(A).

Other instances where the emergency generator is likely to be running is during regular testing of the equipment to ensure the generator is in working order in case of an emergency situation. If testing is for a maximum of 15 minutes in any 24 hour period, the INP recommends an adjustment for duration be added to the acceptable noise level.

A project specific limit of 35 dB(A) has therefore been adopted at the residential receivers.

3.3 Traffic Noise Criteria

Road traffic noise from vehicles entering and leaving the hospital site from public roads is subject to noise criteria in the Environmental Criteria for Road Traffic Noise (ECRTN). The ECRTN provides several categories for the type of development, and appropriate noise planning targets are given for each type of development.

The ECRTN noise criteria are planning goals for new developments and as such are not legislative requirements which must be met by new developments, as the ECRTN recognises that achieving these criteria may not be 'feasible and reasonable' for all developments.

The HMRI development is best characterised as *Land use developments with potential to create additional traffic on collector road*[1]. The criteria for such a development are outlined in Table 3.

Table 3: Road traffic noise criteria

	Criteria		
Type of Development	**Day (7am – 10pm) dB(A)**	**Night (10pm – 7am) dB(A)**	**Where criteria are already exceeded**
8[2]. Land use developments with potential to create additional traffic on collector roads	$L_{Aeq(1hr)}$ 60	$L_{Aeq(1hr)}$ 55	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.

[1] Table 1, EPA ECRTN
[2] Row numbering is based on the selected row of Table 1, EPA ECRTN

3.4 Construction Noise Criteria

During demolition and construction works, airborne noise is generated by the operation of construction equipment such as bulldozers, rock-breakers, compactors and generators. While some plant and equipment is used only intermittently, more than one piece of equipment is often used simultaneously, and therefore the cumulative construction noise impact from multiple items of plant must be considered.

The Environmental Protection Authority (EPA) Environmental Noise Control Manual (ENCM) sets guidelines for construction noise.

For a construction period 4 weeks and under:

The L_{10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 20 dB(A).

For a construction period greater than 4 weeks and not exceeding 26 weeks:

The L_{10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 10 dB(A).

For construction periods exceeding 26 weeks, it is considered reasonable to apply the NSW Industrial Noise Policy (INP) criteria for industrial noise, with the limiting criterion based on the intrusiveness criterion of the INP:

The intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of a source by more than 5 dB.

As the construction period at the time of this report is unknown, the more stringent INP criteria has been applied in this assessment, where:

$$L_{Aeq,\ 15min} \leq L_{A90} + 5$$

On the basis of a typical minimum daytime background noise level of 45 dB(A) for suburban residential areas, the construction noise limit adopted for the nearest sensitive residential receivers is **50 dB$L_{A10,15min}$**.

4 Noise and Vibration Assessment

4.1 Mechanical Services

The building will have plantrooms located at each end of the main wings, and on the rooftop. In order to support critical processes within the building it is expected that a significant amount of the equipment will be required to operate 24/hrs a day.

Generally, external noise breakout from the equipment will be designed to achieve a limit of 65 dB(A) immediately external to the plantrooms (ie at 1.5 m from air-intakes and exhausts) to ensure a reasonable level of amenity for nearby hospital buildings and within the HMRI building itself.

In order to achieve this, the plantrooms will incorporate acoustic louvers on air intake and exhausts, where required, and individual equipment will incorporate residential grade mufflers, attenuators and other noise control as required.

The emergency generator should incorporate a 'residential' grade muffler system, and sound attenuated air intake and exhaust systems.

Noise levels at the nearby Kookaburra cottages and existing hospital buildings are expected to be around 40 – 45 dB(A) externally. This is higher than the conservative 30 dB(A) limit established for the non-related residential receivers located at Roberts Circuit and Dangerfield (see Section 3.1), however is consistent with typical hospital precinct noise levels and the night-time 'suburban residential' amenity noise limits given in the Industrial Noise Policy. It would also result in internal noise levels between 25-30 dB(A) which are acceptable.

