External Research Report

ER30 – B [2018]

Acoustical Design of Medium Density Housing

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Project LR0514

Marshall Day Acoustics, Scion, University of Auckland, Enovate Consultants, Jasmax, ECubed, funded by the Building Research Levy

Funded from the
Building Research Levy

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ISSN: 2423-0839

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Funded from the
Building Research Levy

Acoustical Design of Medium-Density Housing

Collaborative research project

FINAL REPORT 30 June 2017

APPENDIX G: Stage 2 Industry Consultation

(Revision 1, March 2018)

Funded from the Building Research Levy
BRANZ
THE UNIVERSITY OF AUCKLAND
NEW ZEALAND
Jasmax
eCubed
SCION
EC PRIVATE CONSULTANTS
MARSHALL DAY Acoustics

Contents

Version information

30 June 2017- Appendix G document originally submitted as part of the final research report to BRANZ.

March 2018 Revision 1 – With minor amendments made to the rest of the report, this report has been relabelled to match - incorporating reference to this being the Study Report pdf 2 of 2. Study Report pdf 1 of 2 contains Chapters 1-7 and Appendices A-F. Also notes that Appendix H survey data may be requested from BRANZ.

APPENDIX G STAGE 2 INDUSTRY CONSULTATION

G1 INTRODUCTION

This appendix documents the industry consultation as collated at the end of the middle stage (stage 2) of the "Acoustic Design of Medium Density Housing (MDH)" project funded by the Building Research Levy 2016-2017. This Appendix should be read in conjunction with the full project report for details of the project goals, and background.

The goal of the project is to help BRANZ in working towards "Providing the building industry with the technical information to design quality, affordable and desirable Medium Density Housing (MDH) in relation to noise control". Stage 1 of the project identified areas of acoustic consideration for MDH projects, current information sources, and research underway.

Stage 2 was the industry consultation phase of this project, and aimed to identify the current state of acoustic knowledge in industry, what industry wants and needs to know, as well as helping to prioritise the key areas that need addressing.

Three methods were used as part of this industry consultation phase:

SURVEY: The main method used was an electronic survey distributed primarily to the BRANZ email list. The development of the survey, along with analysis of the results, is documented here along with initial analysis. Further analysis will occur during Stage 3 of the project. Screen shots of the actual survey and detailed tabulation of results/comments can be found in the separate final report Appendix H

INTERVIEWS: In addition, several interviews were undertaken with various groups that were less represented in the mailing list and research team. Key interviews to date are documented here, with further interviews ongoing.

CASE STUDIES: Practical examples of how acoustic considerations can impact building projects are also included as mini case studies, for a variety of structure types and areas of consideration.

Results from these investigations are included along with initial analysis as noted at the end of this Appendix.

Note this report is designed for A3 paper printing to facilitate full display of graphs and tables

G2 "TOWARDS QUIET HOUSING" A BUILDING INDUSTRY SURVEY

G2.1 Survey Introduction

The key method of industry consultation was through an online survey.

As noted in the information page of the survey,

"Acoustic design for housing aims to ensure residents have appropriate levels of acoustic comfort in their home (i.e. residents experience acceptable noise levels and privacy). To achieve this there needs to be:

- *Consideration of noise sources for site planning and building layout*
- *Suitable sound insulation, structure and building elements in the building design to meet acoustic building regulations, standards and design guidelines, while integrating well with other design requirements*
- *A suitable range of products available to achieve the design in a cost-effective way, with practical installation and maintenance*
- *Good workmanship at the construction phase to ensure noise control solutions perform as specified."*

Therefore, those involved in planning, designing and constructing MDH along with supporting sectors (e.g. product design/supply, training, building consents and compliance) are all important to achieving good outcomes, not just those involved with the design details.

The survey was designed to canvas ideas from across this range of fields. The survey allowed a much broader industry coverage than could have been achieved through interviews alone.

This section outlines the goals of the survey, the survey design and delivery methodologies, as well as analysis of the results per question.

Full survey results and screen shots of the original online survey are given in the separate large APPENDIX H document which can be requested from BRANZ but is not available for public distribution. This includes the full text responses from participants – tabulated in anonymous form.

G2.2 Survey Methodology

Section G2.2 documents how the survey was designed and run. It covers the survey's:

- Goals
- Design
- Title Choice
- Delivery Method
- Distribution
- Biases
- Analysis

G2.2.1 SURVEY GOALS

The purpose of running the survey was to understand the current state of acoustic knowledge within the building industry in relation to the development of medium density housing (MDH) in NZ. The survey aimed to:

- Canvas a random sample of opinions from multiple disciplines across the building industry
- Canvas opinions from multiple geographic regions (not just Auckland where the research team is based)
- Canvas opinions from a broad range of knowledge levels
- Identify industry perceptions of the key issues and current state of play in NZ
- Understand industry information needs –including sources used, perceived gaps, and format preferences
- Present topics for feedback in a balanced and impartial format
- Get people to share their thoughts in their own words
- Allow for anonymous responses so people can be candid

As a corollary to this it was also hoped the survey could

- Raise awareness and get people thinking and talking about this topic
- Confirm if any major areas were missed during our literature review phase

As we were unsure of the response rate, the intention was not to report highly statistically analysed quantitative findings, but rather to identify general trends and additional information for consideration.

G2.2.2 SURVEY DESIGN

To gauge opinions across a broad range of topics while getting a reasonable level of engagement with participants, the survey needed to balance survey depth and length. Designing the survey took slightly longer than anticipated, with multiple version trialled within the broader project team and a few external groups before the final distribution.

To achieve the survey's goals (sectionG2.2.1) the team decided the survey needed to:

- Include an introduction with the intent of the survey and those for whom the survey was most relevant – with optional additional information for those wanting more
- Include a mix of quantitative and qualitative questions, with a comment box for all quantitative questions to help elicit additional thoughts
- Word questions with neutral / non leading language, while still providing clear guidance on the information sought - with neutral examples if needed for clarity
- Ask some initial questions on the participant's role in industry, to help categorise responses, and general perceptions of their knowledge level and needs
- Lead through broad topic areas so that the ideas were fresh in mind when asking open-ended opinions at the end of sections

Although the survey was slightly longer than perhaps ideal, the level of response and quantity of typed responses was higher than anticipated, so it was felt the design did generate a reasonable level of engagement. The final survey, as seen by participants through the online delivery system (see section G2.2.4 below), is included in Appendix H1 for reference.

G2.2.3 SURVEY TITLE "TOWARDS QUIET HOUSING"

To attract attention and encourage people to participate in the survey it was felt a short catchy title was needed. The team felt the title "Towards Quiet Housing" encapsulated the idea of the survey working towards giving the industry the best tools for the development of housing that provides good acoustic comfort levels, now and into the future. We used 'quiet' rather than 'quieter' since questions of the best levels and whether a change is needed, are a point of discussion.

G2.2.4 SURVEY DELIVERY

The online survey development service **'SurveyMonkey'** was chosen to create and deliver the electronic survey. This online service includes tools for creating the question pages, online display of the survey, options to mail out invitations to email addresses or deliver via a website link, basic analysis tools available from when results start to be collected, as well as data export tools.

Originally the plan was for the survey to run from late January to mid February once most people were back from their Christmas and summer break. In practise, survey delivery occurred between 9th -28th February 2017. This 2-3 week window was expected to be sufficient since responses were anticipated to be highest within a few days of the survey invitation/notification and reminder notices. This did indeed match with the response results obtained (see section G2.4).

G2.2.5 SURVEY DISTRIBUTION

To get a broad cross section of feedback, responses were needed from many building industry sectors including building designers (architects, engineers and other technical consultants), building contractors (including builders, relevant installers), building officials (inspectors, building consent authorities), planners, multi-unit residential developers, trainers, and product suppliers.

As BRANZ has a comprehensive mailing list it was decided this would be the main distribution list used for the survey. Using the BRANZ mailing list was more efficient than approaching lots of different organisations to distribute the survey, each in their own way. It also allowed good geographic coverage across NZ.

The BRANZ list includes recipients who have agreed to be contacted with regards to building research in NZ and a subset of their total mailing list was used for this project, as per Table 1. As agreed with BRANZ, to clarify that the survey invitations were not unsolicited, all invitations to these email addresses clearly stated the invitation came on behalf of BRANZ and Marshall Day Acoustics as part of this collaborative research project.

Table 1: A subset of the full BRANZ mailing list was used for survey invitations– those listed with the following relevant 'Occupations'

Architect	Electrician	Mason	Scientist
Builder	Engineer	Plasterer	Tiler
Building Consultant	Fire	Plumber	Tutor
Building Official	Flooring	Researcher	
Concreters	Glazier	Roofer	
Designer	Manufacturer	Sales	

The BRANZ email list was loaded into the survey delivery system so that invitations and reminders could be sent, only one response per invitation would be recorded, but results could remain anonymous. The main survey invitation went out on 9th February with a few additional occupation groups added and emailed on 15th February 2017.

Some relevant areas were under-represented number wise in the BRANZ list, so a web link to the survey was also distributed as follows in Table 2

Table 2: Additional locations that survey weblinks were distributed to

Organisation	Distribution path
NZ Planning Institute (NZPI)	Invitation and weblink in the NZPI eBulletin "Planning Focus" (17th February 2017
The Institution of Professional Engineers New Zealand (IPENZ)	Short invite and Weblink as IPENZ Facebook and LinkedIn posts (15 February2017)
Acoustical Society of New Zealand (ASNZ)	Email from the ASNZ committee to members with weblink (15 February 2017)
BRANZ	Short invite and weblink as BRANZ LinkedIn and Twitter posts (20 February 2017)

Attempts were also made to distribute the survey link to developers through the NZ Property Council and to Quantity Surveyors through the NZ Institute of Quantity Surveyors but these did not happen in the required timeframe.

The survey officially closed on the 28th February 2017. A separate copy of the survey has been set up for reference and late additions and can be viewed at https://www.surveymonkey.com/r/TKHVSLF

G2.2.6 SURVEY BIAS

This section gives a brief rundown of biases introduced from the methodology chosen. Although a full statistical analysis of the survey was not intended, these points should be born in mind.

Uneven distribution of industry group responses: The mailing list and web invites did not have an even spread across the different sectors of the building industry and response rates tended to be higher among groups who felt this topic was more relevant to them. Those identifying their role as Architects/Architectural Designer, Main contractor/builder and Building Officials were the three largest respondent groups.

To address this in analysing quantitative results, respondents have been combined by role into 'Design', 'Construction', 'Compliance' and 'General' groups and for some questions percentage responses compared to spot trends across the different groups.

Qualitative responses were grouped by the respondent's role in industry to help identify patterns within different groups.

Email distribution: By limiting the survey to electronic distribution, there is perhaps a slight bias against more hands-on aspects of the construction industry, who are not so often at a computer, although the prevalence of electronic communications is such that this should no longer provide too much of a bias. The straight forward interface of the survey delivery hopefully also did not deter those with lower levels of computer literacy – and the survey could be done on a mobile phone.

Spam Filtering: Emails from SurveyMonkey may be on the spam list of some organisations, meaning some people will not receive the email invitations. There is no way to work around this, so this is regarded as a method of random sampling of the invitations sent out.

Survey length – The survey introduction explained this was a comprehensive, >15min survey, so only those with spare time and an especial interest in the subject are likely to have participated.

G2.2.7 SURVEY ANALYSIS

Survey Monkey allows some analysis from the moment results begin to be collected, allowing progress to be monitored. However, it is not always possible or easy to arrange and export the results exactly as wanted. All the survey data was therefore exported to Excel format and analysis was performed using pivot table and consolidation of the raw data.

The results presented in this report are just a sample of what is possible. Further analysis to spot further patterns can be done using the source data if required.

G2.3 Survey Overview

This section gives an overview of the survey questions, response rates and shortcuts used for further analysis. Analysis by question is given in the next section. Fuller statistics and complete comment responses for each questions are given in Appendix H.

The basic structure of the survey was as follows, listed with question topic areas not the full actual questions.

INTRODUCTION PAGES

Survey Page 1 – Questions 1-3: Industry Role and Experience

- Question 1 – Role in Industry?
- Question 2 – Relevance of acoustics to you?
- Question 3 – Self assessment of acoustic knowledge

Survey Page 2 – Questions 4-9: Drivers of Acoustic Design

- Question 4 – How often end users specify acoustic comfort in MDH requirements?
- Question 5 – End user feedback on acoustic performance?
- Question 6 – Relative concern levels for noise sources?
- Question 7 – Thoughts on the NZ building Code Clause G6?
- Question 8 – Thoughts on an Acoustic Star Rating system?
- Question 9 – Other drivers for acoustic design?

Survey Page 3 – Questions 10-17: Information and solutions

- Question 10 – Acoustic information: sources used?
- Question 11 – Areas where more acoustic information is needed?
- Question 12 – Thoughts on product range in NZ and innovations needed?
- Question 13 – Research and development needs?
- Question 14 – Useful overseas information/solution to share?
- Question 15 – Goto place for acoustic knowledge?
- Question 16 – Best education methods?
- Question 17 – Other thoughts on information and solutions?

Survey Page 4 – Questions 18-20: Please share your experiences and opinions

- Question 18 - Thoughts on acoustic quality in relation to MDH?
- Question 19 – Effects of acoustic considerations on affordability?
- Question 20 – Practical Examples to offer?

CLOSING PAGE – contact further? Last thoughts

Full analysis of the survey is ongoing, with the aim to use the findings of the survey to help guide Stage 3. This progress report gives the analysis as completed up to this time. As we received fuller responses than anticipated in the open response boxes, the analysis is taking slighter longer than planned, but with the benefit that we will gain a better insight into industry opinions and perceptions.

G2.4 Survey Response and Completion Rates

696 people began the survey, some dropped out at various questions along the way, but 414 (59%) completed the survey.

Overall the response counts were higher than anticipated. The subset of the BRANZ mailing list used was large (> 14k contacts), but the survey was not necessarily relevant to all those who received an invitation. The survey email invite and introduction explained that we were primarily interested in responses from those involved with the planning, design, and construction of MDH and supporting industries (e.g. products, compliance, education).

For example, many builders on the BRANZ list might not work on MDH. The specialised nature of the topic and the fact the survey was more than 15 min long will also have been factors in whether people participated.

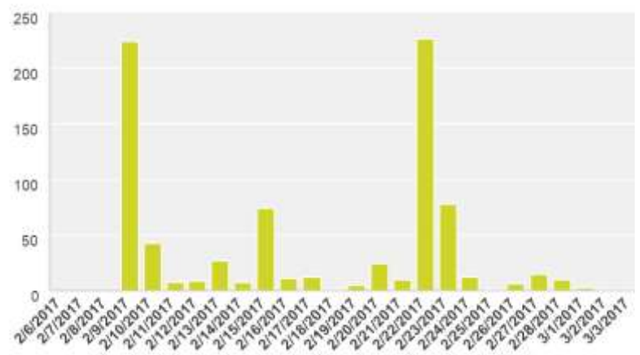
While monitoring the survey response, it was noted that the response patterns for quantitative questions remained largely the same from about

Table 3: Survey response counts for direct email invitations and web links (see section G2.2.5Table 1 for more on distribution)

	Emails sent	Opened email*	Clicked 'begin survey' button	Not begun after reading intro	Incomplete (some answers given)**	Completed (clicked final 'Submit' button)
Email invitation BRANZ 'Builders'	7311	2733	290	79	91	120
Email invitation BRANZ Non Builders	7253	2290	591	166	169	256
Acoustical Society emailed WebLink			30	5	6	19
Planners Institute WebLink in enewsletter			28	9	11	8
IPENZ Social media WebLink			7	3		4
BRANZ social media WebLink			6	3	3	
MiscWebLink			10	1	2	7
Totals	**14564**	**5023**	**962**	**266**	**282**	**414**

* Number of emails that Survey Monkey registered as opened in a mail client so excludes unopened, bounced, spam filtered and unsubscribed emails

Figure 1: Survey responses by date. 9 Feb 2017 initial mailout; 15 Feb 2017 extra mailout and weblinks; 22 Feb 2017 email reminders sent



50 responses – however a full statistical analysis with confidence intervals has not been conducted.

Responses by delivery method: Total response counts for the email invitations and web links to the survey were as per Table 3. Overall 696 people began the survey (ie started to give answers) with 414 completing it. Note that the industry wide 'BRANZ Industry Needs Survey 2016' (larger mailing list?) had about 1100 responses, so for a specialised survey the response rate was reasonably high. Email invitations were far more effective than social media weblinks – although the NZ planners e-newsletter notice with weblink worked quite well.

Responses by date: Note that, as anticipated, most responses occurred within a week of the email invitation, social media post or email reminder – see Figure 1 generated by SurveyMonkey. The reminder email was particularly effective – the subject line was changed so 'BRANZ Survey' was seen first, to clarify it wasn't general spam from overseas.

Time taken: Exact stats for the time people took was not possible (i.e. can't tell those that may have gone away and come back) but for those that completed the survey, 83% look less than 50 min, and the medium time taken across all completed surveys was 23 minutes.

Completion Rates: Of those that read the email invitation to the survey 12.7% began the survey and 7.5% completed it. Overall, 60% of those that began the survey completed it.

G2.4.1 RESPONSES BY ROLE IN INDUSTRY

The first question in the survey asked respondents to give their role in industry so that later responses could be categorised by the sector of industry.

Table 4 shows the choice of roles offered. As some of the role descriptions were quite long, roles may be abbreviated in later tables and quotes as given here.

Table 4: Respondent roles and role abbreviations used for later tables

Role Description	RoleAbbreviation
Acoustician / Acoustic engineer	ACOU
Architect / Architectural designer	ARCH
Building official (e.g. national or local government, building consent authority)	OFFI
Building product research / design / marketing& sales / supplier	PROD
Engineer / Technical consultant (excluding acoustic)	ENG
Main contractor / builder	BUILD
Other consultant (e.g. quantity surveyor, planner)	CONS
Residential housing developer (detached dwellings)	DEV1
Residential housing developer (medium density housing)	DEVM
Specialist contractor or installer (e.g. HVAC installer, plumber, electrician...)	INST
Trainer / Tutor / Educator	EDUC
Other (please specify)	OTH

At a role level acousticians had the highest completion rates (75%) while those who recorded their role as 'Other' had the lowest (48%). Overall 59% competed the survey once begun.

INDUSTRY SECTORS

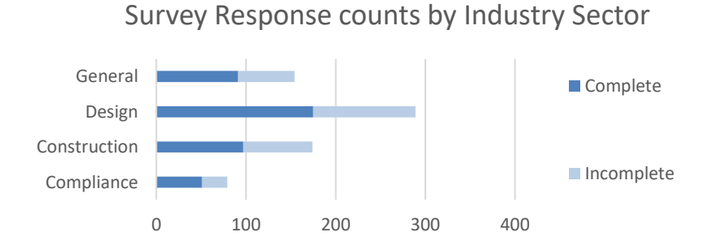
Given the small sample sizes for some of these roles, where comparison across sectors is wanted, respondents have been combined into four 'industry sectors' as per Table 5. Figure 2 shows the survey response count and completion rates by sector. Note the design and construction sectors have the larger sample sizes, but there is still a reasonable sample size (>50) for supporting sectors (General and Compliance).

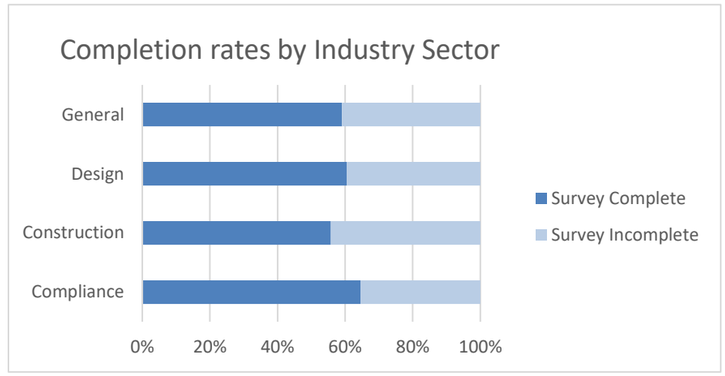
These groupings are somewhat arbitrary but just used to observe trends.

Table 5: Roles included in each industry sector

Building Industry Sector	Roles included
COMPLIANCE	• Building officials
CONSTRUCTION	• Main contractor / builder • Specialist contractor or installer
DESIGN	• Acoustician / Acoustic engineer • Architect / Architectural designer • Engineer / Technical consultant (excluding acoustic)
GENERAL	• Building product research / design / marketing& sales / supplier • Other consultant (e.g. quantity surveyor, planner) • Residential housing developer (detached dwellings) • Residential housing developer (medium density housing) • Trainer / Tutor / Educator • Other (please specify)

Figure 2: Survey responses by Industry Sector as count and completion rates as %





G2.5 Survey results by question

Full text responses and more complete tables of response counts (%) for each question are provided in Appendix H. Further analysis is possible using raw results if required.

Results for each survey question are covered in the following sections. The wording of the question is given highlighted for reference, followed by the aim of the question, results, graphs and discussion. As an example, before the formal questions began, users were asked if they wanted more information.

SURVEY QUESTION: Would you like a little bit more information on the project and survey aims before we begin? Select Yes or No then click the 'Next' button below.

QUESTION AIM

Before the survey proper, respondents were given a brief introduction and the option to see a page with more detailed information on the survey and project. This was to help raise awareness of the project and give people more info on whether they felt they should participate.

RESULTS / ANALYSIS

29% chose YES to see the more detailed information. Acousticians had an especial interest in further information (50% chose 'Yes').

G2.5.1 QUESTION 1 – ROLE IN INDUSTRY?

Question 1: What is your main role in the building industry? Please select the relevant category to help us correlate feedback from different branches of industry:

QUESTION AIM

Knowing the respondent's role in industry would allow comparison of responses for later questions by different sectors of the building industry, as discussed in section G2.4.1

RESULTS / ANALYSIS

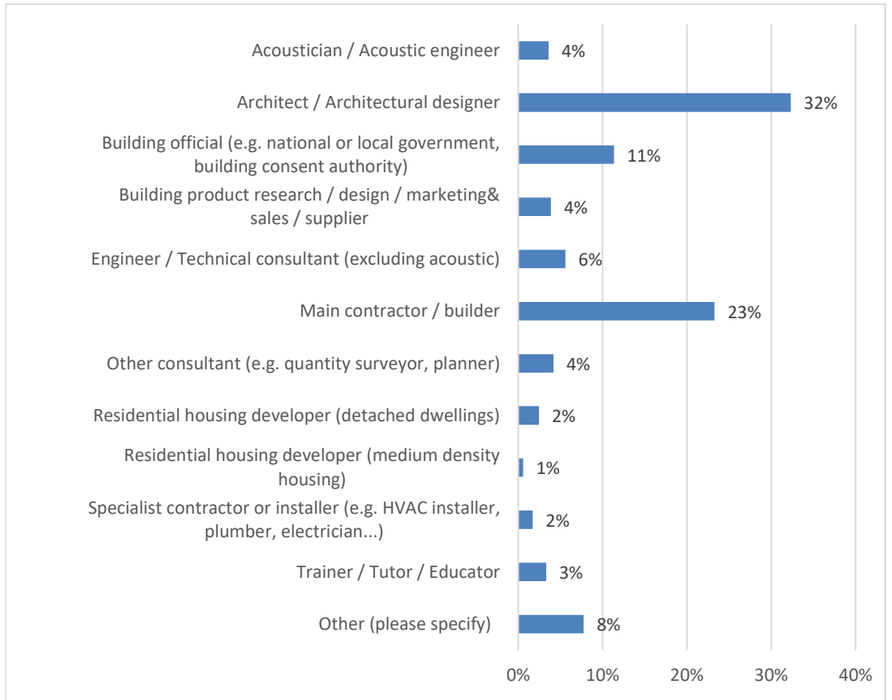
Figure 3 shows the proportion for each category

The three largest groups represented in the survey are

- Architect / Architectural designer
- Main contractor / builder
- Building official (e.g. national or local government, building consent authority)

As noted in Section G2.4.1, there are small sample sizes for some types of role, so responses are grouped into 4 industry sectors, and the final proportions are shown graphically in Figure 4

Figure 3: *Question 1 - What is your main role in the building industry?*
Response % for each role category (696 responses)



Note that those who indicated the 'Other (please specify)' role included:

Architectural Technician, Building Sales, Building Surveyor (x3), Building Surveyor & Architectural Technologist, Building surveyor & Building official, Carpenter, flooring system manufacturer, Design & Build, Draughtsman, engineer & Operations manager, environmental research, director of industry association, Facilities Engineer, furniture manufacturer, Government, architect & lecturer, Builder & insurance, main contractor/builder/developer, Non consent buildings, Planner, Planner / Urban Designer, Pre purchase building inspector, Precast yard worker, product supplier, Project Development Manager, Project Manager in residential housing construction (detached), Project manager/ building inspector, R&D Scientist & Manufacturer of Building products, Residential housing investor, Residential Project Manager, retired builder, retired builder still active, Sales manager, Site manager x2, Specialist repair contractor, Student quantity surveyor, sub contractor, Supplier, Supplier of UV cure coatings, Supplier to building industry, technical support, Urban/Town Planner, Volume home builder, technical advice to all sectors of building industry, Technical Training &Support, Manufacturer & Development Fire/ Noise/ Structure

Question 1a: and further to this your specific job description? e.g. fire engineer; building inspector; urban planner; intertenancy systems sales & marketing

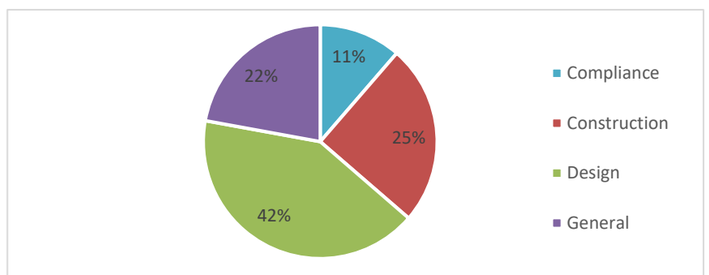
QUESTION AIM

This question was included to provide context for comments if needed (e.g. specific details on a window from a window manufacturer).

RESULTS / ANALYSIS

Appendix H, Q1 lists the responses given for each role category.

