ICSV14
Cairns • Australia
9-12 July, 2007

A SURVEY ON THE CONTROL OF ENVIRONMENTAL NOISE INGRESS INTO RESIDENTIAL APARTMENT BUILDINGS

Gayle Greer[1] and Matthew Stead[2]

[1]Bassett Acoustics
Level 11, 44 Market Street, Sydney, NSW 2000, Australia
[2]Bassett Acoustics
Level 6, 100 Pirie Street, Adelaide, SA 5000, Australia
g.greer@bassett.com.au

Abstract

The urban consolidation of cities has been supported by most Australian State and Territory governments for a number of years in order to make the best use of existing infrastructure. Consequently, new residential developments are being located in areas of relatively high ambient noise levels. The ingress of high levels of environmental noise into homes can cause annoyance, speech, sleep and task interference and arguably, health effects. Additionally, in order for a sustainable community to be created, people must want to live within the built environment and its surrounds.

Bassett Acoustics has been involved in the preparation of a scoping study report on environmental noise and the built environment in Australia. The objectives of the study were to determine if environmental noise ingress into Class 2 & 3 residential buildings within inner city and suburban areas is currently a significant problem and if so, how the problem would be best addressed. A number of options are available including consumer and industry education programmes, guideline documents, industry self-regulation or government regulation. This paper summarises the findings of the study.

1. INTRODUCTION

Concerns have recently been raised regarding the level of external noise which is experienced within residential apartment buildings in inner city and suburban areas. This paper presents the initial findings of a scoping study which had two main objectives. The objectives were to determine if external noise ingress is an issue and, if so, how would the situation be best addressed. This paper seeks to provide an overview of the findings of the scoping study including the key issues and the provision of a national perspective on the control of external noise ingress. Information was gathered in consultation with regulatory authorities and industry stakeholder groups to gain an industry wide perspective. This was completed by means of a web-based survey, complemented by research and conversations with survey respondents who indicated a desire for further discussion. The study was limited to Class 2 and 3 buildings as defined by the Building Code of Australia (BCA).

1.1 Environmental Noise Exposure and Effects

Environmental noise is increasingly becoming a community concern in Australia. The significant sources of environmental noise in Australia include transportation, industrial, commercial and entertainment premises and general neighbourhood noise. Considerable efforts have been made to reduce noise from transportation sources in the last decade, however many of these benefits have been lost due to increased volumes and the sources being spread both temporally and spatially. Concurrently, Government planning departments are effecting shifts in planning and housing policies generally leading to an increase in urban population densities. It is believed that increasing densities will lead to long term benefits for communities and road users and ultimately promote sustainable transportation and land use planning. However, this is having the effect of greater exposure of a larger percentage of the population to increased noise levels.

Research has indicated the most widespread response to environmental noise is annoyance. Annoyance is related to the effect of noise in disrupting conversation, activities requiring attention, rest and relaxation activities. Noise also affects people's ability to gain the appropriate amount and type of sleep needed for maintenance of good health and there are suggestions of disturbed sleep leading to more serious problems. [1] A recent German study found that the risk of heart attack rises significantly with daytime noise levels of over 65 dB(A). [2] Environmental noise ingress can also interfere with the enjoyment of people's homes and amenity areas.

In 2004 three quarters of the Australian population lived in urban areas, of this population approximately 85% lived in Australia's eight capital cities. [3] The most comprehensive study of road traffic noise exposure in Australia undertaken to date indicates that approximately 14-25% of occupants within Australian Capital Cities and associated suburban areas are exposed to $L_{Aeq(24hr)}$ noise levels >55 dB(A). This study concluded that these are unacceptably high proportions given that L_{Aeq} 55 dB(A) is the level recommended by the World Health Organisation to prevent the majority of people from becoming seriously annoyed by noise. [4,5] Adelaide City Council has recently completed research which concluded that the main negative aspect of city living is noise and the situation is perceived to be deteriorating. [6] If sustainable housing plans are to be based on communities being located increasingly in city areas then clearly this issue needs to be addressed to ensure people "want" to live in these areas.

1.2 Current Controls

Currently a consistent approach to the control of external noise intrusion into homes does not exist within Australia. Typically, State Government Departments determine and implement external noise criteria for transportation, industrial and entertainment sources with the control of residential development generally administered by Local Governments. Some Councils take a proactive approach in detailing specific internal noise criteria such as the City of Sydney Council whilst others defer to the levels recommended in Australia/New Zealand Standard AS/NZS 2107:2000 'Acoustics – Recommended design sound levels and reverberation times for building interiors', still other Councils have no external noise intrusion requirements at all. As an example of good practice, Adelaide City Council has recently approved a scheme whereby the Council will reimburse 50% of the cost of work up to a maximum sum for approved sound attenuation work, such as upgraded glazing and window/door seal replacement.