Industrial noise levels at the residential receivers located at Roberts Circuit and Dangerfield Drive are predicted to be well below the 30 dB(A) criteria due to the large distance (approximately 500 m) from the development site..

4.2 Traffic Noise

Road traffic flow predictions conducted for the project (see Table 4, below) indicate that the development is expected to result in a net increase in vehicular traffic in the order of approximately 200 vehicles in peak hours, increasing the hourly 2-way flow from between 3300 (AM peak), and 3800 (PM peak).

Table 4: Traffic flow rates, source: *Traffic and Accessibility Report*, Sections 3.3 and 5.1.1, Better Transport Futures. Noise Criteria.

Road Link	Existing traffic volumes AM peak hour			Additional Traffic generated by HMRI in AM peak hour			Existing Traffic volumes PM peak hour			Additional traffic generated by HMRI in PM peak hour		
	North bound	South bound	Total	North bound	South bound	Total	North bound	South bound	Total	North bound	South bound	Total
North of Jacaranda Dr	1873	1551	3424	20	195	215	1563	2339	3902	130	40	170
Between Jacaranda Drive and Kookaburra Cct	1867	1384	3251	10	95	105	1503	2281	3784	10	20	30
South of Kookaburra Cct	2209	1476	3685	190	20	210	1369	2571	3940	10	170	180

The associated noise increase related to this increase in traffic flow is calculated to be approximately 0.2 dB. This is an insignificant increase in traffic noise levels, and is less than the 2 dB increase limit as required by the ECRTN.

4.3 Construction Noise and Vibration

Preliminary construction noise levels have been calculated using equipment sound power levels from AS 2346[3] and BS 5228[4]. Based on typical construction activities likely to occur during the construction of the proposed development, and taking into account distance losses, shielding and reflections of sound. Typical construction site source noise levels from 'noisy' equipment are shown below.

Table 5: Construction equipment and sound power levels, dB re 10^{-12} W

Equipment	% On	Sound Power Level of equipment L_w dB(A)
Excavator	60	116
Truck and Dog Trailer	80	89
Concrete Pump	60	105

The construction noise level at the residential receivers is predicted to be significantly below the relevant criteria.

It will also be necessary to control construction noise emission to the existing hospital site. Some simple measures can be taken to help reduce the impact of construction noise levels at the adjacent hospital site. These include:

- Equipment that emits noise strongly in one direction should be orientated so that the noise is directed away from noise sensitive areas.
- Machines that are used intermittently should be shut down between periods of work or throttled down to a minimum.
- Regular maintenance of plant and equipment.
- Restricting hours of work of noisy equipment, scheduling noisy construction activities during times when noise impact on residents is likely to be lowest, e.g. No heavy work before 09:00am.
- Providing acoustic screens and/or enclosures for stationary equipment, such as compressors.
- Providing mobile acoustic screens and/or enclosures for construction equipment and activities, where possible.
- Selecting low noise plant and equipment where possible.
- Keeping engine covers and access hatches to equipment closed, e.g. compressors, etc.
- Introducing respite periods during the day or at weekends where no noisy construction work can take place. These periods are best determined through consultation and negotiation with affected stakeholders.
- Regular consultation to advise the hospital of impending noisy activities.

[3] AS 2346 – 1981, Guide to noise control on construction, maintenance and demolition sites
[4] BS 5228: Part 1: 1997, Noise and vibration control on construction and open sites

Vibration from construction activities is not typically perceptible beyond 5 or 10 m from any particular construction process, and is therefore not expected to have any significant impact for this project.

Some construction vibration may be just perceptible or impact on particularly sensitive uses within the adjacent hospital building. Ongoing consultation with the existing hospital building users should be implemented to allow appropriate scheduling of construction activities to manage the effect of noise and vibration.