Figure 4: *Question 1 – What is your main role in the building industry?*
Response % by industry sectors, combining roles as per Table 5(696 responses)



G2.5.2 QUESTION 2 – RELEVANCE OF ACOUSTICS TO YOU?

Question 2: How important do you think knowledge of acoustic considerations is for your role in MDH projects? Please select one:

Table 6: Question 2 responses

Response option	Response %	Response Count
a) don't think it is relevant	2%	12
b) not needed as professional acoustic advice would be sought	2%	15
c) basic understanding should be sufficient	13%	86
d) basic understanding needed but professional advice usually sought for projects	30%	207
e) a good level of understanding is required	31%	211
f) good understanding is critical	23%	155
Grand Total	**100%**	**686**

QUESTION AIM

To gauge how relevant respondents think acoustic knowledge is to them.

RESULTS / ANALYSIS

Table 6 and Figure 5 shows the overall responses and Figure 6 shows responses broken down by industry sector. Only a very small proportion (4%) thinks it isn't relevant to them or they are happy to rely only on professional advice. Everyone else felt they needed at least a basic understanding with the highest level of understanding required by those in design and compliance, and least for those in construction. Those that felt they only needed a basic understanding felt they were usually supported by professional advice.

A breakdown by role (not shown here) showed the only exceptions to these sector patterns were acousticians who, as you would expect, overwhelmingly chose *(f) good understanding is critical*. Proportionally those with role PROD (those in the production of acoustic related products), EDUC (Educators) and ARCH (Architects/Designers) were the groups who were most likely to consider acoustic knowledge critical after acousticians.

Figure 5: Question 2 – How important do you think knowledge of acoustic considerations is for your role in MDH projects? Response as % of 686 total responses

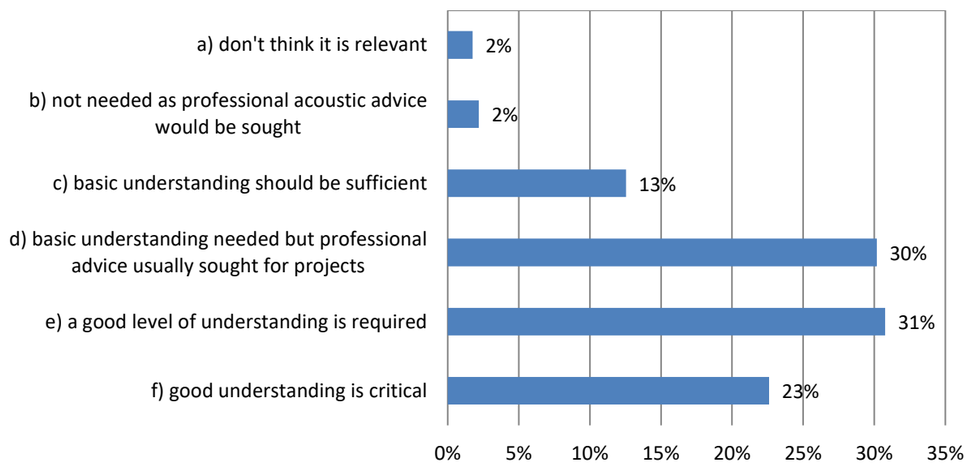
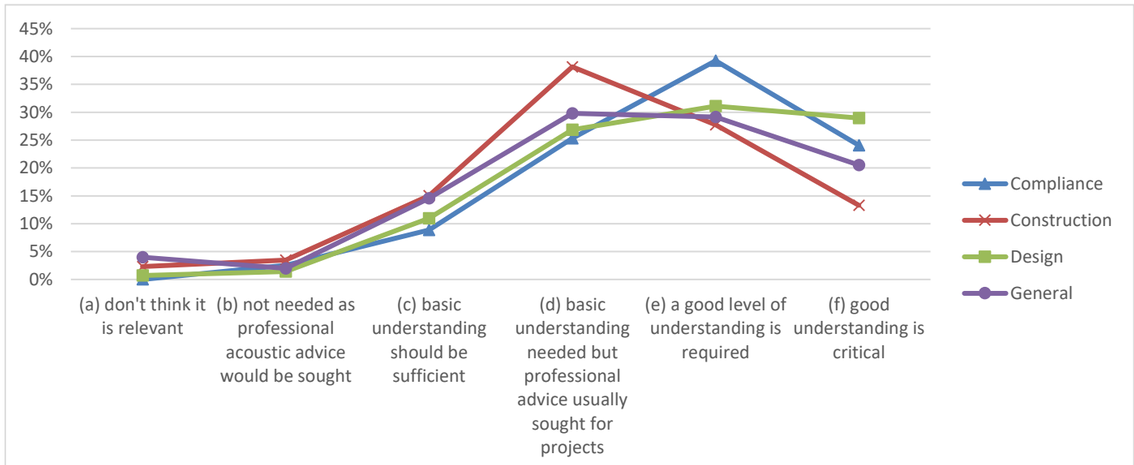


Figure 6: Question 2 – How important do you think knowledge of acoustic considerations is for your role in MDH projects? Response as % of total for each Industry Sector



Question 2 comments: Other thoughts?

QUESTION AIM

To give people a chance to consider and express their initial thoughts on the importance of acoustic understanding to them

RESULTS / ANALYSIS

Fairly low rate of comments - 63 in total – see Appendix H, Q2 for full responses

Commonly raised themes included:

- needing a reasonable level of understanding / awareness as appropriate to their role but also the importance of recognising when specialist advice is needed, as this is a specialist subject
- Need to consider acoustics very early in the design process to incorporate solutions well and cost effectively. Acoustic mitigation later is more costly, disruptive and inefficient.
- Good noise control was noted as a critical aspect for successful MDH design for health, social needs, amenity and acceptance as a housing type. Need awareness of this and understanding of occupier needs / expectations for good design
- Failure in the design and installation of noise reducing systems has significant impact on occupants.
- General lack of understanding and awareness of acoustic issues and options in the NZ building industry. Specific repercussions / points noted include: dependence on proprietary systems and reps; having to rely on specialist consultants who won't understand the project overall; not enough attention to urban design; lack of understanding of compliance with G6, options for testing etc.
- Acoustic and fire considerations are major components when considering structure for MDH – awareness of both requirements together is needed for structure, IT wall and IT floor designs.
- Need to understand how acoustic considerations relate to your role - e.g. for an engineer where changes to structure or fire detail create acoustic flanking paths and reduces acoustic performance
- Detailed knowledge isn't needed if tested/accredited solutions available – several noted cost /time savings in the consent / compliance process if approved solutions can be used and double handing and extra peer reviews are not needed

- Builders tend to rely on manufacturer information and project plans so these need to be clear on the installation requirements. Sometimes installation issues reduce expected performance – better awareness of general considerations by builders could help.

Other topics raised, in only one or two comments:

- One noted regulations should not be so complicated that only specialists can understand them, while another pointed to UK building regulations [which include simple declarations of intent supported by extensive documents for requirements and approved solutions (robust details)] https://www.gov.uk/government/publications/resistance-to-sound-approved-document-e
- the Building Code Clause G6 minimum criteria is insufficient to meet needs - eg addressing transmission frequency,
- developers not interested to invest in acoustic design and tend to build to Building Code minimum criteria to save costs.
- Need to have good tech support from system providers to help designers customise them as needed.
- You learn a lot from experience on past projects
- Better understanding at all levels would allow knowledge to be conveyed more effectively to clients and trades on site

Example Quotes

> *"Architects need to know the how of acoustics - the principles of how different materials interact and why. The calculations to achieve desired STC ratings are best carried out by an acoustics professional, or provided by a manufacturer, when using proprietary systems." [ARCH]*

> *"if you don't know what's required you won't know what to ask or where to go for advice etc." [OFFI]*

G2.5.3 QUESTION 3 – SELF ASSESSMENT OF ACOUSTIC KNOWLEDGE

Question 3: How would you rate your own understanding for each of the following acoustic related areas for MDH projects.

QUESTION AIM

The survey aimed to get opinions from across industry at all understanding levels, to ensure that solutions developed later in the project could meet the broadest needs possible (not just that of acoustic specialists). We had no way of gauging people's actual level of acoustic understanding, and of course this would differ in different areas, so had to rely on some form of self-assessment. This question format allowed some differentiation between areas of consideration too.

RESULTS / ANALYSIS

Table 7 gives the responses in a similar format to the way the responses were collected. Figure 7 charts these results, as well as showing the breakdown of results by industry sector.

Overall there was a pretty good spread with the majority feeling they had average/good understanding, and not many who rated themselves acoustic experts. A not relevant option was offered but not really used (0.5% of responses).

From the sector breakdown, the data backs up what you would expect. You can see that those in the design sector felt they had a better understanding of design/planning, than other sectors. Those in construction felt they best understood construction / product practicalities although this was general felt to be the best understood area. The compliance sector felt they understood compliance issues best.

Note this was the point after which most people who didn't complete the survey dropped out – perhaps sensing they might not be able to contribute based on areas of consideration.

Question 3 extras: Any extra thoughts on your own understanding level and how it relates to your role?

e.g. A better understanding of ___would help in my role as an ___

QUESTION AIM

Give people a chance to consider and express their initial thoughts on their information needs / gaps. – explored more in later questions

RESULTS / ANALYSIS

77 comment responses– see Appendix H, Q3 for full responses

Themes commonly raised included:

- Wanting a good understanding of basic acoustic principles - but supported by professional advice when needed. Main points raised to understand were:
  - IT Walls/Floors,
  - impact noise transmission
  - Units used (eg STC, IIC, R_w),
  - Use of mass/ insulation / air-tightness,
  - Frequency responses,
  - Effect of penetrations on fire/acoustic rated elements
  - Flanking paths
- Wanting more acoustic information and not sure where to find it
- Wanting sources of general acoustic information independent of manufacturer's marketing
- The need to keep up to date on latest product /systems available. Need to know their performance, practicality / cost effectiveness / code compliance of products, and have good supporting

Table 7: Results for *Question 3: How would you rate your own understanding for each of the following acoustic related areas for MDH projects?* In the survey this was presented as a matrix allowing users to choose one option for each line. This table shows the same format with the response count and percentage for each option.

Area of consideration	very limited	basic	average	good	high level (acoustic specialist)	not relevant	Total responses
Acoustic design (including planning & design of a building to provide appropriate noise control / acoustic performance)	63 (9%)	173 (25%)	204 (30%)	215 (31%)	30 (4%)	4 (1%)	689 (100%)
Construction / Installation (knowledge of the practicalities of products used to improve acoustic performance in a building)	30 (4%)	120 (18%)	212 (31%)	287 (42%)	33 (5%)	3 (0%)	685 (100%)
Compliance (knowledge of relevant acoustic building code and regulation requirements, and compliance methods)	88 (13%)	142 (21%)	218 (32%)	192 (28%)	43 (6%)	3 (0%)	686 (100%)

Figure 7: *Question 3 - How would you rate your own understanding for each of the following acoustic related areas for MDH projects.*
Response proportions for each area

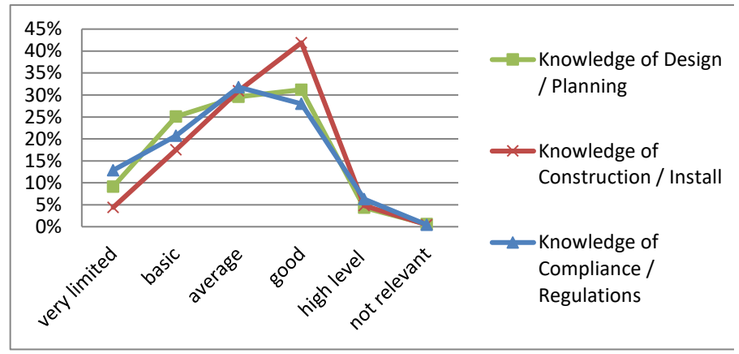


Figure 8a: Question 3 Response % by industry sector for knowledge of acoustic design/planning

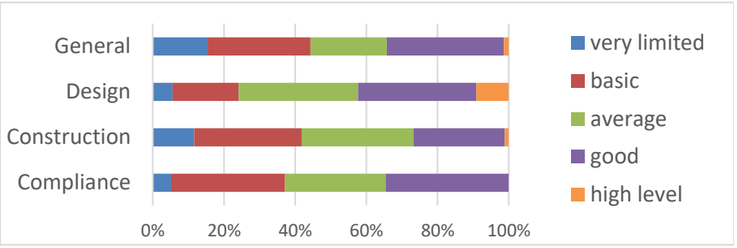


Figure 8b: Question 3 -Response % by industry sector for knowledge of construction practicalities

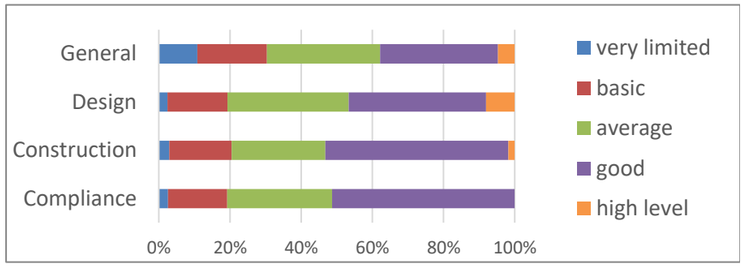
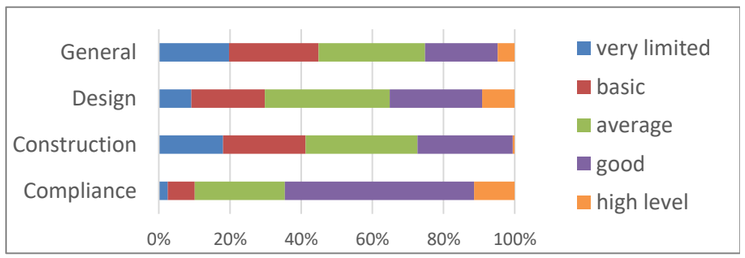


Figure 8cL Question 3 - Response % by industry sector for knowledge of compliance



documentation (GIB Manual regularly quoted as a good example for this) and installation information. Independent reviews wanted.

- Need for standardised and code approved solutions to aid with compliance - more options than current G6 approved solutions. e.g. *"Pre-approved solutions to common situations so that designers with a basic knowledge can add them to documents" [ARCH], Q3*
- Needing a better understanding of compliance inspection and testing requirements to meet Building Code G6
- Wanting good / better /best guides
- Information on combining different systems (e.g. junction details / flanking transmission)
- interdisciplinary requirements (Acoustic / fire/ ventilation, and code compliance with all)
- Understanding outcomes for occupants for different solutions (including health, frequency range responses)
- It was noted the area of acoustics and noise control is often overlook or not well understood by designers

Interesting quote

[Urban planner] "I was born in Europe and spent 3 decades there 2 of which living in an apartment and I know the extreme importance of acoustic insulation, which sadly, is very much overlooked here. I am quite familiar with the European sound insulation methods and reasonably familiar with what is used here and I believe that that will be one of the major pitfalls of many apartments and medium density housing in Auckland unless you, experts, can change it. The best of luck with the success of this survey!" – CONS, Q3

(Questions 4-9 focus on drivers for acoustical design)

G2.5.4 QUESTION 4 – HOW OFTEN END USERS SPECIFY ACOUSTIC COMFORT IN MDH REQUIREMENTS

Question 4: How often would you say end-users specify good acoustic comfort (e.g. quiet and privacy) in their requirements for MDH?

Table 8 - Question 4 responses

Response option	Response %	Response Count
a) It is rarely mentioned as a design criteria*	24%	141
b) It is usually mentioned as a requirement	9%	51
c) Varies significantly - for some it is important and others don't really care	43%	251
d) It is an important factor for most end users	15%	89
e) Not applicable to my role so I don't know	9%	52
Grand Total	**100%**	**584**

QUESTION AIM

Help to understand industry perceptions of end user requirements. The scope of the project does not allow a full survey of end users but since industry perceptions ultimately drive how acoustic design in actually incorporated in MDH developments, this is still worth investigating. The response options were given to get people thinking, with additional views hoped for in the comments.

ANALYSIS

The overall results are given in Table 8 and graphically in Figure 8. *Figure 9* shows the very similar response pattern across the various industry sectors.

The fact so many chose option (c) demonstrates one of the key dilemmas for acoustic design – the subjective nature of people's responses to noise / privacy and that in relation to acoustic comfort, end user requirements vary significantly – "for some it is important and others don't really care". Designing to please some will be over-engineering for others.

The wording of the options could perhaps have been better as they can be interpreted in several ways. For example, the fact that a quarter of respondents chose*(a) (rarely mentioned as a design criteria)* could indicate the importance to end users was small or it could indicate people don't think of specifying it as a requirement (see comments next). Similarly, for option *(d) (important factor for most end users)*– this could mean most users specify it or the respondent thinks most users think it is important.

The comments help clarify some key points in this topic.

It is interesting to compare this with responses to Question 18a which shows respondents thinking that good quality noise control is very important for the desirability of MDH.

Question 4 comments: Extra thoughts? e.g. I don't deal with end users but this is always / sometimes / rarely pushed by architect / developer/ other as a major requirement….

QUESTION AIM

This gives an opportunity for respondents to give their thoughts on end user awareness and requirements for acoustic comfort, or who else pushes this on their behalf.

RESULTS / ANALYSIS

125 comment responses – see Appendix H, Q4 for full responses.

Common themes across the board

- For MDH, end users are rarely involved as this is usually developer driven. Developers usually aim for building code minimum criteria which may or may not align with end user expectation – key drivers are usually cost not user comfort (at least for low end MDH)
- Important for end users (owners / occupiers) but perhaps doesn't get prioritized as much as it needs to in the design process – especially early on
- Awareness of noise nuisance is low since experience of MDH is limited in NZ – including for end users, developers and designers. As more people experience good and bad noise control in MDH, the importance of good sound insulation will become apparent for quiet and privacy
- Assumption that meeting the building code and regulations will provide good levels of noise control, but lack of understanding of what the performance criteria mean in practise (and it is hard to demonstrate)
- Clients (owners / developers) rely on designers to help them understand acoustic requirements and benefits for decision making, so designers need a good working knowledge
- For invisible topics like acoustics, additional costs like exceeding code are hard to justify to clients (owners /developers), so are often axed when costs are tight

Extra comments from those that selected a) It is rarely mentioned as a design criteria

"There would be an assumption that noise would be considered and that the minimum statutory requirements should achieve a good level of noise control" [OFFI]

Main themes included:

- Many noted that clients [owners/developers] don't bring this up often and need inter-tenancy sound transmission requirements and benefits explained.

Figure 8*: Question 4: How often would you say end users specify good acoustic comfort (e.g. quiet and privacy) in their requirements for MDH?* Response as % (584 total responses)

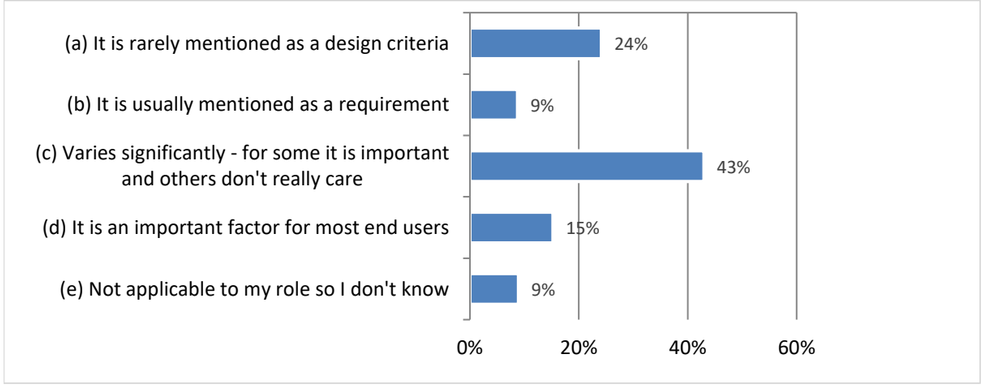
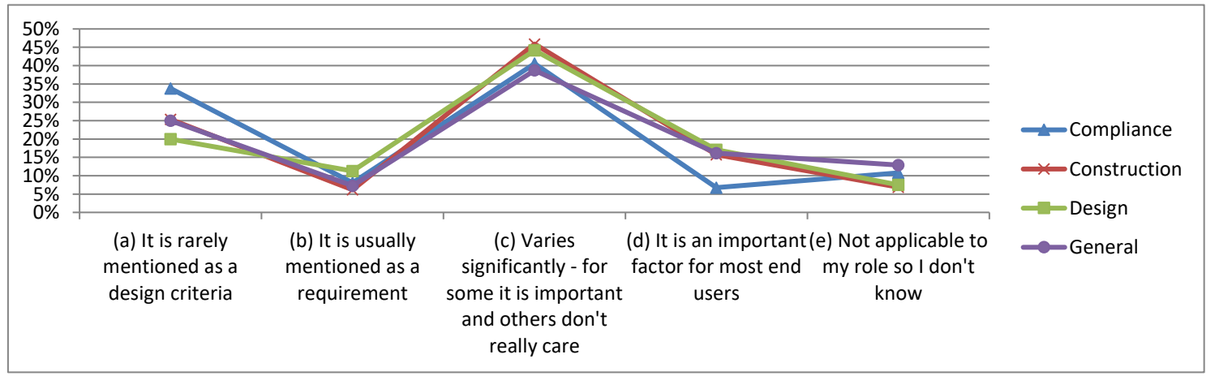


***Figure 9: Question 4: How often would you say end users specify good acoustic comfort (e.g. quiet and privacy) in their requirements for MDH?* Response as % of total for each Industry Sector**



- Most end users rely on professional advice, but visual aesthetics and cost considerations are often a higher priority prior to occupancy.
- Many noted they don't hear / know end-user needs
- Many end users and developers aren't aware of the effects of poor sound insulation (from poor design/construction) since MDH is reasonably new to NZ and many haven't experienced living in it long term. It is only once occupiers move in that they realise the importance of good sound insulation
- Important for planners to group spaces with 'like uses'
- One noted a visit post occupancy raised issues for walls within a dwelling (between bedroom and living room), another noted internal walls aren't covered by code and it needs proactive engagement to raise this issue with clients.
- Concern raised for plumbing noise.

Extra comments from those that selected (b) It is usually mentioned as a requirement

- Often not mentioned at the beginning of a project but as an afterthought when harder to deal with – designers should initiate discussions on this from the start
- Industry focus is usually on meeting code minimum, except for higher end MDH
- Until recently, this has not been a driving fact in the selection of building materials but is now gradually changing and suppliers are now considering this more

Extra comments from those that selected (c) Varies significantly…

- Can be down to lack of knowledge – e.g. not expecting sound transmission from neighbours through IT walls/floors; not having thought about it!
- Depends on construction – concrete less an issue
- Don't hear feedback directly, usually filtered through others, few complaints from systems recommended [ACOU],
- It is often acknowledged to be important but ends up getting a low priority in the design process. Often devolves to 'comply with G6' even in high end projects.
- cost driven and rarely pushed beyond meeting G6 minimum, assumed will be fine
- Developers decide MDH design criteria, so helpful to raise awareness with them to consider this in decision making
- Infill projects and MDH work needs careful consideration of construction noise for existing occupiers.
- Depends on various factors including
    - Clients past experiences
    - Age of end users
    - Location and nearby noise sources
- Tolerance for noise may decrease as density increases, therefore need to plan ahead
- Better awareness for commercial (eg privacy) than residential?
- Some designers lack sufficient knowledge to advise sufficiently on compliance requirements
- Trend in last 5 years for more mid/high level MDH to aim significantly above code minimum and extras such as internal walls
- Compliance information provided often doesn't highlight acoustic needs [OFFI]
- Some solutions are seen by contractors as difficult to install and may be quoted at overly high prices to avoid their use.
- Some designs chosen to give good acoustic performance are simply impractical both for cost and build-ability
- People must balance what they can afford to include, with what they would like to have.
- No one wants noisy but most are happy with normal quiet levels?
- Left to designers to figure out a suitable solution

Extra comments from those that selected (d) It is an important factor for most end users:

- Needs to be considered from the earliest stage of the design process
- Important factor post occupancy but not often considered at the briefing stage?
- Importance understood well by those who have lived in older MDH
- Owners of standalone housing have much more say than for MDH developments which relies on what is driven by developers
- Recent trend to aim above code minimum
- Rightly or wrongly there is a perception from developers that good noise control is hard to achieve above code
- People need to understand living in dense neighbourhoods is noisier than suburbia – almost need lessons in what to expect!
- End users don't appreciate the effects until they experience a poorly designed example – often forces people to more

Extra comments from those that selected (e) not applicable…

- Not enough awareness of the importance of acoustic separation, end users may not understand "until its too late" once they move in.
- There is generally a lack of awareness of acoustic comfort– eg very noisy cafes with no consideration for acoustics
- Commercial clients tend to be careful in specifying acoustic requirements

"The more they pay the more they want"

G2.5.5 QUESTION 5 – END USER FEEDBACK ON ACOUSTIC PERFORMANCE?

Question 5: Once people have lived in the dwelling, what sort of feedback do you get on the dwelling's acoustic performance? (i.e. post occupancy feedback)

Table 9: Question 5 responses

Answer Options	Response %	Response Count
Feedback is mostly positive	11%	61
Mixed response - more positive than negative feedback	13%	78
Mixed response - more negative than positive feedback	11%	65
Mostly negative feedback	2%	13
Rarely get feedback on acoustic performance	32%	187
Don't hear direct feedback in my role	29%	167
Other (as below)	2%	9
Grand Total	**100%**	**580**

QUESTION AIM

Help to understand whether /how those in the building industry get feedback on the success or failure of their building projects, to learn lessons for the future. In particular, if acoustic issues are highlighted as an issue for recent builds.

ANALYSIS

The overall results are given in Table 9, graphically in Figure 10. Figure 11 shows the response pattern across the various industry sectors.

There was a pretty even split between those that don't hear any feedback (29%), those that rarely got feedback on acoustic performance as part of their general feedback (32%), and those that noted some feedback 37%. "Mainly negative feedback" was only chosen by 2% of recipients (although there may be a slight bias in not wanting to admit the failure of your own projects), with 11% thinking there was more negative than positive feedback.

As we can't tell the proportion of projects they received feedback on, the results can't really tell us much beyond there not being major negative feedback in relation to acoustic performance, at least that gets back directly to those involved in the building's production.