There are varied approaches to the control of external noise intrusion worldwide, ranging from specific internal criteria required in the UK regardless of the external environment, specific façade acoustic performances in France, again regardless of the external

environment and many scenarios in between. [7,8] For example, in the USA, façade performances are related to the external noise levels and in the Netherlands compensations must be given to the occupants of residential buildings where the external noise criteria are exceeded. The compensations can be very low noise levels within the residential buildings and/or the provision of 'quiet' communal parkland areas. [9,10] Generally in Europe there is a trend towards the use of internal noise criteria in conjunction with increased residential development in "brownfield" sites due to sustainability initiatives.

2. WEB-BASED STAKEHOLDER SURVEY

As previously mentioned a web-based survey has been completed by regulatory authorities and stakeholder groups within the housing industry to determine and analyse the extent of issues relating to external noise and the acoustic performance of the façades of Building Code of Australia (BCA) Class 2 and Class 3 buildings located within inner city and suburban areas.

Class 2 buildings are those containing 2 or more sole occupancy units, each being a separate dwelling, most residential apartment buildings fit into this classification. Class 3 buildings include residential buildings which are common places of long term or transient living for a number of unrelated persons such as guest houses and hotels.

The survey has been completed by 95 respondents, 43% of the responses were from Local Government employees, 12% were from State Government employees with the remainder from industry stakeholder groups such as the Master Builders Association and the Planning Institute of Australia. Responses were received from all States and Territories; however these numbered less than ten from the Australian Capital Territory, the Northern Territory and Tasmania and therefore these responses may not be reliable.

2.1 Is External Noise Ingress a Problem?

Table 1 indicates the percentage of survey respondents who believe environmental noise from various sources has a detrimental effect on apartment building occupants. It can be seen that most people perceive noise from entertainment premises to have the most detrimental effect in inner city areas, with transport sources causing the most problems in suburban areas.

Table 1. Percentage of survey respondents who believe noise from the following sources has a detrimental effect on apartment building occupants.

Environmental Noise Source	Inner City Areas	Suburban Areas
Transport	78%	81%
Neighbours	72%	66%
Industrial/Commercial Premises	68%	61%
Entertainment Premises	88%	63%

Table 2 indicates the percentage of survey respondents who believe the following effects result from high environmental noise exposure. It can be seen that the most widespread effects are annoyance and sleep disturbance in both inner city and suburban areas.

Table 2. Percentage of survey respondents who believe the following effects result from high environmental noise exposure.

Effect	Inner City Areas	Suburban Areas
Annoyance	93%	87%
Sleep Disturbance	88%	81%
Task Disturbance	58%	45%
Speech Interference	38%	32%
Health Effects	56%	48%

74% of survey respondents were aware of technical solutions to control the transmission of external noise into residential apartment buildings. These included the use of barriers, buffer zones, improved building envelope acoustical performance and good internal layouts.

71% of survey respondents were aware of regulations, standards or guidelines that limit external noise transmission into residential apartment buildings. These included Regulations, various State and Local Government documents and Australian Standards. However 64% of respondents felt that applicable requirements were inadequate, including 72% of responses from Local Government. Table 3 below indicates how responses varied by State/Territory. Table 4 details how the responses varied between Members and Non-members of the Australian Acoustical Society (AAS).

Table 3. Percentage of survey respondents who believe any applicable requirements to control external noise transmission into residential apartment buildings are not adequate by State/Territory.

	State/Territory							
Overall	**ACT**	**NSW**	**NT**	**QLD**	**SA**	**TAS**	**VIC**	**WA**
64%	33%	43%	67%	83%	83%	100%	75%	50%

Table 4. Percentage of survey respondents who believe any applicable requirements to control external noise transmission into residential apartment buildings are not adequate by membership of the AAS.

Overall	Responses from Members of the Australian Acoustical Society	Responses from Non-Members of the Australian Acoustical Society
64%	56%	66%

83% of respondents, including 88% of Local Government, considered a review of the current Regulations, standards and guideline documents necessary in order to adequately mitigate external noise transmission into residential apartment buildings. Table 5 below indicates variations between States/Territories. Table 6 details how the responses varied between Members and Non-members of the AAS.

Table 5. Percentage of survey respondents who consider a review of current regulations, standards and guides necessary by State/Territory.