Similarly, construction noise at the exterior of the Kookaburra Cottages would be between 60 – 80 dBL_{Amax} during the daytime, depending on the amount of local shielding. This would be expected to be clearly audible and possibly adversely impact the residences during the daytime. However, internal noise levels would be 20 - 25 dB(A) lower assuming windows were kept closed, and construction would not be undertaken during the sensitive night-time period. The use of the Kookaburra Cottages would need to be managed carefully with the local health department administration during the construction period.

It is understood that some rock removal may be required during the excavation of the site. Impact noise from hydraulic rock-breakers would be expected to be substantially higher than other construction activities considered above, and could adversely impact the nearby hospital and Kookaburra Cottages. Low-noise rock removal techniques, for example ripping with a bulldozer or using a rock-saw are likely to be required.

5 Conclusions

The proposed HMRI development is located within the existing John Hunter Hospital precinct in Newcastle and is within a large nature reserve. The nearest noise sensitive residential receivers are located over 500 m from the development site.

Construction noise is predicted to be below the criteria at these residential receivers. However, construction noise will still require management to limit impacts on associated hospital and short-term buildings (Kookaburra cottages) adjacent to the development site within the hospital precinct.

Similarly, operational noise from plant and equipment serving the building is also predicted to be well below the criteria at the residential receivers. Noise attenuation for the proposed plant and equipment will be provided where necessary to limit noise ingress to the HMRI building itself. This will be sufficient to ensure that operational noise from plant and equipment is also acceptable at the adjacent hospital buildings.

The proposed development is therefore capable of complying with the applicable noise criteria outlined in this report by incorporating basic noise controls within the plantrooms.

The acoustic measures recommended will be further refined in the detailed design stage of the development.

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Appendix A

Acoustic Terminology

DECIBEL

The ratio of sound pressures which we can hear is a ratio of 10^6 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

dB(A)

The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). An A-weighting network can be built into a sound level measuring instrument such that sound levels in dB(A) can be read directly from a meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is worth noting that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.

EQUIVALENT CONTINUOUS SOUND LEVEL

Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

FREQUENCY

The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kHz, eg 2 kHz = 2000 Hz. Human hearing ranges approximately from 20Hz to 20kHz. For design purposes, the octave bands between 63Hz to 8kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.

IMPACT SOUND PRESSURE LEVEL

The technical parameter used to determine impact sound isolation of floors is the impact sound pressure level, L_i.

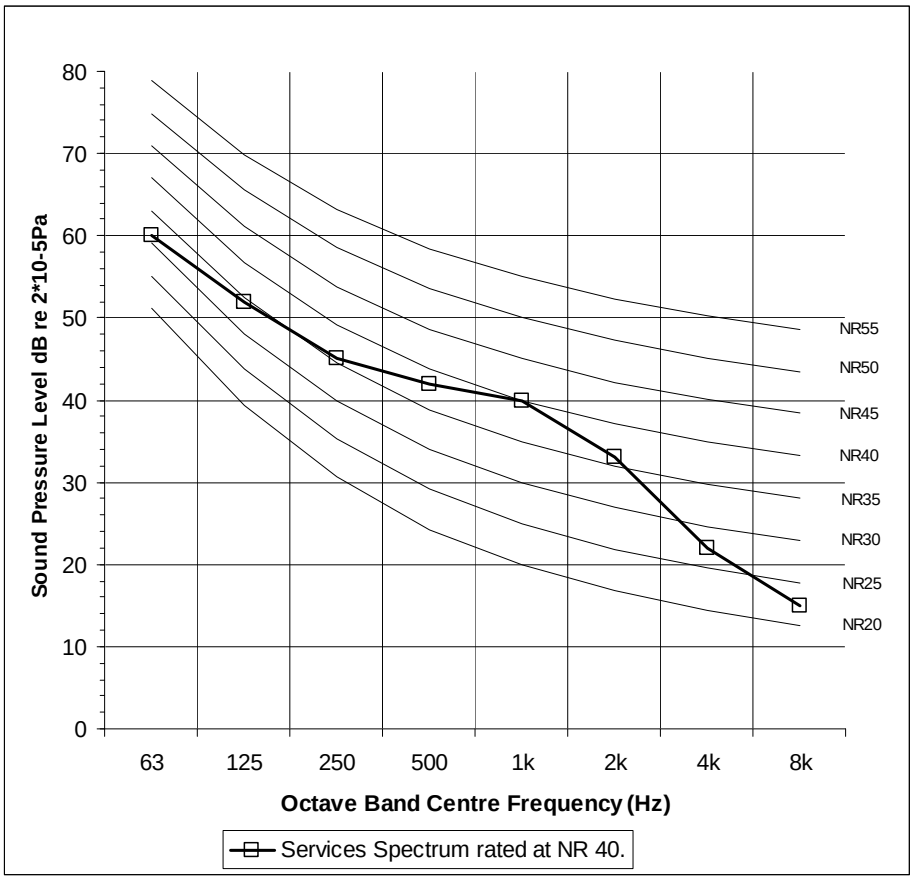
In the laboratory, the weighted normalised impact sound pressure level, $L_{n,w}$, is used to represent the impact sound isolation as a single figure.