Question 5 comments: Any extra thoughts, detail or examples you'd like to give?

e.g. More post occupancy info would be helpful to validate designs; Only get feedback in about ___ % of projects and it is mostly ___;In my role I don't hear directly from occupants but from other sources I think ___;When meeting the building code minimum we'd get positive/negative feedback about ___% of the time, when using higher performance criteria we'd ___.

RESULTS / ANALYSIS

89 comments – see Appendix H, Q5 for raw comments

Common points are that most respondents don't often hear directly from end-users, especially for MDH. The feedback will often come second hand via developer. Overall there is little feedback re acoustics. Most think the projects they are involved with have mostly produced good results .

(a) Mostly positive feedback

- One respondent conducted 92 Post occupancy evaluations and most noted good acoustics [to follow this up to see if detailed acoustic performance was available]
- Positive feedback from those moving from older houses and appreciating insulation and double glazing effect on noise control; (2) and consequently better quality of life (1)
- Insulation between important rooms within a dwelling is greatly appreciated for noise reduction.
- Good results with a good performing fire/acoustic rated IT wall for terrace

(b) Mixed results more positive that negative

- Usually the move from older buildings to new is an improvement from a noise perspective. Still low expectations though "it's not too bad", "we can live with it"
- Varies significantly depending on client and costs quality achieved
- Feedback via developer usually positive
- More post occupancy info would be useful for future projects.
- Road noise a bigger negative than neighbours.
- Negative feedback usually relates to installation errors
- Negative feedback usually relates to reverb / high sound levels from lots of hard surfaces.
- Attention to insulating internal walls in a dwelling helps.
- Get complaints over roof expansion creating (1), some like rain noise others don't

Figure 10: Question 5: Once people have lived in the dwelling, what sort of feedback do you get on the dwelling's acoustic performance? Results as % of 580 total responses

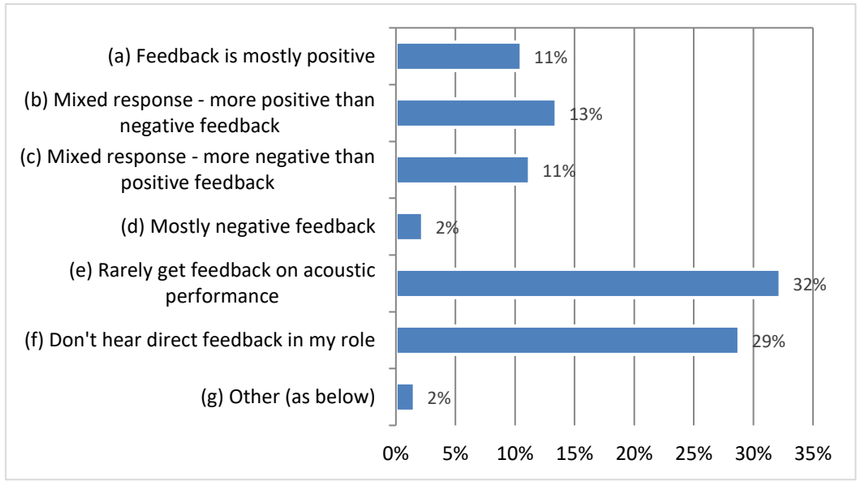
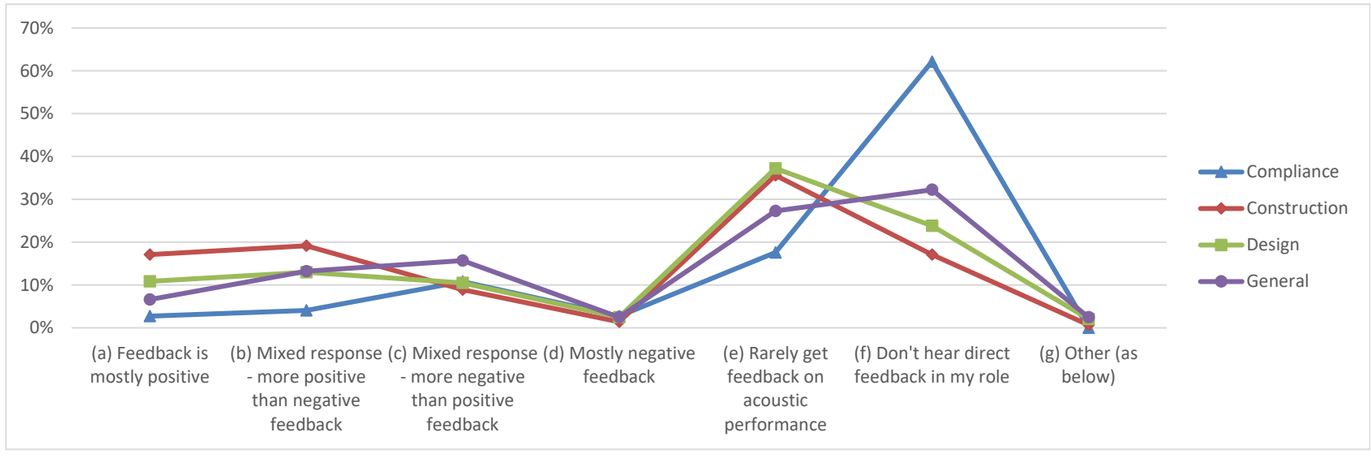


Figure 11: Question 5: Once people have lived in the dwelling, what sort of feedback do you get on the dwelling's acoustic performance? Response as % of total for each Industry Sector



(c) mixed response – more negative than positive feedback

- If satisfactory performance, then we don't hear, only really hear of negative issues.
- Rarely get any feedback (3)
- When just meeting the NZBC minimum criteria there are more likely to be complaints (2)– also issues with inadequate ventilation via NZBC G4 for thermal comfort, so still need windows open for cooling and get noise. (1)
- Often don't hear negative feedback until a few years after build, once occupants have experienced long term. (1)
- If end users expect " total" noise exclusion, they may be disappointed (2)
- Negative feedback tends to come from older buildings not newer (1)– retrofits therefore important. (1)
- Negative feedback noted for: footfalls on stairs (1); floor impact noise (1); flanking (1); interior finishes (1); environmental noise (1); stereo or tv placement (2); plumbing noise (1)

(d) mostly negative feedback

- Only hear feedback when there are negative issues (3), mostly due to detailing or installation errors (1)
- Hard surfaces makes for poorer results in newer dwellings than older [carpeted] (2)
- More likely to be negative results for light weight construction.

"Mostly negative applies specifically to light weight just meeting BC. Satisfaction improves with level of performance." - ACOU, Q5

(e) rarely get feedback

- Only rarely hear feedback, usually only if there is an issue.(4) Usually hear about other factors much more.(1)
- Working to STC 60, ASTC 55 (tests no fails) and no issues.
- Don't often hear, more post occupancy information linked to performance data would be beneficial (4) – and needs to specify noise issues observed.
- Issues noted include: particularly noise sensitive person (1); doors slamming (1); foot falls (1); back to back beds (1); plumbing / drainage noise (1); low freq noise; (1) ; impact noise(1);
- If don't hear, it isn't necessarily that noise isn't annoying, just that it is no worse than experienced before

"An ever-growing online database of successful acoustic details for resolving a range of complex junctions and situations would be a great help. The generic wall/floor/ceiling construction type feedback in acoustician reports is of limited value." - ARCH, Q5

- Never really get feedback on this (2)
- Of 100 detached houses only 1 complaint
- Rarely get feedback on NZBC compliant structures – complaints for non-compliant, or conversions.

(f) don't hear feedback/ Other

- Comments mostly relate to not getting any feedback or only for serious issues, or to it only being recognised once people have lived in a dwelling.
- Only hear feedback if doesn't meet expectations.
- One noted only one project issue– phones heard through IT wall, so upgraded for later stages of development
- Would like post occupancy info linked to performance to understand what works and what doesn't (4)
- Noise is perceived differently by different people so expect different feedback.

"The feedback I receive is more related to other aspects of health such as thermal conditions, moisture, light etc. In my experience, people usually blame their neighbours rather than their home for noise issues and accept the constraints of the location for external noise." - ENG, Q5

G2.5.6 QUESTION 6 – RELATIVE CONCERN LEVELS FOR NOISE SOURCES?

Question 6: Based on your experience, please rate the relative level of concern from end users for each of these noise sources. Please select from "never raised", "low", "moderate", "high" or leave blank if you are unsure.

QUESTION AIM

Firstly, to get people thinking about the many types of noise sources that affect occupiers, so they are fresh in mind when they come to later questions. Secondly, to learn perceptions of the key sources to be addressed since we aren't asking end users directly. Respondents may use their own or others experience, and this question was just intended to observe trends and patterns rather than absolute concern levels.

Users could only select one of the four options for each noise source.

ANALYSIS

The full table of results is given in Appendix H, Q6 (with approximately 520 responses for each source) but the results can be more easily understood graphically as in Figure 12. E.g. for rain noise 35% said this was "never raised", 47% gave it "low" relative level of concern, 16% a "moderate" level and only 2% ranked in "high". From this chart it can be seen that trends are quite consistent, with the pattern for "High" concern mirroring that for "moderate or high" concern with the exception of noise transfer within a dwelling and traffic noise which rank slightly higher if the moderate and high options are combined.

Figure 13 more clearly shows the relative ranking for different types of noise by showing the proportion that ranked it "high". Music through walls and impact noise through IT floors ranked highest, followed a little further behind by speech through IT walls, traffic noise and plumbing noise.

Of least general concern were rain noise, building movement /wind effects and room reverb times.

Figure 12: Question 6 - *Based on your experience, please rate the relative level of concern from end users for each of these noise sources.* Responses shown proportionally for each source (approximately 520 responses for each source)

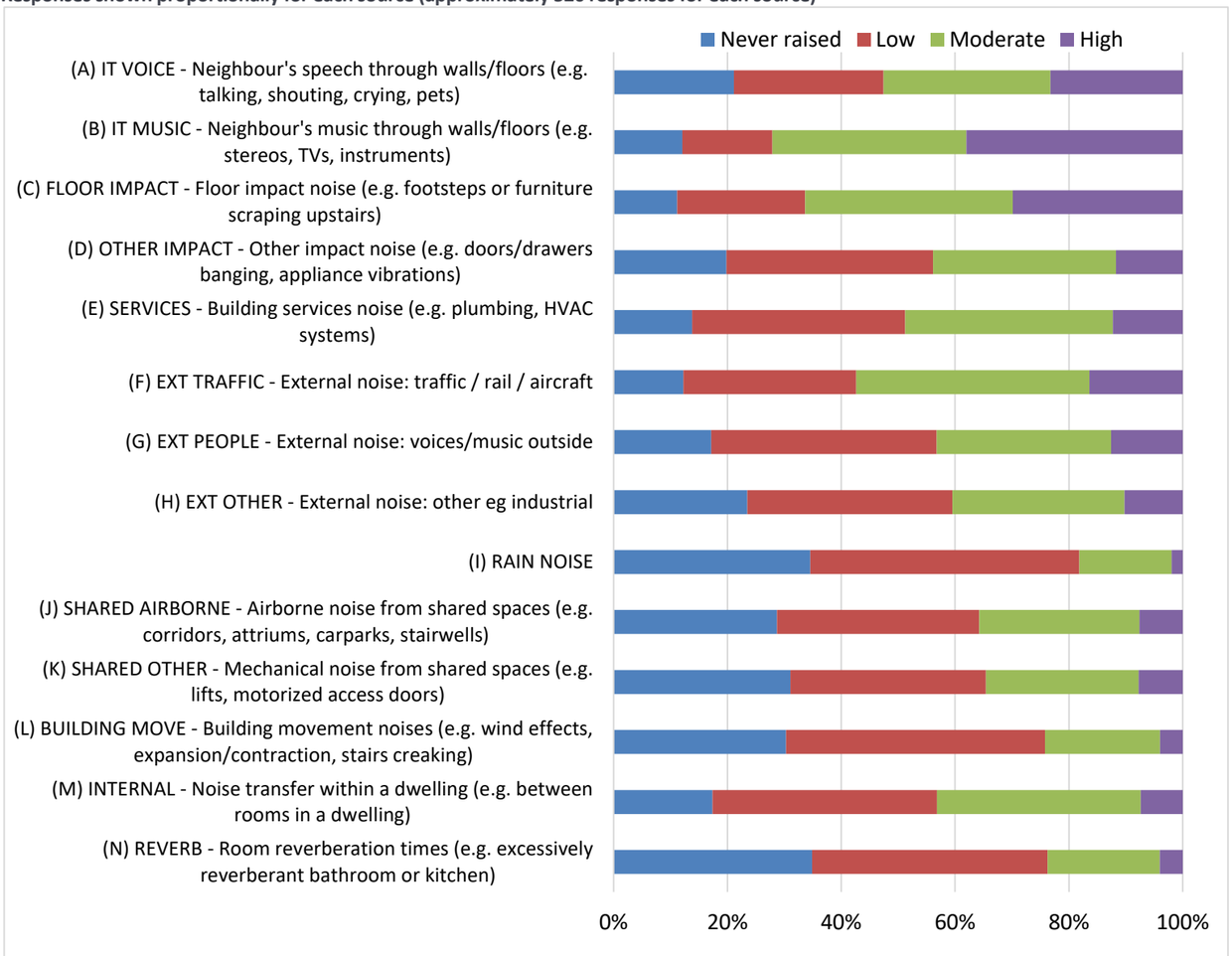
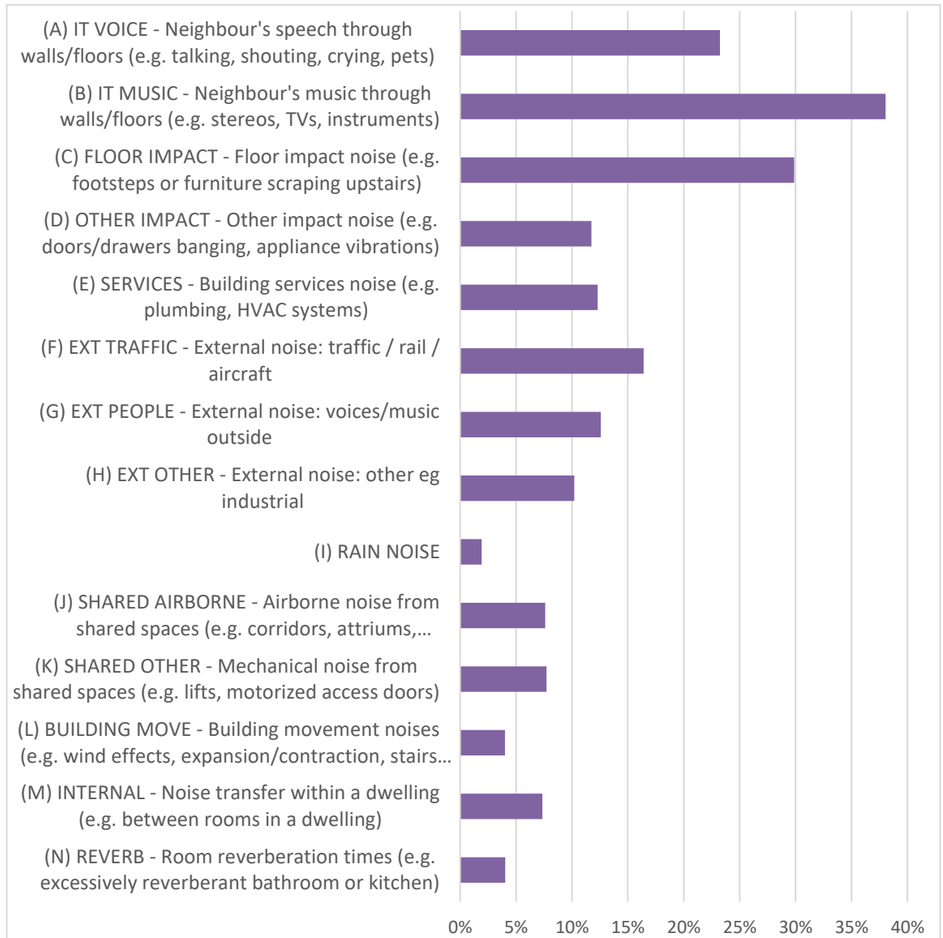


Figure 13: Question 6: *Based on your experience, please rate the relative level of concern from end users for each of these noise sources.* Proportion that selected 'high' relative concern level for each source.



inter-tenancy (IT)

Question 6 comments: Any specific sources missed, extra thoughts or significant concerns?

QUESTION AIM

To confirm Stage 1 hadn't missed any major sources of annoyance and what specific aspects people think are the most significant or problematic to fix, through open comments

RESULTS / ANALYSIS

120 comment responses – see Appendix H, Q6 for full responses.

Several noted that all these sources should be considered in the design process.

Noise sources outside our control, especially if the producer is thought to be being inconsiderate, can cause greater levels of annoyance. Noise is subjective – one person's pleasant sounds is another's noise. (eg kids play).

There were several noting that good noise control works both ways, not just to protect others from noise but to allow residents better amenity by not having to worry about annoying others.

> *"Some are constrained in their freedom to enjoy the amenity of their MDH because of concern not to disturb a neighbour so it is not merely the sensitivity to noise coming in but sensitivity of their own noise going out." EDUC, Q6*

Expectations change the feedback you receive – if occupiers are not expecting great noise control, they are less likely to complain when it performs poorly.

Specific notes of different types of noise included

Impact noise

- Impact noise from mid/IT floors a major issue though often not understand as such pre-occupancy (2),
- Particular issue with hard floor finishes (1)
- Especially an issue at night-time (2)
- For footstep noise can be an issue for both receiver and walker (not wanting to bother others)

Flanking

- Flanking paths a major concern

External noise

- People want to add value to outdoor spaces (e.g. pools etc.) but with MDH end up right on the boundary and there can be noise issues, as well as visual privacy issues. (4) Not much that can be done
- External noise is important but often occupiers have a better understanding of external noise zone to anticipate this when choosing a location – internal noise is more unknown. (1)
- Double glazing helps lots (2)
- Rubbish trucks at odd hours are most disturbing – glass break etc. wakes you up (3)
- Traffic noise not really so much an issue – people adjust to the hum. Excessive ventilation requirements an issue and people usually leave windows open anyway. (1)
- One noted interest in researching whether hearing traffic noise impacts perception of traffic pollutants. (1)

Low frequency

- Low frequencies are an issue (4) and not addressed in performance criteria rating systems. (1)

Building services

- Water hammer effects for plumbing (1)
- Back to back services noise; toilet flush (2) ; drains (2)
- Heat pump fans can cause noise issues if not placed appropriately (2)

Rain noise

- Usually raised as a positive sound (2)
- Can be an issue and needs reducing (1)

Reverberant rooms

- Not so much an issue and easy fix with furnishings (1), more an issue for cafes (1)
- For bathroom, hard surfaces make Reverb times long, this negatively effects noise transfer to other spaces

Other

- Stairwells noisy – keep away from apartment or protect wall well. (1)

Building noises:

- Expansion and contraction creaks from metal roofing heating and cooling. (1)

Common areas: deal with noise for both inside (eg corridors) and outside (parking areas etc).

Internal noise transfer

- Especially important to treat walls between bathrooms and other rooms. (3) Also for walls connecting to bedrooms for good sleep (1)
- Solid core doors help (1) and even just batts in internal walls helps (1)

Other comments

- For detached dwellings, owners are usually directly involved with decision making and actively involved in acoustic decisions – mostly improving internal noise transfer (walls and floor) - but not the case in larger developments (MDH)
- Professionals can only really be brought in for larger attached MDH complexes with economy of scale.
- Biggest problem is unrealistic expectations.
- Important to check out the neighbours before occupying!
- Acoustic considerations need to be raised earlier when planning structure

G2.5.7 QUESTION 7 – THOUGHTS ON THE NZ BUILDING CODE CLAUSE G6?

Question 7: What do you think about the NZ Building Code Clause G6, which relates to sound insulation / transmission between "abutting occupancies"?

Table 10: Question 7 responses

	Response %	Response Count
(a) The performance criteria set the minimum standard too high	1%	8
(b) The performance criteria seem about right	30%	168
(c) The current performance criteria seem about right but other areas need to be covered too (please specify below)	12%	70
(d) The performance criteria set the minimum standard too low and should be increased	24%	138
(e) Don't know	31%	173
(f) Other (please specify below)	2%	9
Grand Total	**100%**	**566**

QUESTION AIM

The building code is the main driver of the level of quality to be obtained in new residences, with the minimum criteria often taken as the required level. We wanted to get a broad feel across industry of how people were feeling about the code. Did they think the minimum performance criteria are too high, too low, about right and give the option to offer a fuller opinion.

RESULTS / ANALYSIS

The overall results are given in Table 10, graphically in Figure 14 and Figure 15 shows the response pattern for different industry sectors.

It is fairly clear from response (a), that virtually no one (1.4%) thinks the criteria are too high, and (f) having a very low response (1.6%) indicates the choice of options was adequate.

Of those that had an opinion (chose b, c, or d), 45% thought the performance criteria were about right and 55% thought change was necessary - either by keeping the level about the same but adding extra protections (18%) or a general upgrade of the minimum requirements (36%)

Looking at the industry sector break down, you can see that those in compliance were mostly likely to have an opinion and consider that an increase in standard was necessary. It is interesting to note that those in compliance were also the ones in question 5 who were least likely to hear direct feedback on the outcomes for end users.

Those in construction were least likely to have an opinion and were most likely to think the current requirements were about right.

"The standard needs to be expanded to include construction forms and frequency of sound rather than reliance upon a flat rate, as this does not allow for variance in type of noise. Currently the standard is undetailed and is far too low." - ARCH, Q7

"I believe it is about right - developers can always choose to sell/design a higher spec value added building! But of course there is a price consideration associated with that." - OFFI, Q7

Question 7 comments: SPECIFIC THOUGHTS? Please give your specific thoughts / suggestions about the current NZ Building Code requirements for protecting residents from noise:

QUESTION AIM

To understand the specific areas where change is thought necessary and why

RESULTS / ANALYSIS

120 comment responses – see Appendix H, Q7 for full responses and these are probably best to be read in full in this instance rather than summarised.

This is a very topical issues with strong opinions in both directions.

Some strongly believe regulation is the answer while some think the market should drive this and that increased regulation is not the way to go.

Some think the code minimum doesn't provide sufficiently good outcomes for health and amenity while others think it does, at least to a satisfactory level, and that enforcing a higher level is detrimental of overall affordability with over engineering for many situations.

The role of the code minimum also generates discussion, and whether there is a role for some form of add-on to allow for different quality levels above the code minimum. End user expectations and awareness also play a part.

The subjective nature of acoustics and perception of noise, the perceived lack of clarity of benefits from higher performance and the clear division of opinions is probably a reason an update to the existing G6 code struggles

Figure 14: ***Question 7: What do you think about the NZ Building Code Clause G6, which relates to sound insulation / transmission between "abutting occupancies"?*** **Response as % of 566 total responses**

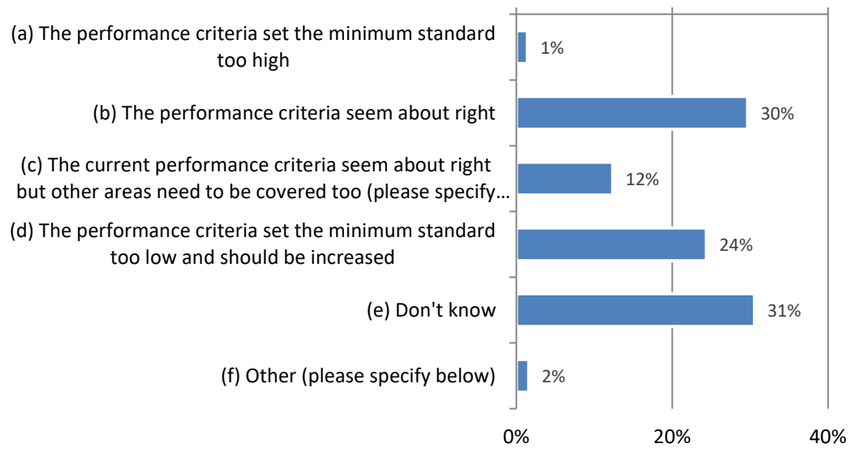
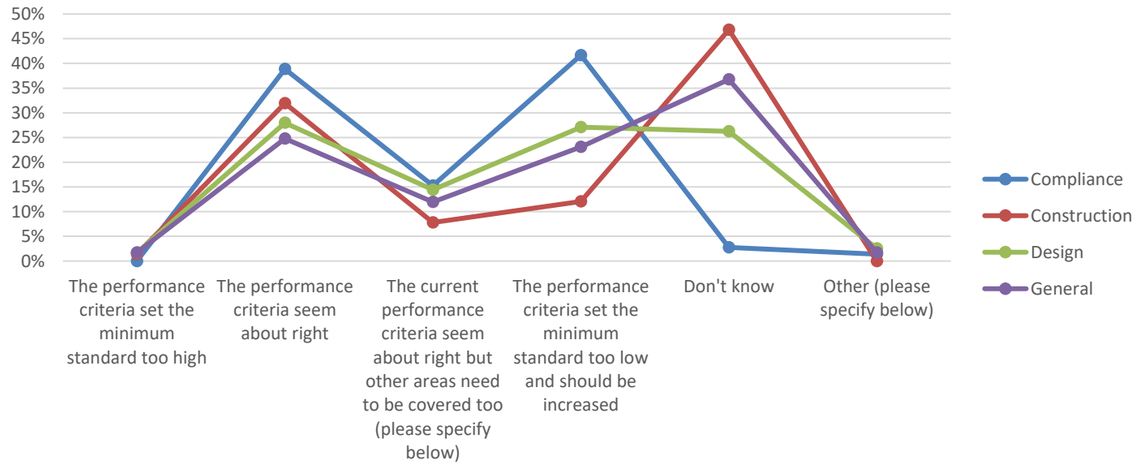


Figure 15: ***Question 7: What do you think about the NZ Building Code Clause G6, which relates to sound insulation / transmission between "abutting occupancies"?*** **Response as % of total for each Industry Sector**



to occur. Lack of clarity around the performance at current levels is also important.

Many that thought the basic levels were ok (e.g. airborne STC 55, and impact (IIC 55), did also mention that attention needed to paid to other areas (e.g. plumbing, building services and penetrations; and environmental noise; common spaces; covering other forms of accommodation; reducing bass noise transfer; internal walls).