	State/Territory							
Overall	**ACT**	**NSW**	**NT**	**QLD**	**SA**	**TAS**	**VIC**	**WA**
83%	67%	83%	100%	93%	80%	33%	89%	75%

Table 6. Percentage of survey respondents who consider a review of current regulations, standards and guides necessary by membership of the AAS.

Overall	Responses from Members of the Australian Acoustical Society	Responses from Non-Members of the Australian Acoustical Society
83%	81%	94%

Some of the reasons which were listed for considering a review necessary included:

- The lack of a consistent approach within and across States;
- The need for the provision of a single document encompassing all acoustic requirements

for residential apartment buildings;
- Growing consumer expectations in relation to acoustic amenity;
- Councils receiving ever increasing numbers of complaints implying the current systems must not be adequate;
- Residential apartment buildings being built in urban areas where previously the acoustic environment would have been considered too loud;
- Perception of social inequity, apartment buildings which do have high degrees of noise intrusion control are almost exclusively at the luxury end of the market;
- The difficulty in ensuring completed buildings have good acoustic properties where mandatory requirements do not exist; and
- Other amenity affecting the human environment such as air standards and energy efficiency are addressed in the BCA, however the BCA does not fully address all acoustic issues.

Others who did not think a review necessary made the following comments:
- There is inadequate application of existing requirements;
- Additional requirements may lead to excessive costs during construction;
- BCA requirements are already difficult to apply, the addition of an external criterion would be onerous; and
- Property owners should not have to face costs arising from external noise sources;

2.2 How Would the Problem be Best Addressed?

A number of options were identified in the survey as having the potential to address the issue of external noise intrusion into residential apartment buildings. This section examines the survey responses in relation to these options.

In terms of how a review of regulations, standards and guides should occur, the most popular response selected (38%) was Government intervention through changes to the BCA, next (17%) Government intervention through planning schemes, with 14% of respondents selecting development of design and construction aids, such as handbooks and guidelines, 9% selecting the development of a consumer and industry education programme and 2% selecting a self-regulated industry scheme. 20% of respondents detailed another option with 8% selecting a combination of all of the above with the exception of industry self-regulation. Table 7 indicates how results varied by State/Territory. Table 8 indicates how responses varied between AAS Members and Non-members. Similar percentages preferred Government intervention by either building code or planning whilst significantly more AAS Members chose the development of design and construction aids. Responses from Local Government were ranked in the same order as the overall results with the exception of Local Government preferring the development of a consumer and industry education programme to the development of design and construction aids.

Table 7. Methods of review of current regulations, standards and guides by State/Territory.

Method of Review	All	ACT	NSW	NT	QLD	SA	TAS	VIC	WA
Government intervention through building codes	38%	33%	23%	60%	40%	54%	0%	53%	25%
Government intervention through planning schemes	17%	0%	27%	20%	27%	8%	0%	6%	17%
Development of design & construction aids	14%	0%	14%	20%	20%	8%	0%	12%	17%
Development of a consumer & industry education programme	9%	0%	14%	0%	0%	8%	100 %	0%	17%
Implementation of an industry system of self regulation	2%	0%	5%	0%	7%	0%	0%	0%	0%%
Other	20%	67%	18%	0%	7%	23%	0%	29%	25%

Table 8. Methods of review of current regulations, standards and guides by AAS Membership.

Method of Review	Responses from Members of the Australian Acoustical Society	Responses from Non-Members of the Australian Acoustical Society
Government intervention through building codes	35%	39%
Government intervention through planning schemes	12%	18%
Development of design & construction aids	29%	10%
Development of a consumer & industry education programme	6%	10%
Implementation of an industry system of self regulation	6%	1%
Other	12%	22%

50% of survey respondents believe that any change should be the responsibility of the Australian Building Codes Board, with 21% thinking it should be the responsibility of the State Government and 8% believing the responsibility should be shared between the ABCB and State/Local Governments. The ranking of responses from Local Government was identical to the overall responses.

Table 9 Body responsible for a new scheme to control of the ingress of external noise by State/Territory.

Body Responsible	All	ACT	NSW	NT	QLD	SA	TAS	VIC	WA
Building Code of Australia	50%	0%	35%	60%	53%	50%	100%	71%	42%
State Government	21%	33%	35%	40%	7%	21%	0%	12%	17%
Local Government	7%	0%	9%	0%	20%	7%	0%	0%	0%
Self-regulation of Industry	7%	33%	4%	0%	13%	7%	0%	0%	6%
Other	17%	33%	17%	0%	7%	14%	0%	18%	33%

Table 10 Body responsible for a new scheme to control of the ingress of external noise by AAS membership.