On site, the weighted normalised impact sound pressure level, $L'_{n,w}$, and the weighted standardised impact sound pressure level, $L'_{n,Tw}$, is used to represent the impact sound isolation as a single figure.

These single weighted values are determined by comparing the spectral impact sound pressure levels (as defined in ISO 140-6 & -7) with reference values, as outlined in AS/NZS ISO 717.2.

NOISE RATING (NR) CURVES

Noise rating (NR) curves are a set of internationally-agreed octave band sound pressure level curves, based on the concept of equal loudness. The curves are commonly used to define building services noise limits. The NR value of a noise is obtained by plotting the octave band spectrum on the set of standard curves. The highest value curve which is reached by the spectrum is the NR value. Shown below is a plant noise spectrum that is equivalent to NR 40.



REVERBERATION TIME (RT_{60})

The time, in seconds, taken for a sound within a space to decay by 60 dB after the sound source has stopped. An important indicator of the subjective acoustic within an auditorium.

SOUND LEVEL DIFFERENCE (D)

The sound insulation required between two spaces may be determined by the sound level difference needed between them. A single figure descriptor, the weighted sound level difference, D_w, is sometimes used (see AS/NZS ISO 717.1).

The terms used to describe the airborne sound insulation rating of a building element when tested on-site are the weighted normalised level difference ($D_{n,w}$), which corresponds to a reference absorption area in the receiving room, or the weighted standardized level difference ($D_{nT,w}$), which corresponds to a reference reverberation time in the receiving room.

These single numbers are determined by comparing the spectral sound insulation test results (as defined in ISO 140-4) with reference values, as outlined in AS/NZS ISO 717.1.

SOUND REDUCTION INDEX (R)

The sound reduction index (or transmission loss) of a building element is a measure of the loss of sound through the material, ie its attenuation properties. It is a property of the component, unlike the sound level difference which is affected by the common area between the rooms and the acoustic of the receiving room.

The weighted sound reduction index, R_w, is a single figure description of sound reduction index which is defined in AS/NZS ISO 717.1. The R_w is calculated from measurements in an acoustic laboratory. Sound insulation ratings derived from site (which are invariably lower than the laboratory figures) are referred to as the apparent weighted sound reduction index (R'_w) ratings.

STATISTICAL NOISE LEVELS

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for ten percent of the time period under consideration, has been adopted in this country for the assessment of road traffic noise. The L_{90}, the level exceeded for ninety percent of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for one percent of the time, is representative of the maximum levels recorded during the sample period. A-weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, eg $dBL_{A10,\ 5min}$ or $dBL_{A90,\ 8hr}$.