There are mixed thoughts on enforced testing of code compliance and whether this should be strictly enforced by councils (some in NZ do, some don't), but construction issues were noted to be common issue. There was however general agreement that more acceptable solutions are required across multiple structure types, especially junction details. The use of Acceptable solutions vs. testing is also raised.

> *"the requirement is too low, doesn't protect occupants from their neighbour who they have no control over and then when the building is built there is no requirement for testing to ensure the standard is actually met (which usually it is not when you are dealing with timber framed acoustic walls reliant on gib board" - ARCH, Q7*

Overall people most commonly noted wanting to aim above the code where possible but that costs often restrict this.

> *"If an increasing proportion of the population are to transfer into new medium level density housing this housing typology must provide a good level of general amenity to encourage this of which acoustic is a very important element.The building code needs to change to reflect higher amenity level expectations" - ARCH, Q7*

G2.5.8 QUESTION 8 – THOUGHTS ON AN ACOUSTIC STAR RATING SYSTEM?

Question 8: Do you think an optional acoustic star rating system* for new residential buildings would be useful in NZ?

**An acoustic star rating system could assess the acoustic performance levels of a dwelling, for things like noise transmission for walls/floors, external noise reduction, plumbing noise. This could help provide owners / residents / sellers / purchasers with an understanding of the dwelling's acoustic performance*

Table 11 - Question 8 overall responses

	%	Count
(a) NO (reasons as below)	3%	17
(b) NO - extra work and cost for minimal gain	13%	75
(c) NO - nice in theory, but probably impractical	20%	113
(d) NOT SURE	13%	77
(e) YES (reasons as below)	4%	24
(f) YES - this could help incentivize new builds to be built to higher levels of acoustic performance	44%	250
(g) YES - acoustic performance star ratings should be incorporated in other building performance rating systems? (give examples below)	3%	16
Grand Total	**100%**	**572**

QUESTION AIM

Star rating systems have been suggested or are in use in other countries, including in Australia (Australasian Association of Acoustical Consultants AAAC - recently changed from Australia to Australasian). This question aimed to see whether this could be a useful type of tool to adopt in NZ, at least at a conceptual level.

RESULTS / ANALYSIS

The overall results are given in Table 11, graphically in Figure 16 and Figure 17 shows the similar response pattern across the various industry sectors.

Overall there was a fairly positive interest in the idea, with 51% thinking yes, 13% not sure and 36% thinking no (although of those more than half liked the idea but thought it would be impractical).

Question 8 comments: Other thoughts?

e.g. Should / shouldn't be linked to building code because ___; would/wouldn't be useful for use for renovations or existing buildings; should/ shouldn't be optional because ___;

QUESTION AIM

This was to tease out some of the reservations and practical issues people thought about this idea.

RESULTS / ANALYSIS

105 responses – see Appendix H, Q8 for full responses. .

Those that said NO or gave no response usually thought that code compliance should be the priority not a rating with an extra compliance path. Common topics included

- Better to increase legislation to a higher standard (4)
- Should strive to aim above minimum requirements anyway (1)
- Should be able to rely on code minimum to provide good level for health and amenity (6) - backed up with testing (1) review code to improve if needed (2), otherwise another compliance industry created (1)
- Extra cost /work / effort for minimal gain (6)
- First need better guidance on acoustic design (4), good – better - best information available (1), and change attitudes to the topic first (1)

Specific comments by answer included:

(a) No (reasons as below) and (b) No, extra work for minimal gain

- Rather than separate rating, just allow access to test results above minimum from council.(1)
- Just another rating which won't be adopted (3), would just be skewed by developer or supplier marketing anyway (2),
- Other ratings e.g. greenstar/homestar, not really widely adopted and don't really work (3). Could be done within this framework though (1)
- Let designers choose priorities and work with requirements rather than narrow focus of star rating
- Will highlight issues with old units if these were retrospectively tested. (1)
- Too many variables for effective rating system (2), how do plumbing noise? (1) how test? (1)
- Not needed, certainly optional extra, as add to cost (2) and homes performing okay already – people ask if wanted (1)

" it will ramp up the cost on regular homes which are performing quite well at the moment." -ARCH , Q10

Figure 16: ***Question 8: Do you think an optional acoustic star rating system* for new residential buildings would be useful in NZ?*** **Response as % (572 total responses)**

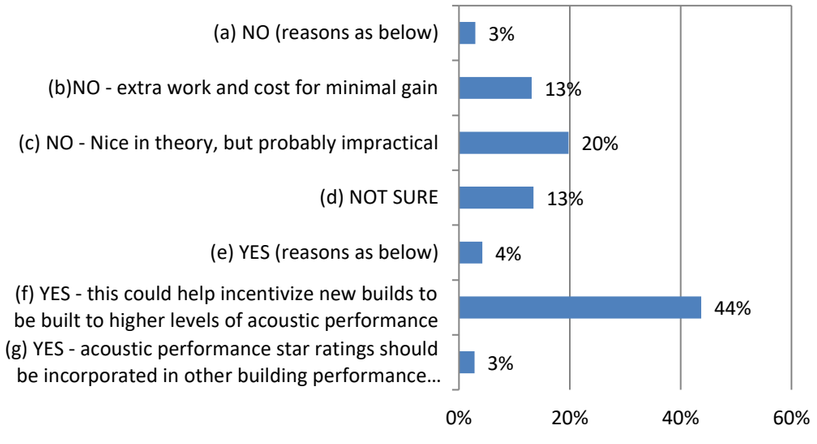
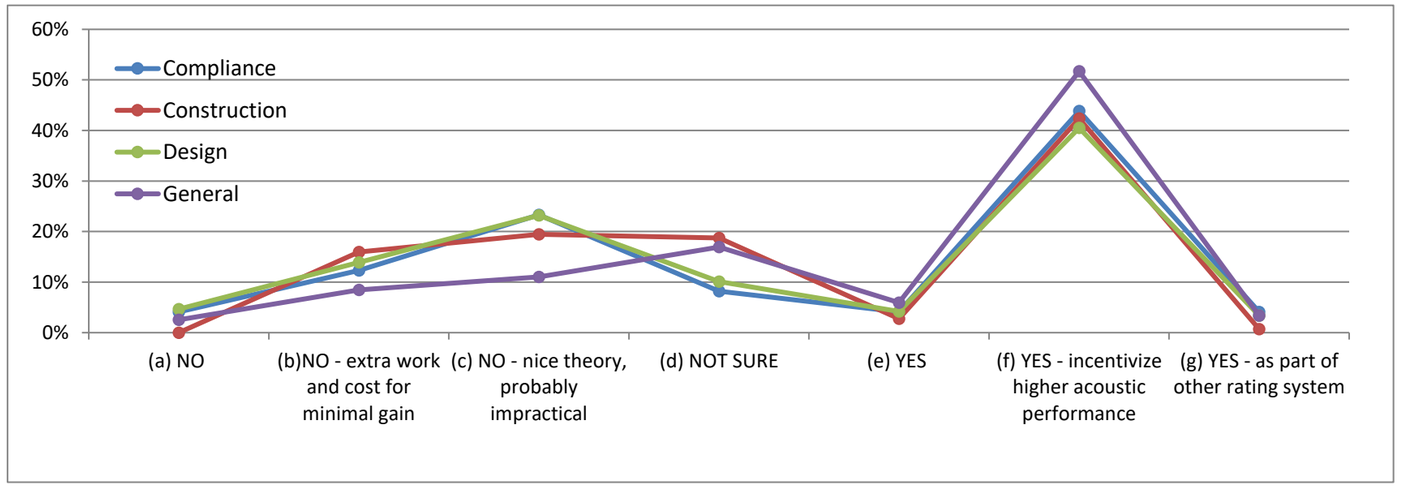


Figure 17: ***Question 8: Do you think an optional acoustic star rating system* for new residential buildings would be useful in NZ?*** **Response as % of total for each Industry Sector**



- **Not Optional - Make it mandatory** instead to give buyers a better understanding of what they are getting

(c) Nice in theory but probably impractical

Topics included

- Could adopt existing Australian Acoustic star ratings as optional extra (some do already)
- Complexity for rating systems as complex subjective issue (e.g. effect of furnishing (2), what if open windows (2), neighbours a factor too (1))
- Councils will request testing / PS4 of outcomes which is a massive risk (1) [note testing / PS4 requirement already occurs in Auckland]
- Would increase need for pre occupancy testing with risks associated (2) who pay for test? (1)
- Have to engage acousticians at extra costs and harder to do smaller towns (1)
- Need to educate the market for meaningful uptake.(1) Would be hard for people to understand (1)
- Current code works (1)
- Could be useful to demonstrate construction errors. (1)

(d) NOT SURE

- Probably wouldn't be adopted as a separate tool, better to incorporate in existing eg Greenstar (1), and based on testing (1)
- Good better best design guides probably a better option. (1)
- Hard to get consistent measures across the sector (1) and hard to understand complexity that would be needed (1)
- If introduced might need to consider for existing housing (1) and renovations (1)
- Like the idea but not sure of implications (2)

(e) (f) (g) YES responses

Some of the main topics were

- Building code system only allows for minimum requirement and no measure of quality above this, so optional ways to demonstrate quality useful (5), star system easier to understand than STC ratings etc (5)
- Needs to be based on site testing, (2) Maybe incorporate as add on to building code compliance – testing as part of code compliance and use results to rate for quality. (2)
- Yes but raising code minimum standards would be better (1), if demand for higher stars strong should probably amend code (1)
- Should really be able to rely on code minimum for good standard. (4).
- Only for attached, MDH not detached (1). Could be additional RMA requirements for larger subdivisions. (1)
- Adopt within Homestar / Greenstar (5). Goes hand in hand with rating other requirements eg ventilation, thermal control energy efficiency (3). Or something like NABERS (Australian rating system).
- Not in Greenstar- different focus (1), would only be a small part there (1)
- Australian Acoustic Star Rating seems to work.
- Whatever rating system used needs to be independent of industry lobbying (1), and simple/clear to understand or industry won't use (2)
- Would allow potential occupants to be more informed with performance comparisons (7)
- Encourage better knowledge of outcomes, better living standards, better design (7), future proofing (1), but not at expense of durability (1)
- Recognition of developers that aim higher than minimum (1)
- Should be mandatory (2)

Negatives relate to added costs

- Needs quite wide adoption to be useful and think who pays for the extra work? (1) Extra cost involved from acoustician and testing requirements (1)
- Can be wastage in aiming for star rating rather than looking at actual needs (1). Needs to be a clear understanding of the benefits achieved by better performance. (1)
- Is there a desire for this from developers, real estate and home buyers? (1)
- Yes, but only if can be done without large costs (4) Construction so expensive (1)
- Noted Greenstar/ Homestar compliance costs seem excessive for gain – money better spent elsewhere. (2)

G2.5.9 QUESTION 9 – OTHER DRIVERS FOR ACOUSTIC DESIGN?

Question 9: What other factors do you think drive acoustic design for MDH in NZ?

e.g. These could relate to other regulations, health benefits, cost, materials, or anything unique to NZ

QUESTION AIM

We only discussed some of the drivers for acoustical design in the previous questions and wanted to allow people to identify what they felt was driving this in NZ

RESULTS / ANALYSIS

283 comment responses – see Appendix H, Q9 for full responses. There is a lot of information here so quite a useful section to read through.

There were however some common themes

Cost

By far the most common driver mentioned: Sometimes not qualified as to which area, but often mentioned that MDH is developer driven and as a business their driver is profit, so usually working to minimize construction costs and often work to code minimum. Even when they want good performance, acoustics often loses out when costs come in. Cost of products/systems, compliance, design, expertise, all get a mention, as is the fact NZ is a small market so costs will always be an issue. Excessive costs due to lack of competition and availability issues were also noted for products and trades. Can also be cost of time, through additional work needed.

> *.." Developers justify a poorer acoustic quality on the basis of serving the public good by delivering lower cost housing." - ACOU, Q20*

The cost reduction from developing good MDH also noted – more dwellings / area = less cost / dwelling. Weighing up costs and benefits can be done better with greater general awareness. Rating systems were also a possible option. E.g.

> *"cost benefit is the huge one, there needs to be a place for the lowest common denominator for building affordability, but there needs to be a simple way of providing a higher standard that can be sold to users/ owners- i think a star system would be very helpful as long as it is backer up with good information and systems for designers and potential users/owners" - ARCH, Q20*

Health / wellbeing (desire for peace, privacy, comfort)

Health was commonly raised as something that should be a driver but isn't as much as it should be. WHO studies on noise etc. quoted, issues with lack of sleep and stress from noise, neighbour disputes, violence, and just general wellbeing that comes from a comfortable living environment

> *"Health - refer to World Health Organisation publication 'Burden of disease from environmental noise' (Quantification of healthy life years lost in Europe)" - ACOU, Q20*

Tied into this was also the feeling that there is becoming more and more desire for peace and privacy in homes, and general quality of life.

It was noted there is some lack of end user awareness of the impact of noise control on these factors, until they move in. Many noted that growing awareness will drive desire for better acoustic outcomes.

Lack of knowledge / understanding

Many noted there is a general lack of knowledge and understanding in the industry – developers, designers, trades. This drives poorer outcomes. For better design need better awareness of the benefits. Need for better understanding of best practice, how to produce good acoustic outcome – which are good systems, details to use, construction techniques etc. The need for good design, site and urban planning.

Product availability, choice etc.

Another driver for design is the range and availability of materials/ products/ systems – using what is there and has the best information.

Location

MDH noted as often not being in ideal locations and location is important for noise outcomes (e.g. near main roads, airports, industry, ports etc.). So location is a factor in design requirements. This can significantly affect the ventilation and façade requirements.

Regulations / Compliance

Building Code, District plans, NZTA and RMA requirements can all drive design. It was noted that it is important to have good regulations to ensure good outcomes as often minimum standards are worked towards, and wouldn't be considered at all if not legislated for. Leadership from the top was seen as important.

Compliance needs also drive design. Where testing /inspections are enforced more (e.g. as in Auckland) this means there is more incentive to get it right – serious consequences if fail.

Expectations / types of occupants /usage

Expectations were frequently mentioned. Inexperience with MDH often meant people don't know what to expect and don't know to ask. If designers understand benefits, then these can be clearly explained to clients to better weight up if extra costs justified.

There is the feeling awareness will grow with more experience of MDH, which will raise expectation levels and require developers to pay this area more attention.

Who is living there (ages, genders, socio-economic, number of occupants) and what they use spaces for are also relevant for design.

End users also need to be aware of likely performance outcome – can't soundproof completely.

Need to integrate with other factors

Acoustic design is tied in with other design and code requirements - ventilation, fire, thermal / energy efficiency / glazing, structural . All need to be considered together for cost-effective solutions – often they can be complimentary e.g. increasing insulation and double glazing also good for noise control.

Structural was commonly referred to, especially in relation to earthquake requirements – especially since the Christchurch earthquakes.

Acoustics needs to be considered early in the design process to get integrated solutions.

Structure types

Many noted that in NZ we are primarily use timber construction for residential (unlike most of Europe), which is not ideal for acoustics. So a major driver for acoustical design in NZ was seen to be finding wood based solutions and / or better information and availability to be able to move to heavier or innovative new construction methods (eg prefab, sips) .

Obviously different requirements for terraces vrs apartments.

NOT DIRECT DRIVERS BUT CONTRIBUTING FACTORS

Construction / Trades

Often mentioned is the issue of lack of understanding among trades when it comes to actual construction / installation of solutions, and also shortage / availability of trades also limits choice of who you can use

OTHER

- Should consider for renovations/retrofits
- Trends to hard surfaces – more reverb issues.

G2.5.10 QUESTION 10 – ACOUSTIC INFORMATION: SOURCES USED?

Question 10: How often do you use the following sources to find information to support good acoustic performance in MDH projects?

Please select from "never", "once or twice", "sometimes", or "frequently" or leave blank if you are not sure

QUESTION AIM

To understand the key places where people currently go to get information on acoustics and acoustical requirements

RESULTS / ANALYSIS

The full table of results is given in Appendix H, Q10 (with approximately 400 responses for each source), but the results can be more easily understood graphically, as in Figure 18, with Figure 19 helping to highlight the most frequently used sources. What is interesting is how rarely many of the available resources are used

The most frequently used resource is manufacturer information. Since detailed design and construction for every project relies on understanding the products used this is what you might expect. It also highlights the importance that the information provided is of a good quality and provides the information needed, and the benefit to manufacturers of paying special attention to these resources.

The building code documents come next, so people understand the core requirements and what they need to achieve – also Acceptable solutions. Council requirements are slightly less frequently used but also important for this (probably used less as they don't include solutions).

Gaining professional advice and using relevant resources collected within their own organisation (internal knowledge sharing) were rated about the same. This shows the importance that education and training can have – the knowledge and awareness can be spread within an organisation even if it doesn't reach all individuals.

Software tools were by far the least used (though the comments noted these would be used if they knew they were available!), primarily only used by acousticians. Given the specialist nature this is to be expected.

Some resources such as training will never be frequent but can still be important.

Question 10 Comments: Other resources you use frequently?

QUESTION AIM

To see if we missed any key resources used.

RESULTS / ANALYSIS

See Appendix H, Q10 for full responses. Only26 comment responses – so mostly covered in the list, although the following were also mentioned

- Several mentioned using the UK building regulations E and robust details as a source of details that they can use.
- Research papers and conference results were useful to acousticians and researchers
- The importance and usefulness of specialist advice including the designer / architect as the usual contact (rather than acoustician
- For those in construction – the plans they work to.
- Talking to manufacturer / supplier tech support where marketing material do not have sufficient detail
- Google searches generally for information and product comparison
- The specific building consent requirements
- Personal experience and that of peers, and what learnt from post occupancy in other projects
- Case studies to learn usage in practice

Figure 18: ***Question 10: How often do you use the following sources to find information to support good acoustic performance in MDH projects?*** **Responses shown proportionally for each source (approximately 400 responses for each source)**

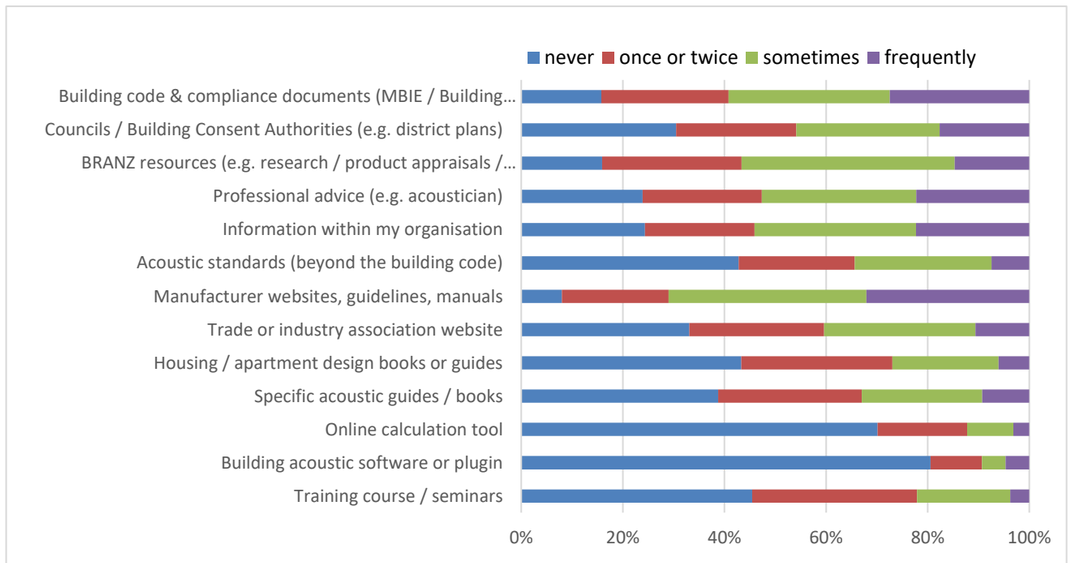
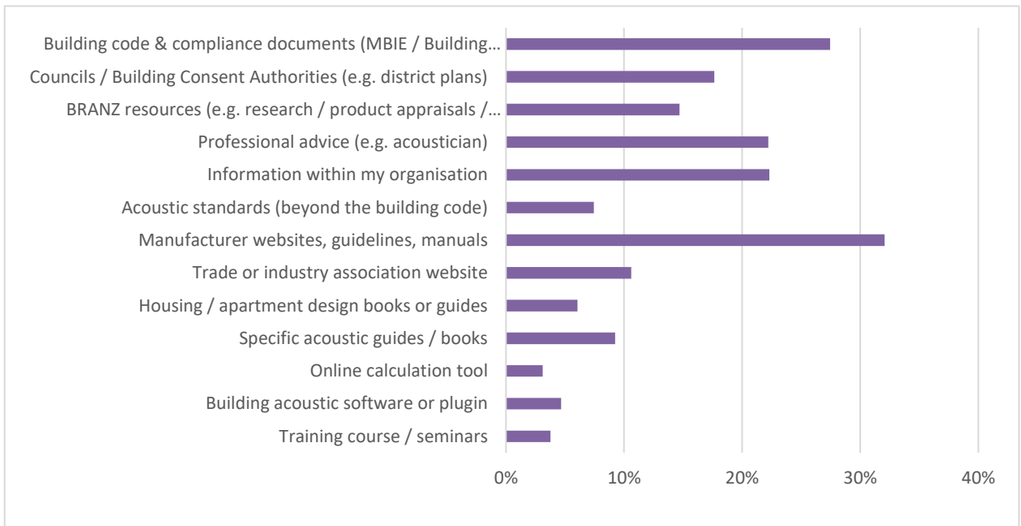


Figure 19: ***Question 10: How often do you use the following sources to find information to support good acoustic performance in MDH projects?*** **Proportion that selected 'frequently' for each information source. (approx 400 responses per source)**



G2.5.10.1 Question 10a – Best resources used?

Question 10a: With the above sources in mind, what specific information resources have you found most helpful?

e.g. The guideline ___ on the website ___; The course ___ run by ___; The product manual ___ by ___; The book ___; Information about ___ on the industry association website ___; Structural details for ___-framed structures by ___

QUESTION AIM

To get a feel for what kinds of information sources have been found to be most helpful

RESULTS / ANALYSIS

271 responses, See Appendix H, Q10 for full responses. A quick tally of responses mentioned was made as per

Table 12: Quick tally of specific information resources thought most helpful

Area	Specifically mentioned	tally
Products	Product data, manuals, docs	76
	Test results	4
	Winstones/Gib manuals	60
	Hardies	11
	USG Boral	1
	Speedwall	2
	Insul	3
	Stahlton Rib handbook	1
	Autex	3
	Pink Batts	1
	rondo	1
	EBOSS arch product lib	2
	Gib trade show/course	2
	Trade shows	1
	Metroglass / glazing	2
Advice	Designer / Architect	5
	Professional advice	56
	Industry reps	3
	Internal (shared knowledge_	9
	Prior experience	3
	User Feedback	1
BRANZ	BRANZ	22
	BRANZ Appraisals	1
	BRANZ bulletins	1
	BRANZ study SR208	1
	BRANZ course	3
	Build mag	6
	BRANZ Guideline	12
Compliance	Building code / MBIE	26
	Local Authority	8
	NZ Standards	4
Training	Seminars	12
	Training course	10
	T&R Seminar	1
	ADNZ Arch Design Course	1
	Cert build Tool Box mtg	1
	Part of training	3
	Exova training Oz	1
Web gen	Web/Internet/Google	21
NZ Industry Info	Concrete manual	1
	Building Officials Ins BOINZ	1
	ArchiPro	1
	Cement and concrete site	1
	Industry association	4
	NASH	1
	Metal Roofing Manufactures MRM	1
	ADC Air duct countil	1
Misc literature	Metric handbook (AAA)	2
	Urban Design guidelines (Oz)	1
	Book	1
	Building Networks	1
	Tech booklets	1
	Tech literature	1
	G6 workgroup doc	1
	Best practise guidelines	1
Site Info	Site Plans/Drawings/docs	2
International	NRC Canada)	2
	Timber design guides Oz	1
	UK building regs	2
	German/Danish acoustic MDH and HDH	1
	International building codes and solutions	1
TOTAL		408

Specific acoustic related training courses were quite highly rated, although interestingly only three mentioned the training received as part of their qualifications. Does this indicate their needs to be more inclusion at this level to ensure good baseline understanding?

General google / internet searches were also very helpful for picking up information especially overseas ideas and research, and for product comparison.

There was also an array of specific documents etc. that were found helpful as per the table.

Product information generally was considered especially helpful, with some specific manufacturer information highlighted – key amongst them being Winstones/GIB and hardies information as key players in this market. This demonstrates the importance to manufacturers of getting this information right.

Although the building code was second most frequently used, in terms of being a helpful resource other options were more highly rated. e.g. Professional advice and BRANZ resources (including Guidelines newsletter and Build magazine).

> *"acoustic consultant and their transfer of knowledge to us" - ARCH, Q20*

G2.5.11 QUESTION 11 – AREAS WHERE MORE ACOUSTIC INFORMATION IS NEEDED?

Question 11: For good acoustic outcomes in MDH projects, how helpful would more acoustic related information be in the following areas?

Select from "not needed" (enough information), "a little helpful" (but can do without), "helpful", "very helpful" or leave blank if you aren't sure. To help prioritize responses please select "very helpful" for no more than three areas.

QUESTION AIM

To discover the areas where more information would be most beneficial. This should help with prioritising which information to concentrate on first when looking at providing the industry with technical information

.

RESULTS / ANALYSIS

The overall results are given graphically in Figure 20 with the prioritized topics shown in Figure 21. More information was generally thought to be helpful in all areas, with very few areas marked as not needing extra information.

Priorities included more information for IT floors and IT walls, but just as important is information on integrated solutions to meet multiple needs. Next up General principles, code compliance information and product information.

Question 11 comments: SPECIFIC TOPICS? Please list any specific topics relating to the above areas or other areas missed where you think more acoustic related information needs to be available?

e.g. Floating floors & acoustic under-lays; Comparison of acoustic performance for ___; More on building 3+ storey apartments using ___ construction;

QUESTION AIM

Identify specific topics for attention.