Body Responsible	Responses from Members of the Australian Acoustical Society	Responses from Non-Members of the Australian Acoustical Society
Building Code of Australia	53%	49%
State Government	24%	20%
Local Government	6%	7%
Self-regulation of Industry	6%	7%
Other	12%	18%

83% of the survey respondents believe that a scheme addressing external noise transmission into residential apartment buildings would provide a justifiable community benefit. Table 11 indicates the variations between States and Territories. 94% of the AAS Members who responded considered a review to be a justifiable community benefit, compared with 81% of non-members.

Table 11 Percentage of survey respondents who consider a review of current regulations, standards and guides a justifiable community benefit.

All	ACT	NSW	NT	QLD	SA	TAS	VIC	WA
83%	33%	83%	100%	80%	93%	67%	89%	75%

Additional comments by survey respondents included:

- Any recommendations should be site specific;
- The burden of noise attenuation must be borne by not only the noise generators but by new residential building occupants;
- A ‘one solution fits all’ would be overkill; and
- Any recommendation should be locality specific.

3. CONCLUSIONS

It is likely that the amenity and health of the general population is being negatively affected by exposure to high environmental noise levels in their homes. It there were to be no regulatory reform this situation will continue, and potentially deteriorate given that State and Territory Governments are adopting policies that will increase residential densities in urban areas. Therefore it is concluded that the issue of external noise intrusion into residential apartment buildings needs to be addressed. This could be facilitated by:

- Development of a consumer and industry education programme;
- Development of design and construction aids, such as handbooks and guidelines;
- Implementation of an industry system of self-regulation;
- Government intervention through planning schemes; or
- Government intervention through building codes;

Melbourne City Council has provided an extensive online education system, Citysounds, for prospective buyers and developers of residential apartments however they have concluded that education alone is not enough. Some survey respondents thought a document produced and circulated by the ABCB may prove to be more successful. Results of the survey indicate that the industry is aware of effective technical solutions, however as external noise ingress is considered to be a problem this approach does not seem to have been effective. From the survey it has been concluded that the industry is not capable of self-regulation, rating systems which could form part of self-regulation are rarely implemented due to financial burden and a lack of perceived value. A system regulated solely by Local

Government will not eliminate the inconsistencies within and between States and Territories that many stakeholders identified in the survey. An approach which involves changes to the BCA alone may not allow enough flexibility to allow site specific controls to be implemented. This type of approach may also lead to a blanket standard being applied which would be excessive and unnecessary in some scenarios and inadequate in others.

Responses to the survey indicated that the preferred solution would be a hybrid of the above approaches with responsibility shared between the ABCB and State/Local Governments. A quantified performance requirement for the building envelope of residential apartment buildings within "Noise Zones" could be developed and specified within the Building Code of Australia (BCA). The "Noise Zones" would provide an indication of the likely noise level to be experienced within a subject area and could be identified by Local Governments as deemed necessary.

REFERENCES

[1] enhealth Council, *The health effects of environmental noise – other than hearing loss*, Department of Health and Ageing, 2004.

[2] Babisch, W, (2006) *Transportation noise and cardiovascular risk*, Federal Environmental Agency, Dessau, Germany.

[3] Australian Bureau of Statistics, *Yearbook Australia 2006*, http://www.abs.gov.au/ausstats/abs@.nsf/b4005c38619c665aca25709000203b8d/b4310d02ff4047f9ca2570de00065392!OpenDocument, accessed 23rd March 2007.

[4] Brown, AL, Bullen RB, (2003) "Road traffic noise exposure in Australian capital cities" *Acoustics Australia* Vol 31, No. 1, pp 11-16.

[5] World Health Organisation, *Guidelines for community noise*, World Health Organisation, 2000.

[6] Adelaide City Council, *Noise Attenuation and Awareness Project Presentation*, Adelaide City Council, 2006.

[7] British Standard Institution (1999) BS 8233: 1999 *Sound insulation and noise reduction for building* – Code of practice, London, BSI.

[8] Lambert J, Vallet, M (1994) *Study related to the preparation of a communication on a future EC noise policy (LRN Report No 9420)* Institut National de Recherché sur les Transports et leur Sécurité, Cedex, France.

[9] Federal Agency Committee on Urban Noise (FICUN), (1980) *Guidelines for considering noise in land use planning and control*, FICUN, Washington DC, USA.

[10] The Netherlands Ministry of Housing, Spatial Planning and the Environment (2003) *Liveable Cities*, Dutch Ministry of Housing, Spatial Planning, and the Environment, The Hague, Netherlands.