RESULTS / ANALYSIS

57 comment– see Appendix H, Q11 for full responses topic areas included

Floors: meeting IIC (3) insulation (1) and underlays (5); floating floors (5); options generally (1); laminated timber floors (1), lightweight concrete floors (2); balcony impact noise with waterproof underlays (1);

Timber: IT floor and junction details (5), integration of fire and acoustics

Figure 20: : *Question 11: For good acoustic outcomes in MDH projects, how helpful would more acoustic related information be in the following areas?* **Responses shown proportionally for each topic (approximately 380 responses for each)**

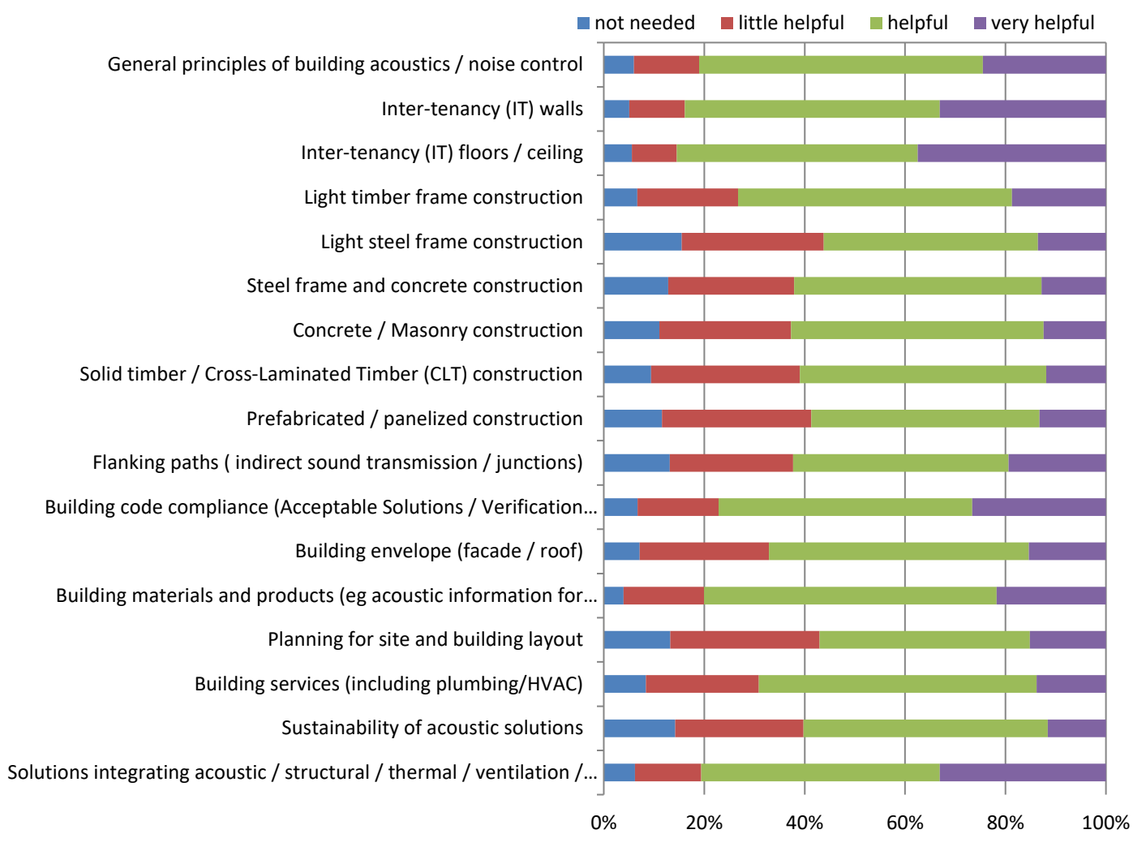
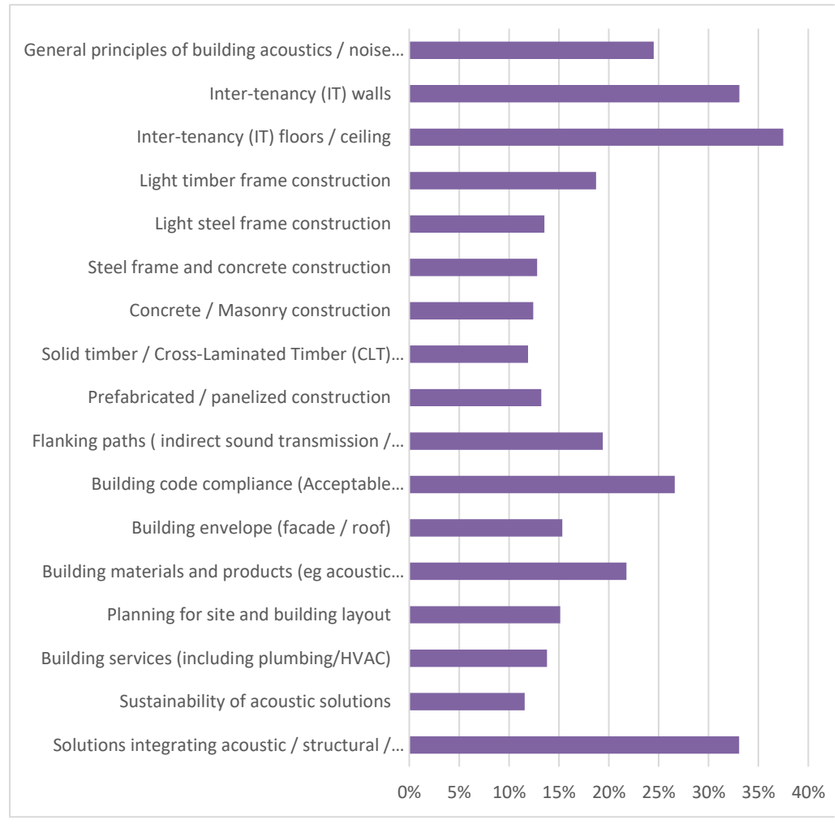


Figure 21 ***Question 11: For good acoustic outcomes in MDH projects, how helpful would more acoustic related information be in the following areas?*** **Proportion that prioritised each information source– ie selected 'very helpful' (approximately 380 responses for each source)**



(2); Light timber frame design to 3 storeys (2);

Systems: that meet code needs (2); ways to identify product options and compare for cost-effectiveness (4);

Integrated systems: for floor and walls together, detailing (2); meeting all requirements (fire/acoustic/structure/energy efficiency etc.) (4); risks if consider in isolation (3)

> *"Structural connections across acoustic breaks; "building stay up" is way more important than any acoustic requirements. I'm concerned that fiddly detailing and modern advancements in acoustic understanding and demand could confuse constructors and/or compromise the redundancy of traditional stability load paths." - ENG, Q11*

> *"The importance of detailing. I suspect that high mass solutions are inherently less risky as they require less on site quality control to achieve the desired outcome. Complex lightweight solutions can involve skill sets which are hard to find in our present ecomony." - ENG, Q11*

Flanking: general (2); via light weight concrete floors (1), via continuous steel structure (1); in timber construction (1); Structural connections vrs acoustic breaks (1);

Information: more independent information (2), case studies/practical examples (1); some way to demonstrate performance levels to occupiers and building industry (1); good better best info – building above code (1); Manufacturer info and support (1)

Ventilation: slot vents (1) HVAC requirements and meeting successfully with acoustic needs (5) natural venting (1)

Effects of **seismic movement**: (2)

External screening options for outdoor spaces (2);

Building services: managing penetrations (1); layout(1)

Windows: glazing test data (1); understanding acoustic performance (1)

Planning: adjacencies (1) and layout (1), for noise corridors (1)

Exterior envelope: understanding how improve acoustic performance, and junctions to internal. (1); roofing needs;

Software: product for prediction of acoustic performance system and training to use (1)

I**nsulation**: understanding durability, shrinkage (1)

IT Wall: more info (1);

Modular construction (1)

Other comments

- It is not so much about design failures as construction issues
- Extend G6 requirements to short term accommodations too.

G2.5.12 QUESTION 12 – THOUGHTS ON PRODUCT RANGE IN NZ?

Question 12: PRODUCTS: Do you think the product range available in NZ significantly limits the choice of noise control solutions used by designers of MDH in NZ?

Table 13 - Question 12 Overall responses

Response	Response %	Response Count
No	21%	93
don't know	58%	254
Yes (as below)	21%	90
Grand Total	**100%**	**437**

QUESTION AIM

To gauge opinions on the products range in NZ, and how this affects outcomes.

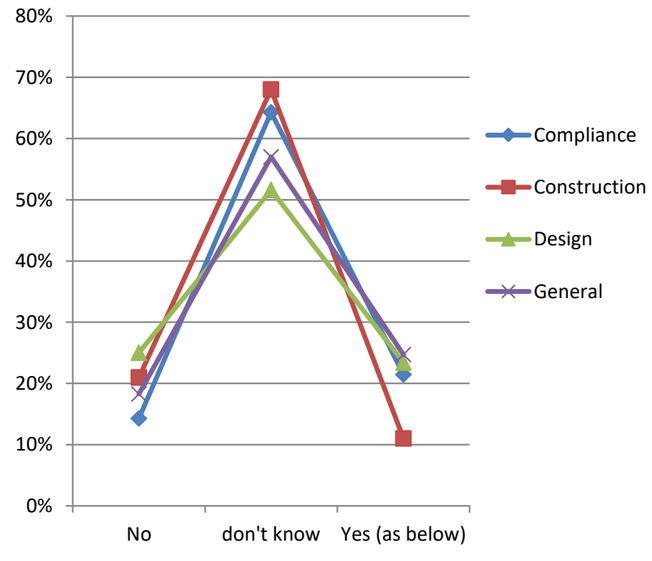
RESULTS / ANALYSIS

The overall results are given in Table 13, and graphically in Figure 22with the split across industry sectors.

Most didn't know (58%), probably indicating they understand they don't know about what other options are available, with the rest evenly split between yes and no overall. Those in compliance were more likely to think the range had a significant impact and those in construction more likely to think it didn't. There is no clear indication of an overwhelming issue with the product range, but there is some concern.

In this case going to the comments is more useful.

Figure 22: ***Question 12: PRODUCTS: Do you think the product range available in NZ significantly limits the choice of noise control solutions used by designers of MDH in NZ?***
Response as % of total for each Industry Sector (437 responses overall



Question 12 comments: If Yes, please give examples (eg this could be in terms of availability / build-ability / cost / awareness)

QUESTION AIM

To clarify the product areas with issues.

RESULTS / ANALYSIS

82 comment responses– see Appendix H, Q12 for full responses.

Key ideas from those that chose 'No' or 'don't know'

- It is not so much about individual products but lack of tested integrated systems that limits choice. (3)
- no availability of expanding foam acoustic sealants (1)
- Difficulties getting acceptance of alternative solutions for consents tends to limit usage to the limited acceptable solutions and curbs innovation and new product use. (1)
- Limited to what the market can offer / demands. Increasing requirements would drive demand for a new set of products – plenty of offshore examples to bring in as needed. (1)

For those that chose Yes,

There was a range of individual topics – see raw feedback but a quick tally notes several predominant themes. Items with several mentions included

- Firstly that there just isn't enough range of product to choose from, but also that there is a cost premium for some and need more cost effective solutions.
- Often products are there, but awareness of different options is limited – hard to find out what is available beyond big players. Also other general notes that NZ is a small market so have to expect some range restrictions
- Some (5) specifically note that in MDH in NZ Winstones/GIB dominates the market, and limits market. Others noted the need for competition to increase options.
  "dominated by major players limits material selection or cost effective solutions" - ARCH, Q12
- Getting alternative solutions (not NZBC Acceptable Solutions) approved by council was noted as tricky while compliance noted a general lack of awareness of how to present alternative solutions.
- There was a strong desire for more tested solutions, appraisal of products available, and acceptable solutions. Also for manufactures to work together and produce fully integrated solutions

"Only large companies can afford to do testing that will satisfy council for compliance. Detailed acceptable solution options in the BC will help this" - ARCH, Q12

"limited choice of tested products not enough tests been undertaken for new products (procedure is too complicated, or is perceived this way)" - OFFI, Q12

"It is the lack of reliable test information to the relevant construction element systems which is the problem not the range of products. Also the relevance of the claimed test performance to the system it is being used in." - ENG, Q12

- Cost of testing and approving products was noted an issue for getting products into wider use –

"Too high a cost to certify products only allow the big players to dictate price and choices" -ARCH, Q12

- Products were often available but skills to install often lacking
- Need to be using and importing ideas and products from overseas
- *" Too much money from levies also collected to research subjects that have been extensively researched elsewhere many years ago despite New Zealand's insistence that it is new innovation. " - ARCH, Q12*

Individual product examples included

Few residential products for reverb	2
Few eco friendly options like MgO board	2
Few choices of impact insulation underlay	1
For concrete solutions few tested floor systems	1
Cost of floating floors	1
Few ceiling options	1
Need consider triple glaze options	1
Need acoustic insulation for mechanical plant	1
More panelised systems	1

Other points noted included

More info on price comparisons for design process	1
Acoustic products tend to cost more	1
If acoustic product not aesthetically pleasing, tend to go without	1
Availability / lead times	2
Most investors won't pay to improve	1
Specific design requires professionals	1
Lack of understanding of building physics	1
For construction sites need sheet piling rig	1
Seismic considerations	1
Intransigence - refusal to change views	1
Need acoustic design guides	1

G2.5.12.1Question 12a – Practical innovations needed?

Question 12a – Can you suggest any practical innovations that would help the industry in building quiet housing

See Appendix H, Q12 for full list, over 100 suggestions, lots of one off suggestions but more common themes include:

- Provision of free independent design guides, available to all online. (Also mentioned were independent site for product reviews/comparisons and case studies)
- Widespread education across industry needed with particular mention for installers / lbps - Also information to end users
- Increasing the acoustic requirements and coverage in the building code. To go with this also easier and cheaper method for testing outcomes

"The mother of invention is necessity; higher acoustic specifications being adopted as mainstream will beget practical innovations." - ACOU, Q12

- Use more mass in nz residential building and develop lightweight concrete solutions
- Develop more prefabricated systems – easier to install and meeting multiple requirements.

"I have heard air rated concrete panels achieve a better standard of noise control, perhaps some research and resulting fact sheet could shed more light on the use of different products." - DEV1, Q12

- Look at overseas usage rather than inventing new, several mentions of the UK system for Robust details and UK floating floors
- Addressing air-leakage in façades, framing and window installations was also important and also mentioned in regards to education and acoustic sealants

"The installation methods of residential window suites needs review of E2/AS1 reliance on temporary PEF and foams to achieve air control." - PROD, Q12

Other specific product innovations suggested included

- noise cancellation in buildings? X3
- Eco products (eg straw bale, hemp) x 5
- Better junction design using rubberised compounds or bitumised banket for sound damping;
- ventilation with acoustic dampers;
- integrated CLT systems;
- product with small footprint can expose to weather;
- denser safer insulation materials;
- sophisticated panels that absorb sound;
- cost effective IT floors for LTF to 4 storeys;
- better pipe attachment and insulation;
- quality triple glazing and installation;
- door sound proofing;
- sound absorbent linings;
- quieter AC units;
- need lightweight acoustic foam solutions;
- tested integrated solutions;
- standardize insulation requirements ;
- products to stop doors slamming (egsoftSlam);
- to reduce RT times in outside spaces;

"Subdivisions very close to main arterial roads need to be stopped. People live inside AND outside their properties, a noisy environment forces people inside and a fence stops very little noise. Multi story buildings can be affected especially when opening windows" - ARCH, Q12

"finding a product that doesn't use a large footprint, can be installed in exposed elements (eg installed during framing stage not lining stage)" - ARCH, Q12

"Acoustically rated window/doors in exterior walls including aluminium joinery and optimum glazing configurations, acoustically rated cladding materials that achieve drained and vented cavities whilst avoiding flanking path issues." - ARCH, Q12

"keep it simple. With leaking building problems arose when we had complex building solutions and multiple products. A solid masonry, wall although basic, works." - ENG, Q12

Other notes

"Live in the country " - BUILD, Q12

"Who said there's a noise problem with our new homes built over the last few years?" - ARCH, Q12

"Some competition in materials supply? Only kidding, this is NZ." - ARCH, Q12

"Quiet Neighbours" - ARCH, Q12

G2.5.13 QUESTION 13 – RESEARCH AND DEVELOPMENT NEEDS?

Question 13: To help enable the building industry to provide better MDH in NZ, how helpful would acoustic related research and development be in the following areas? (In this context 'better' can mean higher performing, more affordable, more reliable, or easier to build)

Select from "not needed" (enough information), "a little helpful" (but can do without), "helpful", "very helpful" or leave blank if you aren't sure. To help prioritize responses please select "very helpful" for no more than two areas

(For reference the areas were listed as follows)

Research areas listed
Building Designs and Solutions: *e.g. development of more affordable inter-tenancy walls; higher performing floor systems; easier to build acoustic facades; integrated solutions meeting structural / fire / thermal / acoustic requirements;*
Building products / materials: *e.g. more effective acoustic flooring underlays; better resilient mount systems; acoustic rated trickle vents*
End user acoustic requirements: *e.g. more complete understanding of end user satisfaction relative to acoustic performance in the NZ context;*
Acoustic testing: *e.g. quicker testing of room to room acoustic performance; better availability of material / system testing services;*
Prediction of acoustic performance: *e.g. for complex structures not just individual building elements; for lightweight timber structures;*
Flanking paths: *e.g. research on the best junction designs;performance with composite materials;*
Information tools: *e.g. online tool for sourcing solution details,acoustic add-ons to modeling software;*

QUESTION AIM

To understand where people think additional research could be beneficial. Originally we had broad fields with a box for people to fill in topics of interest but this proved too hard – opted for offering areas and asking in the comments for precise topic suggestions.

RESULTS / ANALYSIS

The overall results are given graphically in Figure 23 and just the prioritised "very helpful" responses in Figure 24. As you can see very few selected "not needed" or "a little helpful", and this could be taken to indicate that there is a certainly more to learn in all these areas.

Development of better complete systems was given the highest priority, followed by 3 groups at similar priority - information tools, a better understanding of end user needs, and products. This pattern was consistent across industry sectors with the exception that the design sector rated prediction methods 2nd to solutions.

Question 13 Comments: SPECIFIC TOPICS? Please write specify acoustic related R&D topics you think would be most beneficial.

QUESTION AIM

Now that people are thinking about this topic, see if they can suggest specific gaps in knowledge

RESULTS / ANALYSIS

54 comments – see Appendix H, Q4 for full responses

The most common theme in the comments was that there is plenty of information and research done overseas, NZ is small and shouldn't try to "reinvent the wheel".

Better information distribution and education was often mentioned as more efficient than more research - the need to enable the best use of existing resources. Guidelines for different structure types, approved details, good better best etc. Guides / reviews / pitfalls on using existing products.

Other than that, the next most common theme related to developing cost effective solutions that integrate various aspects. It was also noted technical info for informed decisions.

> *"Research into cost-effective systems for multi-story and terraced multi-tenancy buildings that provides symbiotic use of structural, acoustic, thermal and fire resistance elements and aspects would be helpful. The creation of such systems would greatly enhance development of prefabricated modular housing and other buildings." - OFFI, Q13*

Information on detailing and junctions, and flanking effects were the next priority, with a desire for an easy way to look up details for various structures.

Some other specific research topics did receive multiple mentions including

- details for CLT
- Need for better impact / flanking noise control for flooring (eg floating floors)
- Better ventilation systems (passive and mechanical – eg slot vents, mechanical fans)
- Post occupancy evaluation, to ensure working to actual needs

Single mentions included: impact of uninsulated space (eg contiguous bathrooms) on IT wall transmission/flanking, BIM compatible modelling tools; noise ratings for lifts for low rise; interior door design, junction design around windows/doors; options for improvements for renovations; "Airborne, impact and flanking performance of profiled slab systems." - ACOU, Q13

Not related to research but also mentioned were

- Education needed on how to be a considerate neighbour
- Need to avoid building close to major roads and have better urban planning.

Figure 23: ***Question 13 - How helpful would acoustic related research and development be in the following areas.*** **Responses shown proportionally for each area (approximately 390 responses for each)**

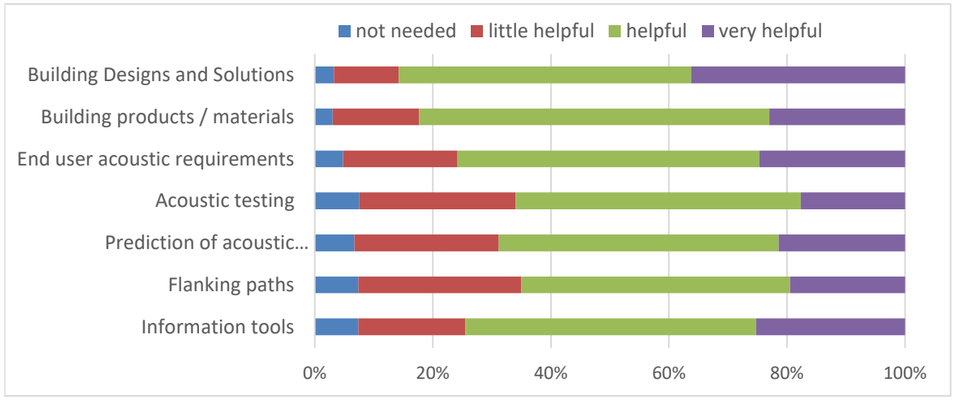
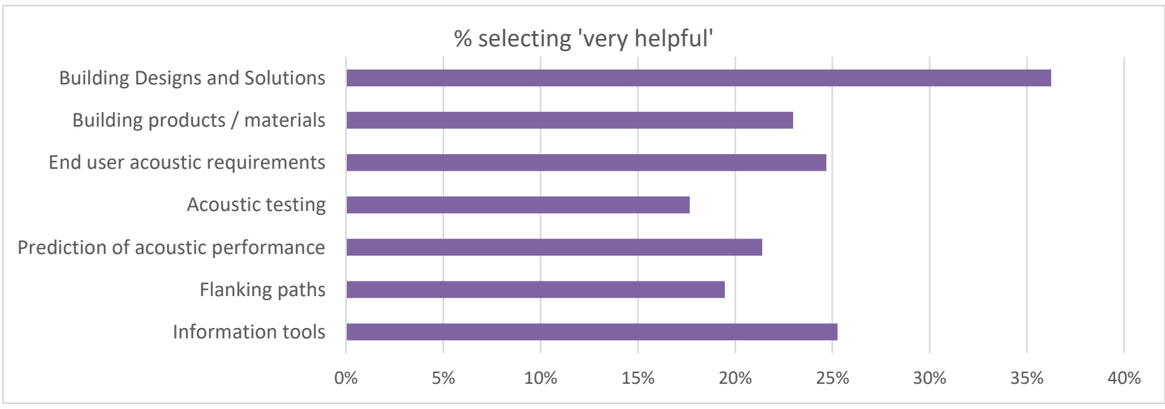


Figure 24: ***Question 13 - How helpful would acoustic related research and development be in the following areas***
Proportion that selected 'very helpful' concern level for each source.



suppliers should focus on providing better

G2.5.14 QUESTION 14 – USEFUL OVERSEAS INFORMATION/SOLUTIONS TO SHARE?

Question 14: Can you give overseas examples that could be modified for use in NZ to improve the design or construction of MDH in relation to acoustic performance? The categories below are given to prompt you for ideas and you can write as little or as much as you like for each.

QUESTION AIM

From the pool of respondents, it was expected there would be some with overseas experience. This question hoped to tease out good approaches used overseas.

RESULTS / ANALYSIS

See Appendix H, Q14 for the full comment list, but the constructive points raised are summarised in the following tables

Table 14: Overseas "Information tools & knowledge transfer methods" suggestions

Information overseas example	Times mentioned
UK Robust details and Document E [full information provided for British building regulations] - several noted wanting similar for G6 and acceptable solutions, but meeting NZ requirements	7
Canada Mortgage and Housing Corporation (CMHC) • CMHC building solutions handbook, building research digests, • CMHC "Sound control in multi-family wood buildings"	2
Europe • German and Scandinavian acoustic standards • German rules and inner city customs • European design/regulations more robust? • European Design manuals for specific applications – some exemplar examples full details and • Pipe connection requirements • Possibly BRE? [BRE is a UK based multi-disciplinary building science online hub]	 1 1 1 1 1
Australia design guidelines • TDA (Timber Development Association) Guides multi-res • Generally, more design guidelines	2
WHO (World Health Organisation) Noise Guidelines	1
General • Any overseas tested data / results, well supported white papers with full results and real world examples • Any online tool or software • Use of Floating floor • US and Romanian building codes • Overseas more information is provided to clients about noise control	 2 1 1 1 1

"Follow the UK example for regulation. Don't complicate it." – OTH Q14b

Table 15: Overseas "Noise control solutions" and "Products" suggested

"Solutions" and "Products" overseas example	Times mentioned
Floating floors: some specific extra comments… • Europe almost always use light weight floating floors (proprietary) • floating floors in timber joist assemblies • European floating floors to DIN standards. thermal and sound. • Also "DIN45673-5:2010, section 4.4 under low, medium and high load tests the performance of foam under screed floors over time." • "compressed cement flooring sheets with an under layer of rockwool material glued to it to prevent contact noise, no sheets allowed to touch the walls • "Floating floors can be taken from the UK" • "German systems (supplier literature) for floating floors"	8
Floor Screeds • "floating screed requirements and principles from Germany" • "i recall in the USA there was a concrete screed on felt/ something like felt that actually work for impact noise but I've never found it since returning to NZ, the felt ran up the wall the depth of the screed"	2
Not floating floor - "complex and not required with carpet and underlay. Limit permitted trafficable tiled area and require floating floor only if hard floor coverings are specified adjacent to habitable areas. Btw, who determined that horizontal impact is such a big issue? Where is the evidence?" - OTH	1
Need for mass: "How do we get mass without mass?", "Solid Masonry Construction and high mass constructions"	2
Scandinavia - CLT structural designs	1
General • "public good research to provide non-proprietary solutions for use in building code acceptable solutions"	1
• Have seen the use of lightweight concrete overseas	
• More airtight buildings	1
• There are many solutions and products overseas that are not available in NZ,	1
Misc Building elements	
• Trickle vents with supporting acoustic data (UK)	1
• German apartments generally have internal doors with much better acoustic seals for internal noise control.	1
• "better facade systems with technical data that includes framing effects"	1
• "bitumen impreg foam/lead composite sheets. Black iron drainage pipes"	1
• triple glazed or quadruple glazed (double not allowed anymore)	1
• "solutions in renovation using dry lightweight aggregate as sound insulation; traditional Scottish methods of engine ash/plaster mix on timber boards (weight and density) plus large cornices and lath and plaster ceilings	1
• R30 US insulation	1
• Use of floating wall and ceiling linings	1
• Staircase impact noise reduction SchöckTronsole, and Schöck products generally	2
• Use of Hempcrete	1
• "Resilient mounts or gaskets could be used more for isolation purposes in NZ."	1
• Closed cell foam solutions can be manufactured Sekisui Foam Australia	1
Other point • **EU Plastics requirement: "**Alkaline content in cement/concrete is aggressive to most polymers in particular Polyethylene. High temperature and humidity will accelerate the degradation of the PE For instance, all plastic films used as moisture barriers in EU need to be UV and alkali resistant"	1
• Product will come from the UK if the conditions and regulations are aligned	

Table 16: Overseas "Regulations" suggested to learn from

Regulation overseas example	Times mentioned
UK Building Regulations / Document E: specific extras included.. • "code is specific on the amount field testing required to certify a building, and the direction of testing (vertical only for impact). This provides clarity" • "UK Building Regulations use Dntw (+Ctr) which gives a better representation of the actual on site acoustic separation between dwellings" • "Frequently asked questions document provide alternative solutions and ideas of what may provide enhanced requirements of regulations"	8
Levels vrs Reduction eg "Regulations that specify specific levels of acceptable noise in different residential spaces as opposed to requirements for reduction of noise through the building elements"	2
Minimum standards are usually much higher	1
Most European standards / regulations	1
External noise "US construction uses sheet products to strengthen ext frames and limits noise. I have adopted this practise and use 9.5mm ply to all ext frames before adding building wrap. It is cost effective and gives great strength and reduces sound in conjunction with double glazing."	1
Netherland point system "a minimum points system used in the Netherland to use insulation, heat recovery systems, underfloor heating etc"	

"public good research to provide non-proprietary solutions for use in building code acceptable solutions"- ENG, Q14b

G2.5.15 QUESTION 15 – GOTO PLACE FOR ACOUSTIC KNOWLEDGE?

Question 15: Should there be a 'goto' place for general information on acoustic design for MDH? e.g. a hub with appropriate links and resources.

Table 17 - Question 15 overall responses

Response Options	Reponse %	Response count
(a) Yes (as specified below)	23%	96
(b) Yes (as specified below), though professional advice would be sought for project specific design details	34%	145
(c) Not sure	28%	117
(d) Not needed, I'm happy to rely on professional advice	13%	57
(e) No	2%	8
Grand Total	100%	423

QUESTION AIM

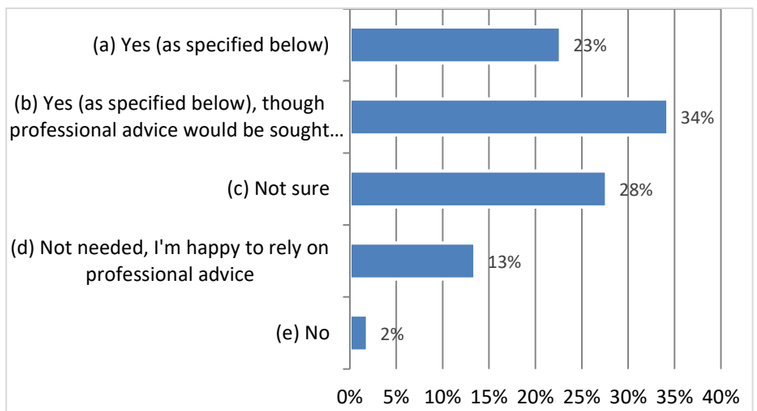
Assess people's desire for a central point from which to look up acoustic related information, to aid with meeting information needs.

RESULTS / ANALYSIS

The overall results are given in Table 17 and Figure 25 – results were similar across industry groups, with the exception that a go to place was seen as less relevant for those in construction.

Overall 57% thought a go to place was a good idea – through professional advice still seen as most important alongside this. 28% weren't sure, 13% didn't think it was needed for them as they relied on professional advice, only 2% thought it a bad idea.

Figure 25: ***Question 15: Should there be a 'goto' place for general information on acoustic design for MDH?*****Response as % (423 total responses)**



Question 15 Comments: If Yes, what format should the 'goto' place be and who should run / maintain it?

e.g. Webpages hosted by _____; Customized overview for my role provided through _____ (eg professional body or association)

QUESTION AIM

Work out where the goto place should be –helpful for advising recommendations at Stage 3. Left open to allow people to think outside the box

RESULTS / ANALYSIS

165 comment responses – see Appendix H, Q15 for full responses

The only reservations raised with having a goto place were that Goto hubs are often not adequately maintained and become out of date. Also noted was that Acoustics is complex and specialist advice is best sought – any goto site needs to be clear that information is general in nature and advice should be sought for project specifics

Table 18 gives a quick tally of responses.

Some combination of MBIE and BRANZ online resources is seen as needed - with MBIE providing core code and compliance information, perhaps linked to BRANZ as the preferred location for general links and broader info.

"If it relates to performance and expectations required by government standards, it needs to be run by a government organisation. One that would provide high quality Acceptable Solutions that councils and others can rely on for consenting and performance. Also one repository would aid in providing good cost effective solutions and promotion of good standards. Finally having one repository would help in providing solutions to non standard situations and even though this is a small percentage it will be a reasonable number. You can't rely on the industry sorting it out as their drivers are to minimise cost and acoustics is not seen as a valuable attribute, just a compliance issue." – ARCH, Q15

Probably this is the role of the building code or related publications. The code should give the requirements. A companion document could give additional commentary and examples. There could be companion documents for timber, steel, concrete, CLT etc.

Table 18 – Question 15: Tally of Goto Sources mentioned

Goto source	Tally
BRANZ related BRANZ(44), BRANZ website(9) Guide of tested solutions BRANZ (1)	54
MBIE and/or BRANZ MBIE and BRANZ combo (5), MBIE or BRANZ (9) Acoustic specific site hosted by BRANZ or MBIE (2)	16
MBIE / code docs MBIE (25) Building code / Acceptable Solutions (9) Building code companion docs (3) Building nz site (3) Regulated set of rules/requirement for specific situations (1) Professional acoustic body provide advice on MBIE site (1) DBH (2), DBH linked to from councils (1)	45
Independent/professional research site Independent research authority (1) Professional research body (2) Site with pre-approved details for common situations (1) Website by professionals/consultants not suppliers (2) Independent of suppliers (4), Generic not product advice (1)	11
Website Website[unspecified] (18), Wikipedia (1)	19
Professional acoustician advice/site Professional advice (2) Acoustic professional body website (13)	15
Industry Assoc IPENZ (1), Industry association (2), National timber organisation (1), Master Builders (1) Greenstar / Homestar (1), NZIA, ADNZ (1)	7
Product info site Masterspec (1) Tests/reviews product manufacturers (1) Pdf manufacturer data on system and junctions (1) System design manual by manufacturers (1) Website with solutions /costs ranges (cheap to ...) (2)	6
Like ...? Code of practice (like roof/concrete assoc) (1) Like BRE uk? (1) Doc like "design for the sun" (1) Online tool like thermal performance Calc (1) Something like Design navigator for H1 (paid) (1)	5
Councils Local council - attached to consent (1), Council (1)	2
End user info More info for buyers on desirable outcomes - developer sites (1), online tool (1)	2
Misc Brochures (1), NZ acoustic guide for MDH (1)	2

G2.5.16 QUESTION 16 – BEST EDUCATION METHODS?

Question 16: In order to understand how to improve access to and uptake of acoustic related information, please rate how effective you find the following information transfer methods.

Select from "ineffective", "low effectiveness", "average", "effective", "very effective" for each.

QUESTION AIM

Learn the ways people want to receive information.

RESULTS / ANALYSIS

Full results can be seen Appendix H, Q16. The overall results are shown graphically in Figure 26 with Figure 27 highlighting methods marked as "very effective". All methods are fairly effective but online printable solutions and seminars were seen to be most effective. Note it is therefore worth the effort to ensure online resources are formatted to allow successful printing – as people still want that option.

It is hard to get seminars and training to large numbers of people. Although online videos are not seen as so effective – if running seminars already, it doesn't cost much extra to video and upload the seminar online as an additional resource too.

Question 16 comments: Other 'very effective' methods of increasing your knowledge?

QUESTION AIM

Did we miss any major methods from the list?

RESULTS / ANALYSIS

Only 25 comments, so most areas probably covered. – see Appendix H, Q16 for full responses.

However, a few other very effective methods were noted, most notably talking to experts

- Talking with experts/ acousticians (8)
- Manufacturer helplines and support staff (2)
- Practical examples helpful
  an example building demonstrating good & bad features (1)1
  case studies (2)
- Study courses (2)
- Needs to be accessible digitally for ease of sharing and staying up to date, but also printable – pdf best, (2)
- Learning from past experiences, especially failures, to better understand outcomes in practise. (2)
- Talking to contractors about buildability (1)
- NZIA online 1 hour series (1)
- Include in license building practitioner (lbp) seminars (1)
- Seminars on details for complex situations not just basics (1)

"Talk to me, show me. I believe what I see and experience" – ARCH, Q16

Other notes were

- Free brochures must include technical information, not just be marketing (technical product statement)
- Seminars you have to pay for are not effective – need free access.
- A builder noted this would not be what he talks to colleagues about! - Might be more relevant option for professional offices.
- Everything depends on the quality of the content – For example some seminars good but some terrible and a good quality online video might be better.

Figure 26: ***Question 16: In order to understand how to improve access to and uptake of acoustic related information, please rate how effective you find the following information transfer methods.***
Responses shown proportionally for each method (approximately 400 responses for each)

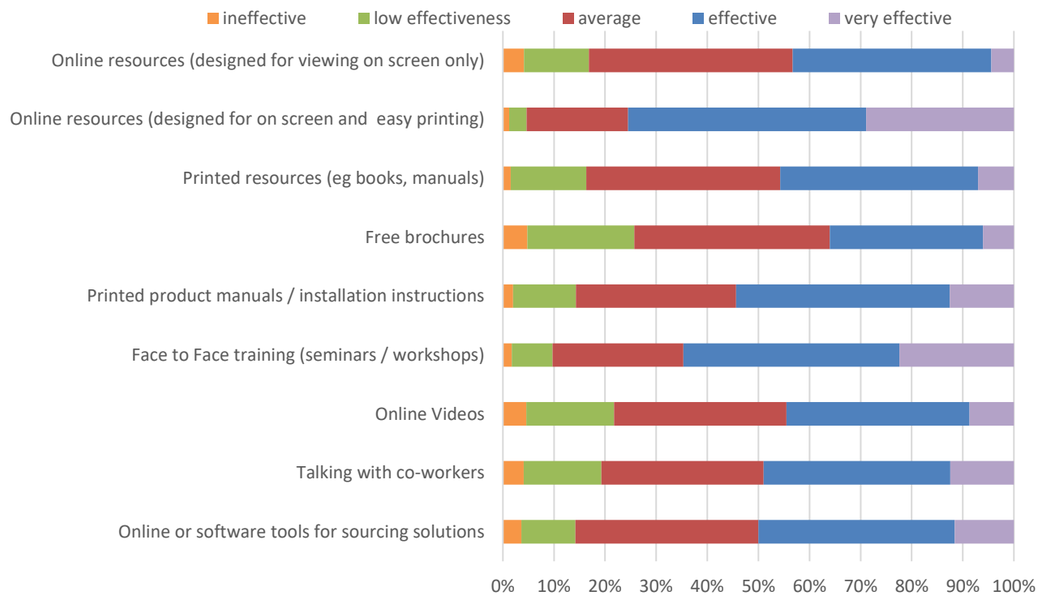
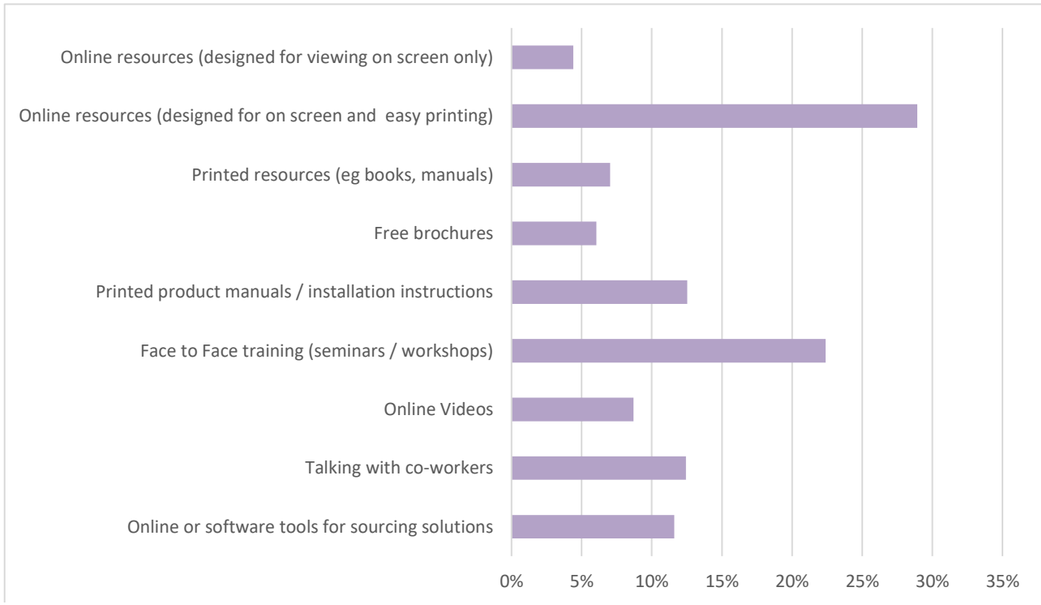


Figure 27: ***Question 16: In order to understand how to improve access to and uptake of acoustic related information, please rate how effective you find the following information transfer methods.*** **Responses % for each those that chose "very effective" (approximately 400 responses for each)**



G2.5.17 QUESTION 17 – OTHER THOUGHTS ON INFORMATION AND SOLUTIONS?

Question 17: Any last thoughts on acoustic related information sources, solutions, education, research and development, and product availability that we haven't covered above?

QUESTION AIM

Just to catch any last points people wanted to make.

RESULTS / ANALYSIS

Full comments are given in Appendix H, Q17, with 56 comments, here is a quick compilation

Industry knowledge – general industry understanding levels on this are low and a general increase in knowledge would be beneficial for all (4); Training for contractors needed (4). General acoustic design courses / seminars are needed (4); Learn from the experiences of those in related fields who may have insights outside your expertise (1); Better education as part of formal training/qualification (1);

Information: would be useful for specifiers to be able to download system details in CAD or pdf formats (1); design guide would be good (5), checklist of things to watch for would be useful (1); BRANZ has a useful library and can summarise research well in its publications (1)

Regulation: Increase standards to improve for all (3)**,** don't over regulate– one size does not fit all, need a realistic minimum (4). Learn from overseas regulations (2). Best practise should be to aim above code minimum (1)

Products: Small market so expect changes and limitations in range (1); For product information, websites are better than printed brochures for being up to date (1); Need more options for absorbing wall and ceiling systems (1); Supplier monopolies affecting price and range(1); independent product reviews needed (1)

Systems / solutions: need more approved systems (1) need standardised solutions (1); need integrated solution that meet multiple needs (3); More emphasis needed on mass products for MDH, as timber poor for this.

Acoustic society: should be working to raise awareness at all levels including government on loss of amenity with poor design/construction

End user /client education: better understanding of benefits and limitations of noise control and understand living at higher densities (3)

Feedback – useful to have more info on end user needs (1), but also testing outcome to feedback the performance of designs (1)

Online forum for sharing experiences? (1)

Software: BIM modelling (e.g. for ArchiCAD) could help with design (1); software to select solution designs than meet certain criteria (1)

Personal experience of poor noise control on health and stress (1)

An aspect of buildings that needs to improve (3)

"Don't lose sight of the wood for the trees. it is very easy to look for additional requirements and miss the fact that the general level of knowledge on sites (and sometimes in architectural/consulting practices) is surprisingly low resulting in silly mistakes. If acoustic consultants spent more time on site testing their designs, I think this would lift everyone's understanding of building acoustics as well as provide better outcomes for owners with minimal cost increases. Clients also need to be better educated to see the benefit of proper QA to get the performance they have already paid for instead of spending more on materials but not getting any real benefits." - ACOU, Q17

G2.5.18 QUESTION 18 - THOUGHTS ON ACOUSTIC QUALITY IN RELATION TO MDH?

Question 18: QUALITY - What are your thoughts on incorporating good quality noise control solutions in the design and construction of MDH in NZ? Following are some prompt questions to help you distil your thoughts - just answer if relevant.

QUESTION AIM

This series of questions was just to gauge what people think about acoustic quality for MDH in NZ. We left these as open responses to let people think outside the box and not give pigeon holed responses, although this does make analysis a little trickier

G2.5.18.1 Question 18a – Role in desirability

18a: How much of a role do you think acoustic quality plays in the desirability of MDH?

RESULTS / ANALYSIS

The complete comments are given in Appendix H, Q18 (273 responses). This question should perhaps have been a sliding scale of options + comments. Often people gave a rating (eg important) with a qualifying statement, while others offered just a rating or a statement. A quick tally of results is given in the following two tables

Overall, the vast majority responded with the feeling that incorporating good acoustic quality was very important for ensuring MDH is desirable. Words such as 'critical', 'vital' etc. Good noise control reduces the feeling of crowdedness which is inherent in increasing density. It isn't necessarily considered as a factor if the performance is good but when it is bad that is when people realise how important it is. Therefore it was seen as very important to have good acoustic quality for the long term success and uptake of MDH - for MDH desirability.

A few noted they felt the minimum code standard achieved satisfactory performance. Others felt people had to understand there would be some noise transfer and expect lower quality for lower budget.

"I believe there is huge scope to improve the quality and comfort experienced by occupants of such developments, without excessive additional cost. Good design should also make these developments more energy efficient and healthier making a huge improvement to the lived experience within the development." - ACOU, Q18a

Table 19:Question 18: How much of a role do you think acoustic quality plays in the desirability of MDH quick tally of responses

Rating	Count	Includes responses
Major role	91	Critical (3), determining factor for desirability (1), essential for good outcomes (1), essential for successful MDH (3), essential with higher density (1), external noise intruding particularly huge (1), extremely important factor (2), Great role (1), Highest priority (1), Huge (7), immense (1), Important with higher densities (1), In top three (1), Is a must (2), Key role (1), Major role for long term comfort (2), make or break for MDH satisfaction (1), Massive (1), top three (with durability, fire safety) (1), very high / big role (13), Very important (38), very large role (3), Very significant (1), Vital (4),
Large role	45	A lot for user satisfaction (1), above average importance (1), High (15), Large importance (1), Large role (5), Lots / A lot (12), one of key factors (1), plenty (1), Significant role (7), Substantial (1),
important	33	good level needed (2), important (25), quite a big role (1), quite a lot (2), reasonably high (2), very desirable (1),
moderate	10	average (2),definitely a factor (1),medium (1),moderate (1),quite important (1),relevant (1),some (3),
Small	15	just enough (1), limited (1), very low (1), 10% (1), a bit (1), a little (1), a role (1), little (1), low (1), low priority (1), minimal (1), not a lot (1), not much (2), small (1),
Not play a role	4	none (1),not important (1),not needed (1),not relevant (1),

Table 20:Question 18: how much of a role acoustic quality plays in MDH desirability - quick tally of extra comments arranged into categories

category	Qualifying comments in relation to desirability
adapt	people adapt to high noise areas (Traffic / aircraft) (1)
budget	comes down to budget - get what pay for (1)
budget	Cost versus gain? (1)
budget	developers are there to make money (2)
budget	higher end developments expect higher (1)
budget	important but cost often override (1)
budget	important but needs to be cost effective (1)
budget	low budget apartments - low expectations (1)
budget	low-end MDH, desirable but price wins (1)
budget	Need choices - choose quality versus cost (1)
budget	not a lot as costly (1)
budget	only high end above code (1)
budget	quality wanted but price overrides (1)
budget	sought after but costs play part (1)
budget	up to developer to determine needs/cost (1)
change	days of large sections gone in Auckland, more infrastructure close together (1)
code min	minimum benchmarks sufficient (1)
code min	costs drive industry aims for code minimum only (1)
code min	not all that significant beyond NZBC? (1)
code min	Not enough as minimum standards too low (1)
comfort	makes for better comfort in dwelling (2)
compare	as much as energy efficiency (2)
compare	Equal to structure, durability and other code clauses (1)
compare	In addition to visual privacy (1)
compare	less than good ventilation and passive heating (1)
compare	Same level as fire (1)
construct	only as good as installer (1)
depends	Very important at high end (2)
depends	dependent on users (4)
depends	different areas diff needs (1)
depends	performance altered by furnishings (2)
design	a design priority (1)
design	a part of overall plans (1)
design	acoustic quality needs to be norm - not compromised by cost/ poor design/const (1)
design	always consider - present designs cope (1)
design	Architects/designers should be trained on this! (1)
design	integral part of design (1)
design	invisible factor for quality accommodation (1)
design	Need consider in all accommodations (1)
design	need good design/performance for MDH to be credible housing form (1)
design	Needed in all building designs (1)
design	needs implementing (1)
design	Needs to be at forefront of design (1)
design	should always be designed for (2)
design	should be incorporated in design/construct (1)
expect	owners coming to expect good acoustics (1)
expect	people don't want to hear neighbours (1)
expect	users need to expect some noise transfer (1)
future	bad MDH noise experiences put off for future (1)
future	becoming more important (3)
future	bigger issues as word spreads of failures (1)
future	future proofing (2)
future	get more important as more move to MDH (2)
future	getting more important as clients become aware new products (1)
future	Good acoustics encourage MDH uptake (1)
future	increasingly improvements to maintain living standard (more traffic/density) (1)
future	Need educate users re consideration for others (1)
future	needed in all new dwellings (1)
future	object to MDH as close, quiet perceive less (1)
future	otherwise turn to slum (1)
future	poor noise control make life miserable, give MDH a bad rap (1)
future	put off MDH by neighbours so close (1)
future	sound helps perception of spatial and built quality (1)
future	Users avoid MDH as concerned for noise (2)
future	very important for occupier retention (1)
if poor	if performs poorly, neighbour conflicts (2)
if poor	Lots if done poorly, little noticed if done well (1)
if poor	minor unless sig difference (1)
if poor	not sure affect buyer choice but notice if poor (1)
misunderstood	Big unrecognised issue inhibits MDH uptake (1)
misunderstood	consumers not aware of issues (2)
misunderstood	extremely overlooked by the design and building industry in NZ (1)
misunderstood	get more important as people experience good and bad (1)
misunderstood	hard to know until live in MDH (1)
misunderstood	important but need educate public on this (1)
misunderstood	little due to ignorance (1)
misunderstood	minor as not understood - will be known to matter once more in MDH (1)
misunderstood	More important than recognized (2)
misunderstood	Most not consider - more aware, more discerning (1)
misunderstood	Not a lot until see quality after construction (1)
misunderstood	not as much as it should (1)
misunderstood	not understood until experience bad (6)
misunderstood	only recognised after period of use (1)
misunderstood	starting to understand the need to make better (1)
misunderstood	underestimated until people lived in MDH (5)
other	make double glaze compulsory (1)
other	shyness towards solid masonry (1)
sales	Before sale, very little, after sale, very important (1)
sales	difficult to assess for short visit - hard to sell (2)
sales	important but often not considered by buyer until move in. (1)
sales	makes resale easier (1)
sales	not big concern to average home buyer (1)
sales	not considered enough by purchasers (5)
	The more the better (1)

G2.5.18.2Question18b – What we do well

Question 18b: What do you think we do well in NZ in terms of noise control for MDH?

RESULTS / ANALYSIS

Full responses in Appendix H, Q18 (235 comments)

A quick tally of response types was make as per the tables below. There was a surprisingly negative split between those that commented along the lines of "not much" (70) and those that suggested positive aspects (103). A quick tally of the items mentioned in the 200 responses is given below ('Don't know' type responses are ignored.)

The main positive comments related to the fact that we do have regulations for this, though with mixed qualifiers as to how good that regulation is. Some inter-tenancy systems were highlighted as being good (mostly IT walls), and a few comments on specific products and information available. It was noted recent changes to require better insulation and double glazing have had a positive impact on acoustic performance, and that there is starting to be growing awareness of and more towards improvements in this area.

Positives noted (103)

Identified area	Tally
Regulations: simple building code (1),there is some regulation through code (11) (even if not thought ideal), code min provides good baseline (10) Regulate for external noise from airports (1)	23
Compliance - site testing to prove compliance works well.	2
Improvements recently: some improvement recently (4); design now more proactive and expectations increasing(3); awareness increasing (4), manage expectations for those moving to MDH (1)	12
Specialist help: good at getting specialist involved (5), specialists ok (2); better advancement of trained people (1);	8
Inter-tenancy systems: good terrace IT walls (2); IT ok but need other areas (5), masonry and concrete IT walls (1), good IT walls (8), concrete floors (2); good precast construction (1)	19
Others that help acoustics: thermal insulation generally helps acoustics (6); good glazing systems help (10)	16
Other things that we do well: what we have works (5); design (2); build quick (1); planting for traffic noise (1); open to innovations (2)	7
Products: some good trade info(2)Gib Manual and info (2); GIB systems work (4); more products coming (2), reasonable product range (4)	14

Other comments

Identified area	Tally
There are some options available	2
Average or ok but not great	7
Have lots of noise control officers!	1
Design well, construct poor	2
Tend to only design and build to minimum [not referred to in a positive way]	14
Not an issue in small town NZ	2
Don't need to reinvent wheel, use overseas lessons	3
This survey a good start	3

Negative responses (70)

What do we do well?	
Not much, not a lot, not really do not a great deal	25
We don't understand it	5
Room for improvement, could do better	4
Don't do well	2
Identified as issue, need educate now	3
Don't know if we do	2
Limited / little	3
Below average, behind others	3
We do poorly, not do well, nothing	6
I'm struggling to think of any	3
Very little	8
Tend to just put up with	1
Need to deal with low freq	1
Acoustics gets cut lst in budget	2
Only do basics	2

G2.5.18.3Question 18c - Proportion built above code minimum

18c: Approximately what proportion of MDH project that you are involved with aim noticeably above regulatory acoustic requirements and what drives this?

See full responses in Appendix H, Q18 (229 comments)

A full tally has not been done as it is hard to compare comments into values.

However there is a definite trend that the majority of projects aim for the regulated minimum standards to minimize costs – that there is a lot of low end housing in the MDH market. It was noted that there is a perception that achieving good noise control is a specialty / high end feature that costs a lot, even if this does not necessarily have to be the case – that it would be nice to have better but clients are not always prepared to invest in it.

At the moment aiming above code is driven more by designers than by end user demand –though this was thought to be more to do with lack of awareness of the issue through MDH being relatively new. It was thought that as more people experience bad noise control there will be shift for more demand for good acoustic quality from end users, which should feed through to developer decision making.

It was noted that things like increasing requirements for fire and energy efficiently can be incorporated well with acoustic needs to produce better results for all, for minimal extra cost.

G2.5.18.4Question 18d and e – Top 3 issues and how to address

18d: What do you see as the three most important issues that need addressing in relation to noise control in MDH?

18e: What steps do you think should be taken to address the issues noted in 18d?

QUESTION AIM

We were interested to see what are considered the key issues by industry as a whole, the priorities that if addressed will provide the best outcomes.

By placing this question at the end of the survey, the full range of ideas would be fresh in mind and they could identify what they see as priorities

RESULTS / ANALYSIS

Although not everyone answered this or all parts, there are over 250 respondents / opinions. The full listing is tabulated in Appendix H, Q20, with the 3 issues and how to address them listed together for each response. Often the issues were also solutions eg more information needed.

Full analysis of what this means is ongoing and will be a core part of the basis for this Project's Stage 3 (Recommendations). However a quick tally was done to identify the core areas mentioned.

Topic	Count	category
Regulation review needed	24	regs / compliance
G6 changes	29	
Robust criteria	3	
Testing on completion	16	
Compliance clarity	14	
IT noise transmission	28	noise type / issue
Flanking	7	
Walls	13	
Impact noise	19	
Floors	13	
Floating floors	1	
Low frequency noise	6	
Internal walls	11	
Façade/roof	5	
Ext noise traffic	33	
Ext from shared	4	
For existing buildings too	2	
Reverb	1	
Common areas	4	
Building services noise	15	
Penetrations	3	
Stairs lifts	2	
Ventilation. Windows	15	
Costs	22	cost
Cost product	3	
Cost of experts	3	
Govt intervene with suppliers costs	4	
Concern prod pricing	3	
Cost effective reliable solutions	47	cost effective reliable products
Tested robust details	17	
Product info better	5	Products
Supplier integration	6	
Good prod range	19	
Tech info	2	
Durable	4	
Sustainable products	1	
Need data on new materials	3	
Guidance docs	7	information
Education / Training / good info	65	
Lack of information / better dissemination	27	
Lack of Knowledge	13	
Understanding	8	
Keep simple	9	
Awareness	9	
Awareness of products	7	
Builder knowledge	5	
Awareness of benefits design/build / BCA	21	
Awareness of benefits -client/developer	49	
Understand outcomes needed / POE	14	
User understanding of MDH living	7	
Expectations? Outcomes	6	
Research	12	
Use international info	7	
Professional advice	1	
Construction quality	35	construction / buildability
Early design	5	plan/design
Urban planning	2	
Good design	19	
Star rating / recognition of good quality	9	
Meeting with other needs	5	
Use mass more	1	

Acousticians tended to have a slightly different take than broader industry with a greater emphasis on the need to change various aspects of G6, or specific information needs on particular transfer methods etc.

Overall however, information and awareness needs (education/training) were by far and away the key priorities, followed by the needs for cost effective solutions with good buildability. Regulation updates were reasonably high but behind these other issues from the broader industry perspective.

The results of this along with other feedback from the survey is incorporated in the consultation summary – section G5.1

G2.5.18.5 Question 18f - Other thoughts on quality

18f Any other thoughts on quality?

About 50 useful comments –responses mostly mirror past ideas. Included

- Needing to get better at MDH living since it will be a necessity going into the future (for population growth and environment, so need to do acoustics well).
- Learn from what the rest of the world does
- For good quality need to consider and ensure suitable code minimum requirements – (several mention the need to increase or conduct extra research to determine 'suitable' criteria to meet expectations, and change code if appropriate)
- Inspection along the way, and testing of the final building as the only way to confirm final quality obtained.
- Installers and construction to be well trained to ensure good outcomes from the design, and systems good buildability
- It is worth putting the effort into a good design- can save costs in the long run
- Education / Training of the building industry is key.
- Increasing awareness generally and enabling demand for quality to increase supply of resources
- Cost effective product/system range to meet varying budget ranges (good better best), and getting the best out of existing products. Also standardisation to enable better mass production of housing for cost efficiency.
- Remember to deal with noise at the source wherever possible.
- Quality is usually overridden by budget constraints – " you get what you pay for".
- Unlike thermal or solar where can quantify cost savings in future, you can't see and qualify acoustic benefits.

"There is only one chance to do it right" – PROD, Q18f

G2.5.19 QUESTION 19 – EFFECTS OF ACOUSTIC CONSIDERATIONS ON AFFORDABILITY?`````

Question 19: AFFORDABILITY - What acoustic considerations do you think impact the most on the affordability of MDH in NZ?

Could be related to products or structure; compliance requirements; testing; design; professional advice; other

QUESTION AIM

Cost is usually claimed as a major hindrance to providing increased noise control. We wanted to understand a bit better which cost aspects are thought to have the most impact.

RESULTS / ANALYSIS

Just under 200 useful responses, with full comments given in Appendix H, Q19. Separating the effect of acoustic requirements on affordability from other costs was not always easy so feedback was often interrelated. Table 21 gives a quick initial tally of response areas. Some general observations follow.

Products

Product and material costs are generally considered to be a major issue although not necessarily just for acoustics but as a broader industry problem. NZ is a small market which has an effect though perceived monopolies and lack of competition were regularly raised (also mentioned in other responses through the survey). Availability was also a factor, some products or materials have longer lead times affecting use in projects.

Being able to better source cost effective solutions, more standardised and integrated systems and installation would be helpful to reduce costs.

Acoustic specific products were noted to attract premium price while often little difference perceived from related products. From a product development perspective the costs of R&D, and testing products and system compliance was important as this feeds through to costs for industry.

Budget / costs / part of whole

It was noted that acoustics is just one part of the overall cost and that the cost has to be absorbed as part of compliance with at least the building code minimum requirements for lots of different factors. There is an inherent cost in building any building, so decisions must be made about how to spread the budget.

> *"If it's not mandatory then unless specified by the client it won't happen - we are all trying to reduce the cost of housing" - ARCH, Q19*

Often the minimum requirements are all that are budgeted for. Adding additional quality was noted to usually increase overall costs, but there was a need for informed decision making about the quality level desired and associated cost (cost benefit), as these are generally incremental differences.

There was also concern raised about the general "cost rules all" mentality, at the detriment of quality and associated long term benefits.

> *"Performance quality should not be compromised by low price. There is a high cost for rectification." - PROD, Q19*

Although perceived as a major cost, many also noted that early consideration in the design, along with good integration with other design requirements can actually lead to lower costs than if treated separately. Many noted that accommodating good acoustics is in fact a small relative cost of the whole, for marked benefits to end users.

> *"Most important to realise that acoustic comfort is in the design and not significantly costly" - ENG, Q19*

Compliance

Compliance requirement (consenting, testing, inspections) were noted as a major cost. For example, acoustic design reports for consenting, the cost to commission acoustic tests at completion [at least for Auckland MDH where required]. Where non-standard designs and details are required this can attract additional costs for approval.

However, it should be remembered that this needs to happen whatever quality level is aimed for, and is an inherent part of building work generally.

Design

There are costs associated with design, and needing to ensure not to over or under design relative to the required outcomes. Acoustics is just one part of the whole building design and the more complex the design, and custom details required the greater the cost. Failure to get the design right is important as it was recognised remediation can be a lot more costly

Professional advice on acoustics was regarded as probably the most specific acoustic cost. Notes included costs to engage, lack of availability, high cost due to lack of competition,

> *"Professional advice costs. Sometimes this fee is a hard sell on projects, and us detailers just have to use what is available in manuals like Gib and hope that we haven't overlooked a factor." - ARCH, Q19*

Building elements

Specific building elements also rated a mention in regards to affordability and acoustics. Most notably, the choice of building structure having an impact on outcomes and requirements, with heavy mass better for acoustic performance generally but not widely used for lower height residential builds due to other cost considerations. This impacts the requirements for Inter-tenancy noise e.g. impact isolation, wall thickness insulation, and linings etc.

Ventilation and glazing requirements as part of dealing with external noise were the other big costs though again these factors relate not just to acoustics but other factors such as energy efficiency, thermal and air-quality.

Construction

Construction and labour costs also were thought to play a part along with availability of suitably qualified installers.

Errors introduced through poor construction – e.g. not following design plans or incorrect installation of systems - also had the potential to add costs as they can effect overall outcomes. So this is where good knowledge within construction industry comes into play and incorporating good buildability into solutions.

Other

There were a few other comments with most frequent being about land costs being a bigger factor than almost everything else in construction and a few general complaints about the building industry as a whole and its effects on affordability, rather than just acoustics

Table 21: Question 19 Affordability notes - Quick tally of topic areas in responses

Area	Topic	Count
Products	Product cost / availability	17
	Material costs (though many noted as demand up, cost should go down)	18
	Need cost effective solutions and info on these	4
	Material availability	2
	'Acoustic' products disproportionally expensive	7
	Need incorporate acoustic performance in products as standard not add-on	2
	Small product range in NZ / scale of industry in NZ -> costs up	6
	Standardised solutions & installs should reduce costs	8
	Supplier monopolies / lack of competition	9
	Lack of range of integrated / tested solutions	3
Product development	Product testing and R&D to comply	5
	Needs to be easier to test and confirm system	1
Budget	Client/developer want spend the min for consented outcome	15
	Funds available for work	1
Cost	Cost	5
	Cost uncertainty scares clients	1
	Good quality costs more	4
	Allow choice, pay more for better	1
Cost/Benefit	Need change emphasis on cost vs. quality	7
	Need convince of benefit for cost	3
	Need to better understand cost vs. benefit	6
Part of whole	More cost if not planned for early	6
	Part of broader requirements need to meet all	7
	Lack of knowledge in acoustic consideration	1
	Acoustic minor compared others	8
Compliance	Compliance - consent, test, inspect	19
	Costs if fail testing, hard to rectify	1
Design	Design	10
	Need to not over-under design	1
	Design complexity	5
	Design expertise cost and availability	17
	Lack of detailing - > later changes / failures	1
	Noted higher cost if have to rectify	1
	Good design min cost - cost more to remediate	7
Building elements	Structure	7
	Structural separation	1
	Ext noise/ventilation requirements	6
	Glazing	5
	Impact isolation floors	2
	Wall thickness and linings	2
	Heavier mass better but less cost effective < 4 storeys	2
	Concrete more straightforward but need wood for seismic	1
	IT requirements	1
	Emphasis on woodframe and wallboard - needs change	1
Build	Construction costs	9
	Installation costs	2
	Construction errors	1
	Need good buildability to reduce time	3
Other	Poor district plan requirements	3
	Don't want more regulation!	1
	Everything if make this an issue	2
Industry general	Land cost not acoustics is the issue	3
	Notes of General industry issues not specially acoustics	5

G2.5.20 QUESTION 20 – PRACTICAL EXAMPLES TO OFFER?

Question 20: PRACTICAL EXPERIENCE - Would you like to share some of your practical experiences relating to how acoustic requirements have impacted on your MDH projects? Please don't identify the project.

e.g. consideration of acoustic requirements early/late in the design process was positive/negative because ___; when complying with the building code we found ___; when installing acoustic solution x we found ___; unexpected flanking noise through ___ meant ____; changes in aesthetic trends such as hardwood floors and exposed structure have meant ___;

QUESTION AIM

The idea was to gain some practical examples, and see if they support the general principles we are finding.

RESULTS / ANALYSIS

See Appendix H, Q20 for the full raw responses. In total there were 127 comments but less than 90 contained real examples. Quotes arranged by topic are included in section 4, which highlights practical examples from throughout the survey.

G2.5.21 FURTHER CONTACT / LAST THOUGHTS

Q21: Would you be willing to be contacted for further thoughts on this subject?

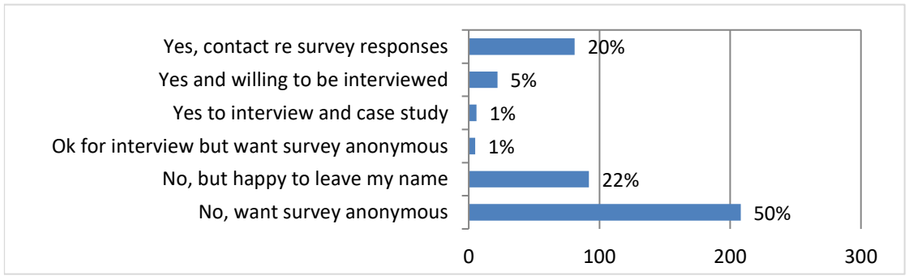
Table 22 - Responses to further contact question

	Response %	Response Count
(a) Yes, I am happy to be contacted if needed to clarify points in the survey - I will enter my details below	20%	81
(b) Yes and I would be willing to participate in an interview (e.g. 15 - 30 min by phone) - I will enter my details below	5%	22
(c) Yes, I would be willing to participate in a more in-depth interview. I have also been involved in a project that could make an interesting case study in relation to acoustic design of MDH and would like to share this - I will enter my details below	1%	6
(d) I would be happy to be an interview subject but would like this survey to remain anonymous - I will contact the interview coordinator directly by email on research@marshallday.co.nz	1%	5
(e) No, but I'm happy to leave my name below	22%	92
(f) No, and I'd like this survey to be anonymous	50%	208
Grand Total	**100%**	**414**

QUESTION AIM

We hoped this would help us get in touch with people in industry who are willing to participate further in the study through interviews and case studies.

Figure 28: "Further Contact" Response count (and %) of 414 total responses



RESULTS / ANALYSIS

The overall results are given in Table 22and Figure 28and show 50% wanted their feedback anonymous with the rest leaving at least their name.

We are in the process of following up the interviewees and case studies.

Appendix H, Q21 tabulates the locations of the respondents who noted their city and these are spread all around NZ as we had hoped, and as you'd expect predominantly in the major cities where MDH is more prevalent – see Table 23 for a summary.

Table 23- Summary of respondent's locations

Respondent City	Count	%
Auckland	72	36%
Christchurch	27	13.5%
Wellington	21	10.5%
Lower Hutt	5	2.5%
Hamilton	5	2.5%
Tauranga	5	2.5%
Nelson	5	2.5%
Dunedin	4	2.0%
Others (<4 respondents)	55	26%
TOTAL	**199**	**100%**

LAST THOUGHTS: Any last thoughts on this survey or points you think we missed?

QUESTION AIM

To test reception of the survey, check we had covered most areas, and allow people to have a final say.

RESULTS / ANALYSIS

Full text responses are given in Appendix H, Q21

General comments included

- Needs to be considered for all housing types not just MDH (standalone and high rise)
- There are also issues with existing buildings and renovations
- Concrete is better for sound insulation but with a strong timber industry prefers lightweight construction which is also good for earthquake zones
- Acoustics is a specialist subject and needs expert advice on projects
- Not wanting more costs or regulations, and another questioning "Is this an important issue?"
- Source overseas examples and solutions
- Issues with combining systems
- *"There is a missing linkage between design/development & end user experience. Very difficult to 'quantify' what effect various design methods/systems have on user experience" – ARCH, Q21*
- *"Sometimes people will put up with noise in their lives and not realise it should be better than what they have. Also good acoustics allow people to be noisy and not in fear of disrupting others." – ARCH, Q21*
- Some noting they don't have too much experience with MDH yet
- Unless forced by regulation or market demands it won't be considered

Survey reception

Overall there was an encouraging response to the survey.

- **Positive comments:**
  "Applaud the initiative to get the industry engaging" - ACOU
  " A good survey" – ARCH
  "Generally very thorough questions" - ARCH
  "Nice one, topic worth investigating further" - ARCH
  "Please make NZ a better place to live."
  "Great job we need to improve the construction industry" – BUILD
  "Keep up the good work on raising the profile of acoustics in multiple unit developments" – BUILD
  "All the best for survey" – INST
  "I'm glad this is being researched as NZ is way behind other countries in addressing their degrading environment" – INST
  "I feel this survey is very important, and the style or intention is very encouraging.." - OTH
- **Suggestions:**
  Add a question asking how many MDH projects worked on
- **Survey length** -
  2 noted the survey was "too long",
  1 that it took more than 15 mins,
  1 that they preferred surveys to be yes/no
  1 worried the length might put off participation/feedback
- **Negative comments**
  Survey a bit wordy

Note there were also some relevant comments through the survey including:

- following a discussion on his concern for noise control in NZ MDH unless action is taken and so*…."The best of luck with the success of this survey!" – ARCH Q3*
- *"A well worded survey, it has made me think" – CONS, Q17*
- *"great topic, we need to raise up our game by providing more available solutions. Doing better and fast ! we're still way behind the rest of the world on this ." - ARCH, Q17*
- Q18b –when asked what we do well in NZ this survey was mentioned:

  "This survey, for example, is an excellent start and more research and education is needed." – CONS
  "This survey is a good start :-)" - CONS
  "At least it is being considered - e.g. this survey" - OTH
- Q18e –steps to address issues included

  "this survey is a great start"
  "Didn't know till this survey there was an issue"
- Negative comments

  "This sounds like a GIB survey to me… Am I correct. This is Gib instigated?
  Q5 poorly designed.

G3 INTERVIEWS

Undertaking interviews with key players in industry was planned as part of this industry consultation phase. In practise it proved harder than expected to arrange many formal interviews within the constraints of the project but some formal interviews have been conducted to date and are detailed below.

However, a number of less formal discussions have been held along the way which have not all been documented or documentation is pending.

The survey enabled a broad reach and easier / more consistent collation of opinions. In addition, getting people to write their thoughts in their own words in the survey was also beneficial, and with anonymity people could respond unconstrained by the ties of their employer.

Many participants indicated a willingness to discuss survey responses further and be interviewed so follow up phone conversations are ongoing.

G3.1 Key interviews

To date, formal interview/discussion sessions have been held with some staff at **Winstone Wallboards** and **USG- Boral**, for a manufacturer's perspective.

A session was held with Rau Hoskins of **designTribe architects,** which specialises in a community design approach. Since MDH is about communities living closely together his perspectives along with his knowledge of Maori / Pacifica cultural considerations was seen as valuable as not covered in the survey.

For a developer's perspective we have spoken with Cameron Baker at **JALCON.**

Formal interview notes are recorded in Appendix I

We are currently negotiating sessions with representatives at Housing New Zealand, TRC (Tamaki Regeneration Company) and Fletchers for further thoughts from larger groups involved in many larger MDH projects

Discussions of survey data and steps forward are also planned shortly with the industry groups we are in contact with (eg CCANZ, WPMA, HERA)

G3.2 Interviews volunteered via the survey

Over 25 participants indicated a willingness to be interviewed further. As we move into stage 3, it may be possible to use these further contacts to test out ideas for possible ways forward.

G3.3 Additional discussions

During the course of the project, we have spoken to many others even if the conversations have not been recorded directly. A presentation about this research project is to be held at the Marshall Day Acoustics biannual conference at the end of March, and this may well generate additional contacts, ideas and case studies going forward.

G4 CASE STUDIES AND PRACTICAL EXAMPLES

This section gives some practical examples we have received relating to incorporating noise control in projects, some as comments in the survey, some as mini case studies and as points raised during discussions.

Most are not yet in a formalised form and this section just gives an overview of the type of information collected to date.

G4.1 Practical experiences given in the survey

Arranged by topic, primarily from answers in question 20, but also a few from throughout survey (see Question number at the end of the quote) –

(these are quoted directly, including typos!)

G4.1.1 DESIGN GENERALLY

Early consideration and use of expertise in the design process:

"The substantial benefits of integrating acoustic design solutions into project designs from the outset rather than being an "add on" at later stages" - ARCH, Q20

"Early understanding in the design phase is vital as the cost can be very low if the Acoustic design is part of the intergral design of the whole project. " - PROD, Q20

"Early involvement of an acoustic specialist, as with any other specialist, should always help to identify suitable and effective designs and avoid last minute over budget add-ons." - ACOU, Q20

"As a consultant, we try to identify any issues early in the design process. Things that are often over looked include; - flanking through thin floor slabs - poor detailing of isolation layers under hard flooring - sealing of IT walls to the underside of profiled slabs" - ACOU, Q20

"We have been involved in a few projects with HNZ, The IHC and The Housing Foundation. These organisations are generally aware of the need to provide good outcomes. We always seek professional advice as the end product is often tested to ensure standards are meet." - ARCH, Q20

"Working with an acoustic consultant makes for an effective outcome." - ARCH, Q20

Late consideration

"Little thought has gone into the design stage and it is usually too late in the build to construct effective acoustic barriers." - OFFI, Q20

"Negative experience - Acoustic requirements were hidden deep in the spec and referred to a standard that was out of date &ambigious. Clearly included as a "tick the box" part of a spec with no real understanding of what it meant or it's implications. Most subbies tagged it out but those that didn't (of whom we were one)

did significant extra research & design work to comply, followed by a whole lot more to justify our higher price and then a redesign to bring the tender within budget but still provide an acceptable solution. " - OTH, Q20

Increasing knowledge to increase results

"In the architectural office, we have a more direct interface with the Acoustic Engineers, you build a body of knowledge working with them. If these tips and understandings could be instilled across the site, then performance across the board will rise for min. code buildings. Being more critical for higher than code projects." - ARCH, Q20

Acoustic design delays

"On a previous project the late delivery of the acoustic report and design resulted in a redesign of inter-tenancy wall details and added a high cost - but essential" - BUILD, Q20

Incorporating good site planning

"positioning of opening windows positioning of toilets with regards to bedrooms and living areas. Wardrobes as sound buffers. Doors to isolate areas. Battening of ground floor ceilings. sound insulation batts and resilient rails." - ARCH, Q20

Good outcomes

"Acoustic requirements have seen the end users of our unit developments are not aware of their neighbor's." - CONS, Q20

Given lower priority

"Insulation always seems to take preference over acoustics and is generally linked with insulation. Not a lot of attention to acoustics specifically." - CONS, Q20

" I rate ventilation and heating giving good clean air way above acoustics as this is the most prevalent problem in NZ construction."- DEV1, Q20

G4.1.2 COST CONSTRAINTS

"Good Acoustic Design Costs - Some projects are willing to pay for this, some aren't" - ARCH, Q20

"I'm keen to designer to higher levels, buit client budget concerns reduce to minimum requirements most times" - ARCH, Q20

"In some cases very cost prohibitive" - ARCH, Q20

"The quality of the development will determine extent of acoustic design, from just compliant to top end." - ARCH, Q20

"We can offer all the good systems to clients at design time, but often clients don't want to pay what it costs. It annoys me that they don't want to pay, but complain if there are problems with acoustics when the building is finished, when they haven't accepted what we have recommended." - ARCH, Q20

" Main consideration / restrictions were always additional costs relating to acoustic solutions particularly for tendered & spec building projects where overall price was dictated by current market conditions These were usually only built to current Building consent conditions as required by client. " - DEV1, Q20

"We missed out on a project recently, our products met all the acoustic requirements but we were 40% more expensive. The builder ended up going with a product that was cheaper and had minimal acoustic properties - very frustrating " - PROD, Q20

G4.1.3 REGULATORY REQUIREMENTS

Building code notes

"Horizontal design/assessment of impact noise. Determination 2015/004 rules this out, if a revised code includes this again it could increase building costs." - ACOU, Q20

Need for inspection

“Inspections by acoustics engineers to ensure the correct construction is happening" - ARCH, Q20

Testing

"Testing after a building is finished. It complied - but what if it was one STC dB too low? Too late and expensive to fix for something that is negligible. The construction may have been correct but unexpected flanking noise could have created a problem. Who carries the risk and cost? " - ARCH, Q20

"Don't assume people want quieter housing across the board. I fear as consultants we are sometimes trying to identify a problem for building developers that then needs us to solve it. The result seems to be expensive provisions (sometimes written as mandatory requirements) that are not good value for money. An evidence based mentality when considering new/updated legislation would help. A classic example is requiring higher insulation ratings for design but not needing them to be tested. Eg. rather than a poorly built project getting FSTC 45 when it was built to STC 60+(but was never tested), a minimum site requirement of FSTC 50 produces a better real world outcome for less cost." - ACOU, Q12

General

"When meeting the Building Code minimum the feedback is often negative: 1) as the existing provisions of G6 are generally inadequate to provide sufficient privacy to afford a good level of amenity. 2) where the acoustic strategy requires windows to be kept closed to protect against the ingress of environmental noise the mechanical ventilation provisions of G4 are insufficient to provide for 'thermal comfort'. As such, occupants often have no option other than to open their windows for cooling which means that occupants are left with the choice of either it being too hot but quiet or too noisy but cool. Feedback from dwellings built to a higher specification is much more positive. " - ACOU, Q5

"more regulation means more costs, which impacts on housing affordability. " - CONS, Q20

"Resource consent conditions imposed because of irrelevant reverse sensitivity issues raised by adjoining landowner forced my client to upgrade acoustic design of major requirement village development. They were probably going to do something high quality anyway, but the consent process forced their hand to a particular standard." - CONS, Q20

"Obtaining sign off of a system once constructed can sometimes be problematic" - ARCH, Q20

"I've recently move to NZ from Canada/USA where MDH is more prevalent. The code minimums there minimise the majority of complaints but every building has 5-10% of occupants that have noise issues. Often the acoustic design meets the building code but other factors (interior finishes, reflective surfaces, placement of stereos, flanking noise), aren't considered in the construction. The net result is the separations overall meet the code performance requirements but the local irregularities result in poor sound isolation." - ENG, Q5

G4.1.4 IT WALL / FLOOR, JUNCTIONS AND FLANKING

Junctions

"lightweight floor junctions - hard to ensure that the building will meet structure codes as well as acoustic codes" - ACOU, Q20

"Have to be careful with design and limit the amount of creativity at noise transfer junctions " - ARCH, Q20

Flanking

"Flanking considerations are key - it all comes down to the flanking paths on site" - ACOU, Q20

"back packers The flanking paths around doors ,steel purlins , HVAC and duct work. it was overly time consuming and ultimately the best practise fell short of required STC rating. The costs racked up on site were horrendous." - DEV1, Q20

Impact / plumbing /flanking example

"I have addressed many buildings for sound protection issues as a designer, consultant and a regulatory officer for multiple councils. a good project I am aware of that highlighted the lack of understanding about the issues of sound was a case that had a sound of a toilet being used and flushed at the other end of a completed new home in the living room which naturally gave an embarrassing sound that appeared to be comsing from the exterior wall of the living room space and no apparent logical reason. But it was discovered that the toilet room at the other end of the home had a typical S trap pan that had the sewer pipe from the pan exit the building via the concrete foundation under the slab, those pipes were not installed with any form of typical lagging around them and was hard against the reinforcing bars in the foundation. That impact sound traveled via the solid contact with the reinforcing bars around the house till it met a direct contact bottom plate hold down bar. That sound then traveled up the hold down bar and changed from the impact sound created in the toilet pan to a transmission class sound within the wall space of the external wall for that living room. This was an excellent example of how impact sound can travel and become an embarrassing nuisance sound in a main living space of a single free standing home. this same thing can and has occurred in multi dwellings due to poor construction and a lack of understanding of all parties involved and not appreciating how impact sound can travel around and through surfaces. " - CONS, Q20

IT Floor / Wall

"acoustic design assumed carpets and ceiling tiles which we later removed for hardwood and concrete ceilings." - ENG, Q20

"noticeable noise reduction when light weight concrete panels are used for flooring " - OFFI, Q20

" IT wall met code performance but the sound transfer was excessive. TV's mounted on IT walls." - ENG, Q20

"We design usually to STC 60, which is 5 points above the current minimum design rating of STC 55. We often test on site as the building nears completion, and have not had a result that fails (i.e. less that ASTC 50), and most test results are ASTC 55 or more. Perhaps as a result of this we don't get much feedback from occupants." - ACOU, Q5

G4.1.5 EXTERNAL NOISE - FAÇADE / ROOF / WINDOWS

Outdoor spaces

"The trend toward hard surfaces means that outdoor reverberation and noise transmission is a large scale problem on medium density housing. In one instance a softly spoken conversation on a ground floor courtyard could be heard from a 3rd floor balcony some considerable distance away. The prevalence of cheap heatpumps is leading to a lot of fan noise between townhouses from outdoor sources. We are increasingly involved in fencing solutions which are often outside of the focus of BRANZ design guides. " - PROD, Q20

Good experiences for exterior envelope

"Double glazing perfect solution my home has double glazing and I live about 50 m away from a railway track and the main road" - ARCH, Q20

"Triple glazing. Thick AAC cladding. Great noise reduction."- BUILD, Q20

"super insulated walls and triple glazing have a significant effect on external noise." - ENG, Q20

""Again the use of H3.2 treated ply to dampen sound noises under a steel coated roof." - PROD, Q20

"Window joinery is rarely to be designed to be airtight (avoiding flanking pathways). This is 'low hanging fruit' to reduce airborne noise both into and out of MD dwellings. " - PROD, Q12

G4.1.6 OTHER GENERAL BUILDING COMPONENTS

Structure

"Changes in design trends have led to pressure to use lightweight solutions in some cases which dont always perform" - ARCH, Q20

"Majority of my mdh design products were timber framed building apartments, schools, which require intensive carpenter labour for installation, need perhaps a single solution material that also looks after fire rating. " - ARCH, Q20

Benefits of incorporating noise control in internal walls

"For example I built a house and they had master bedroom on first floor adjacent to 2 story great room. We put insulation for sound proofing to master bedroom and bedroom upstairs...great improvement. Also added sound proofing where bathrooms adjacent to bedrooms. " - BUILD, Q20

"I have to advise clients about noise control in internal walls as people don't realize that you need more insulation between toilet/bathrooms and living areas. also between bedrooms and living areas when people have parties and kids sleeping in the next room. there is no noise insulation whatsoever if you have 2 gib skins on a partition wall. people are happy to pay a bit more if they get the right advise " - OTH, Q20

"walls between a garage and a bedroom used the full gib acoustic system reduced noise by 90%" - OTH, Q20

Doors

"Did a whole lot of work on a floor/ceiling, but the noise just came in through the door." - CONS, Q20

Stairs

"footfall noise on stairs." - BUILD, Q20

Other

"Housing framing is now being built on packer systems to help lift frames off concrete slabs to reduce bottom plate getting wet. Problem is most of the industry is not filling the gap left under frames between frame and concrete floor slab or timber floor. Better stricter inspections from Council required to make sure void is actually filled and also better products around sound control required for both under frame and also around windows." - BUILD, Q12

G4.1.7 VENTILATION

"Confusion around applying and achieving ventilation provisions in apartments caused significant delays to the project at completion. The design/build mechanical contractor and mechanical consultant had not seriously considered acoustic implications of their design - simply that it needed to move a certain amount of air and that some attenuators might be needed. Because no thought had been given to how balancing and commissioning would be done without dampers at the grilles, we (as the acoustic consultant) had to direct changes and the commissioning process. Because the test requirement was mandatory (but this is not always the case for external façade rules), the knowledge gap became a major issue for closing out the project until system changes could be made to allow quiet balancing." - ACOU, Q20

"ventilation system, could transmits sounds from a room to the other. " - ARCH, Q20

"As an HVAc designer and constructor, we are always concerned with the siting of external air conditioning condensers. With multi-unit dwellings this can be one or two condensers for each unit, on a roof, hung on an external wall, or in a carpark. In the case of some MDH where the roof may be a "shared" garden space, this amenity can be compromised by the batch of condensers sitting on the roof - noise, as well as visual." - INST, Q20

Overseas experience

"Issues with communal ventilation ducting-in Scotland requirement for shunt ducts. Upgrading existing structures difficult in trying to deal with existing construction defects" - ARCH, Q20

G4.1.8 PRODUCTS

"In NZ we don't see the value in building better homes, more insulation, better acoustics. Which is a bit sad its all bit to the bare min and with low quality products. the rest of the world has far better products but due to certain companies and also the government they are unavaliable in this country " - ARCH, Q20

"Approved acoustic brackets and materials sell at inflated prices considering their production cost." - ARCH, Q20

Product not meeting specs?

" We know of one instance where an "industry" system was used which nominated an STC rating but when checked failed to come up to standard and required some reasonably expensive upgrades to achieve compliance. The system nominated a rating of in excess of 50 STC but on actual testing within the completed building an average STC 37 was all that was achieved. There were a few construction issues BUT it left us doubtful about trusting generic advice." - ARCH, Q20

G4.1.9 MEETING MULTIPLE REQUIREMENTS

The difficulty arising as different requirements conflict

"Some three storey timber projects using plasterboard systems end up with complicated junction details to satisfy all of manufacturers specifications and certified details; waterproofness; fireproof ness; durability; vibration and defelction comfort levels AND acoustic criteria, to the point that it became unworkable and expensive." - ARCH, Q20

"The difficulty of meeting requirement to separate for sound, attach for structure integrity and services passing through and get the building within height restrictions. They all conflict with each other" - ARCH, Q20

.."should never be a sole driver but need to be considered at the level of structure and waterproof envelopes for their impact on affordability, practicality and spatial experience. Also it always seems wasteful when the 'best' solution turns out to be double stud inter tenancy walls." - ARCH, Q20

"Accoustic plus fire rating elements together still has some issues that did cause some extra thinking" - BUILD, Q20

G4.1.10 BUILDER EDUCATION

There were quite a few examples of construction issues and the need for broader understanding by builders eg how to deal with penetrations, care with details:

"Builder do not understand principals and limitations. Often fit power or pipework back to back in intertenancy walls withoit staggering. They think lots of batts will solve all problems. They think fire sealants are also acoustic solution" - ARCH, Q20

"Complex junctions and the builder not understanding the principles of what is being constructed and why. " - ARCH, Q20

"Going to site and seeing the contractors have nailed blocks fixing acoustically separated walls together, happens on all projects." - ARCH, Q20

"noise control in numerous multi-unit dwellings, educate the contractor first, then advise the client as to why it was installed. Clients tend to believe the builder.....an interesting observation." - ARCH, Q20

"Have often seen work onsite compromising acoustic performance through lack of knowledge and poor trade practices by the construction works and sub trades." - EDUC, Q20

"Poor understanding of the need to precisely follow the design in order to achieve the required performance." - ENG, Q20

"Walked through a MDH show home recently. The inter tenancy walls were gib lined on independent timber frames. Noise control batts etc were used. However all along these walls were standard electrical outlest. There appear to be no evidence of special detaling around these. Suspect that the walls will not achieve the desired level of noise attenuation." - ENG, Q20

"Numerous installations observed - poor installation of products due to limited staff training , limited product knowledge , limited knowledge of basic acoustic principles ." - OFFI, Q20

"Limited industry awareness about managing penetrations through passive-fire and acoustic-rated partitions. This is demonstrated by the massive issue around passive fire re-work." - EDUC, Q12

Site management and attitude

"when installing systems the integrity of the system was often damaged by poor construction site management and planning. The systems are not carefully enough installed, leading to poor performance down the track (but when developers are selling units and moving on it is often not a high consideration)" - ARCH, Q20

"My spec writing, detailed design and site supervision experience was all gained on low-cost affordable housing for the larger social landlord & social housing developer in the U.K. Builder attitude changes everything. A good build partner understands quality, at whatever price point, and delivers. Analysing, modelling, prediction is all let down by a bad site operation, and is generally a costly, fragile approach compared to managing build quality effectively. " - CONS, Q20

G4.1.11 RENOVATIONS

Not strictly our topic but several referred to renovations

"Obvious areas of internal acoustic management issues in renovated buildings we design are limited by the corporation who engage us. They have standard briefs which dictate specification and levels to be achieved. To be fair to them they have targets to meet which include significant numbers of dwellings and budget constraints. We are dealing with older buildings and construction types. " - ARCH, Q20

" change of use of building to residential , design requirements very difficult to obtain , and sometimes section 112 and 115 of building act 2004 make a joke out of the code altogether." - OFFI, Q20

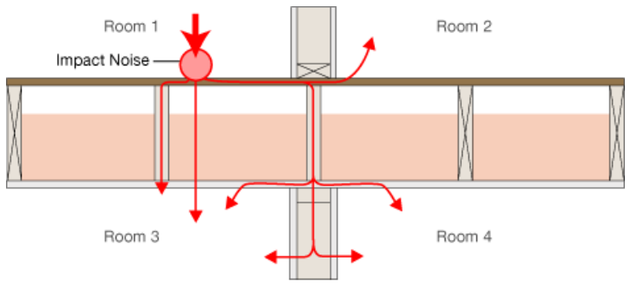
G4.2 Floating Floor case study

G4.2.1 INTRODUCTION

Floor impact noise, with associated transmission of noise via flanking paths, has been noted as an area of concern. In Europe floating floor systems are common, but adoption here is less wide spread. In many situations, impact noise reduction has been aided by using carpet and under-lays, but the trend toward hard floors means other techniques are required. Relying on carpet has also been noted as a poor idea for future proofing, when these soft finishes can easily be removed and replaced with a hard floor covering (e.g. wood, tiles).

Vibrations from impacts (e.g. foot steps, furniture scraping, dropped items) are transmitted via many possible flanking paths (e.g. as below which shows some of the possible paths)

[http://www.soundproofing.com/floor_soundproofing_2.html



A floating floor sits on top of the floor structure and aims to isolate the surface where the impact occurs from the building structure, thereby dampening the vibrations that reach and are transmitted by the structure

This case study considers the use of a floating floor system at a light timber frame apartment complex in Hobsonville. Information has come both from the floating floor supplier, as well as from the developer's perspective.

Supplier notes

Peter Huston of Batten and Cradle undertook our "Towards Quiet Housing" survey and noted they have already put together a case study which could be beneficial for reference for our study, as well as suggesting contacting Jalcon for their thoughts.

Commercial Case study

The following section is the commercial case study / marketing material which outlines the project and key features of the system used, so these are not reiterated here. The system was tested at the Acoustic Testing Service in Auckland with test results available and Marshall Day Acoustics was employed to test the actual on site performance with results also available – these results have been checked to confirm they match the marketing.

Jalcon perspective

To gain a more in-depth understanding of the realities of the project we spoke with Cameron Baker, Design manager at Jalcon (we also spoke with him more broadly on general acoustic design for MDH from a developers perspective– see interview 4).

He confirmed the system worked as noted in the commercial case study notes and they were happy with the outcomes. Some practical points were noted to provide a fuller picture:

- This was the first time using the system so there was a bit of a learning curve
- The first unit took considerably longer than later units, as trades learnt how to implement the system
- There was quite a lot of people involved at one time to build the system and care needed to build the system as specified, but the process became more streamlined for later units.

There was some room for improvement from a buildability perspective, but the impact & flanking noise reduction with the floating floor was very effective.

G4.2.2 CASE STUDY DETAILS

The purpose of including this is not to promote these particular suppliers / products / developers but as an example of a collaboration for a new usage in NZ.

The quoted details below were provided by Batten & Cradle

James Hardie A smarter way to build
Batten&Cradle Flooring Systems

James Hardie Secura Interior Flooring and Batten and Cradle Flooring Systems provide a high-performance solution for medium density housing development in Hobsonville Point

Featured products

Secura™ InteriorFlooring

Batten and Cradle Flooring System ™

Projectdetails

Location: Hobsonville Point, West Auckland

Project Size: 5,584sqm

Project Type: Medium Density Housing

Design Architects: Stevens Lawson Architects

Consent and construction documents by Jalcon Homes

Project Management: Jalcon Homes

October 2016:

A unique solution to Auckland's housing woes

Extending out into the stunning Waitemata Harbour, Hobsonville Point is the location of New Zealand's largest residential building project and Auckland's most livable community. The project is being facilitated by the Hobsonville Land Company, a subsidiary of Housing New Zealand, in answer to Auckland's housing crisis.

Skyrocketing house prices and an increasing population means more people are turning to medium-density housing in Auckland. Hobsonville Point is one of many new subdivisions increasing the supply of this affordable living solution.

The development site is approximately 167 hectares in area and will comprise more than 3,000 homes of different types, divided into precincts. The Sierra Terraces precinct, designed by award-winning architects Stevens Lawson and built by Jalcon Homes, is situated in the heart of this new community and includes a range of affordable housing options that make creative use of smaller land sizes.

Sierra Terraces has been designed to maximise light and space, to create high quality, affordable living environments with materials that are built to last. In this medium density development, the intertenancy walls and floors of the homes needed to meet stringent New Zealand Building Code (NZBC) acoustic performance and fire rating requirements.

The choice of materials for this project, including innovative flooring, reflects the vision for Hobsonville Point to build a strong, thriving community by creating homes that are well designed, well built, and energy efficient, while meeting the fire and acoustic requirements of NZBC.

James Hardie Secura Interior Flooring was specified because it ticked all these boxes. The Fire and Acoustic Floor System utilises a timber joist construction method with Secura flooring fixed to timber battens over rubber cradle system. This forms a structural floor system that provides excellent acoustic and fire resistance performance, required for intertenancy floors to comply with NZBC.

The flooring system underwent field testing by Marshall Day Acoustics in August 2016; achieving scores of 60 FSTC and 55 FIIC, both scores are well above the minimum requirements of NZBC.

Cameron Baker, Design Manager for Jalcon Homes, says that this flooring system allowed them to achieve the highest fire safety and acoustic rating possible, while avoiding using concrete in the structure. "With constraints such as extremely tight sites and narrow roads, we could lift most of the product up by hand if we needed to do so. It was a solution we could work with on site."

During construction James Hardie representatives were on hand to provide support. "They helped us a lot, especially in the early stages providing us with testing and details, and helping us to find the right flooring solution," says Baker, "They have been excellent."

James Hardie's Technical Support Manager, Singh Kamboj, says Secura flooring performs well in medium density typologies because it is specifically engineered to minimize impact and airborne sound, to achieve noise reduction and fire safety. "Homeowners require modern technology and innovation in new builds; they want a house without compromise and don't want to hear their neighbours above them or be concerned by fire safety. Secura flooring fit the brief perfectly on the Sierra Terraces project."

Secura flooring is an all in one product - it can be tiled directly without the need for underlay, saving time and money on the build, which also contributes to the affordability of these homes.

Its rigidity gives a squeak-free, solid feel under carpet, tiles or vinyl, and the system helps absorb sound. The rubber cradles absorb impact noise, and the Secura flooring formulation absorbs airborne noise; providing optimum acoustic performance.

The acoustic properties coupled with the fire resistance rating mean James Hardie's Secura-batten and cradle system are ideal for medium density builds. Although Sierra Terrace is the first residential development to use this system, it's also being used on other Jalcon Homes' developments in the area, including a 16-unit development on another Hobsonville site.

Project Manager for Jalcon Homes says, "There are no other products like this, as far as timber-framed construction goes. This development is unique; intertenancy mid-floors haven't been done in Hobsonville before. It's all geared towards the acoustic performance of the building, which should be much higher than simply meeting the NZBC requirements."

Through the use of innovative, high quality materials Jalcon Homes has created a unique urban development within Hobsonville Point that is accessible to a diverse range of New Zealanders who are seeking a close-knit, coastal community to live, work, and play.

G4.3 Inter-tenancy wall / floor junction example

A designer gave an example illustrating the type of issue designers encounter when integrating different solutions. For a low-rise apartment building it is necessary to connect the IT flooring system with the IT Wall system while still meet structural, fire, and acoustic requirements. Even if individual elements meet code requirements, details at junctions need careful consideration.

For a light timber frame construction project, they had hoped to use a light timber frame based Inter-tenancy (IT) barrier type wall system. This is an IT wall where there is a fire / acoustic barrier sheet between double timber stud walls, so that even with penetrations in the interior wall linings (not fire rated), for electrical socks, pipework etc., there is still an appropriate level of protection for acoustics and fire protection even if the penetrations in the interior linings are not sealed perfectly. This was hoped to aid buildability and reduce risk of reduced performance from construction errors.

However, they came across the following issue when detailing the junction with a fire rated floor system (which included fire rated floor and ceiling surfaces):

- IT barrier wall type systems are usually designed for terraces, rather than multi-unit dwellings where there are multiple fire cell requirements on the same side of the wall.
- The gap between the fire & acoustic rated floor /ceiling system and the central IT wall barrier lining meant there was a gap in the fire cell when combining these two systems

Even if some additional insulation could work from an acoustic perspective, from a fire perspective the protection of the unit upstairs from downstairs damage (and vice versa) becomes a critical concern via fire travel through this gap if the internal linings aren't fire rated.

Therefore an alternative IT wall system with fire rated linings on both surfaces was required. Therefore some of the buildability advantages hoped for from a IT barrier wall type system no longer applied. Careful sealing of penetrations for fire and acoustic compliance along the IT wall remain critical.

G4.4 Engineered wood examples

Various groups have raised engineered wood as an innovative new material for construction.

However acoustically, there are some issues to be addressed to meet NZ BC requirements, especially in terms of flanking transmission, with solutions not yet readily available. This is considered in the first example.

A large scale project that is using CLT for Otago Polytech is discussed second.

G4.4.1 RESOURCES TO SUPPORT THE USE OF ENGINEERED TIMBERS

Confidentially we have heard of several projects where CLT had been considered for apartment construction, but the projects have fallen through or gone considerably over budget because of the lack of available resources to support the use of CLT, even if the raw timber product itself is available. For example, lack of knowledge and lack of choice of products such as isolation pads and fixing – demand having not yet increased availability and generated competitive pricing.

Daiman Otto, Director of Tall Wood Limited also sent us the following

"Design and building multi-residential project using engineered timber can be problematic when considering acoustics. Most of the problems stem from general unfamiliarity of the product and techniques used, rather than inherent issues with the material. As one involved with the full cycle of design, supply and installation of these buildings, we see acoustic issues from all angles.

A key factor to consider in timber buildings is in sound transmission through floors – both impact and flanking noise. Whilst concrete and steel construction is well known - and there are a range of proprietary and tested systems available - the relative 'newness' of engineered timber products like CLT means that there are a limited number of solutions available, and even less understanding. This means that there is often uncertainty around designing and installing solutions that will deliver the onsite testing to the levels required.

This is changing, but what would help with expediting this is learning from offshore examples. There are many examples of engineered timber multi-residential buildings through Europe, and this is ever increasing. New Zealand authorities are often reluctant to accept (or can't legally accept) the learnings of other jurisdictions – even when they have to meet equal or higher testing thresholds. This roadblock increases uncertainty and cost, and often forces clients to stick to the tried and true (to the detriment of diversity, speed and quality of building methodologies).

The pathway to bring in a system into New Zealand is not straightforward. We are aware of tested systems that would work here (because they work 'there'), but the pathway for acceptance is myriad and unreliable. We believe the key to building affordably is a shot of radical certainty in the way we build. We should be absorbing and reformatting offshore examples as quickly and efficiently as we can in order to build the housing that we need."

G4.4.2 OTAGO POLYTECHNIC CLT STUDENT VILLAGE

This project came to our attention as an example of how early integration of acoustic considerations into the design process could generate a better outcome than later adoption.

Although not strictly residential, one wing of this building will contain dormitories, while the other will contain 1 bedroom and 4 bedroom apartments. They have chosen to use CLT for the structure and this presents a good building for further investigation of CLT performance and design principles. Otago university is keen to share knowledge on innovations and lessons learned.

We are currently waiting on a summary case study, looking at the integration of acoustic design considerations in the planning process.

G4.5 Acoustician examples relating to G6 compliance

Peter Horne of DAAL (Design Acoustics Auckland) raised a couple of discussion papers he has been working on in relation to G6.

G4.5.1 TWO RECENT SOUND INSULATION TEST RESULTS

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(for presentation at ACOUSTICS 2016 conference, Nov 2016, Brisbane)

ABSTRACT

A minimum level of inter-tenancy sound insulation is specified in *Clause G6* of the current *New Zealand Building Code*. The clause was first introduced in July 1992, and despite a number of proposed revisions, has not been significantly revised since its introduction. A paper published in 2011 noted that *Clause G6* had the lowest "estimated equivalent R'w" rating amongst the 26 (predominantly European) countries considered. This brief paper discusses two recent sound insulation test results in light of a recent determination regarding the applicability of *Clause G6*, and in light of a proposed revision to *Clause G6*.

TEST RESULTS

In 2014 DAAL carried out airborne and impact sound insulation tests between two recently completed adjoining terrace houses. The internal layouts were the same for both residences:

- Ground floor; entry, open plan kitchen/dining/living area, bedroom, bathroom.
- First floor; two bedrooms, one bathroom.

The separating inter-tenancy wall was full height double timber frame construction, with a published rating of *STC 63*. The mid-floors were timber frame construction. The ground floor was slab on grade

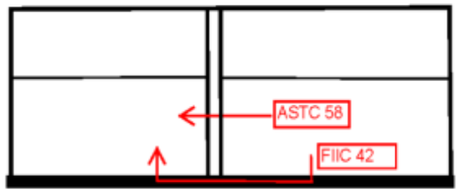
construction and ground floor was finished in polished concrete. There was a 300mm deep ground floor slab thickening centred under the inter-tenancy wall.

Two tests were carried out between the adjacent ground floor kitchen/dining/living areas. The test arrangement is shown below.

The calculated test results, and the test arrangement, are shown below.

Table 24: Test results

Test type	Result
Airborne	*ASTC 58*
Impact	*FIIC 42*



The following ISO metrics were calculated from the test measurements: $R'_w57,L_{n,w}$ 67.

Clause G6 has minimum on-site allowable results of *ASTC 50* and *FIIC 50*. The test result of *ASTC 58* is comfortably above the minimum requirement and shows there were no significant airborne flanking paths between the rooms. However, the impact test result of *FIIC 42* is significantly less than the minimum requirement – if the test is required as part of compliance testing.

DETERMINATION 2015/007

The impact test described above is an example of "horizontal impact noise", i.e. the source room and the receive room are on the same floor level and are not vertically separated.

The applicability of horizontal impact testing has been the subject of some debate over recent years, and *Determination 2015/007* was intended to provide direction in this regard. *Determination 2015/007* was principally concerned with applicability of the general building code sound insulation requirements to apartment-style accommodation within a retirement home complex. Within this determination, the consideration of horizontal impact noise was an "extra" and was not limited to a retirement home context. In reaching a conclusion, the author of *Determination 2015/007* took the wording of *Clause G6* into account, but also considered invited submissions.

The text of *Clause G6* is silent on the "directionality" of testing, however the clause applies to "building elements which are common between occupancies", and the testing standard cited for calculation of *IIC* applies to "floor-ceiling assemblies". The author of *Determination 2015/007* also acknowledged a submission that pointed out "there is currently no known acoustic laboratories world-wide where any horizontal impact testing has been carried out on concrete structures".

Determination 2015/007 found that compliance with the impact noise requirements of *Clause G6* is required vertically, but is not required horizontally. Therefore, the impact test described above need not be carried out, nor reported on, as part of compliance testing. Provided other test results were satisfactory, the building would meet the requirements of *Clause G6*.

PROPOSED CODE REVISION

Despite there having been no substantial changes to *Clause G6* since its introduction, there have been a number of proposed revisions over the years.

In 2014 a revision to *Clause G6* was developed and submitted that proposed: ISO airborne and impact sound insulation requirements; consideration of noise from building services; and consideration of environmental sound.

At the time of writing (July 2016), this revision is still "live" but has not been made public. By the time of the ACOUSTICS 2016 conference in November, it may or may not have been formerly accepted for review and progressed to the public consultation phase. As at July 2016 this proposed code revision does specify that impact noise in a horizontal direction be assessed as part of code requirements.

CONCLUSION

The test results given above, *Determination 2015/007*, and the proposed revision to *Clause G6,* raise a number of questions;

If the technical issues regarding the assessment of horizontal impact noise were considered in New Zealand as recently as 2015, and if the assessment of such noise is not the standard or accepted practice overseas, is there a sound basis for including the assessment of horizontal impact noise in future *Clause G6* code revisions? Should the New Zealand Building Code "lead the world" in this regard?

Putting aside technical arguments and justifications, is the on-site test result of *FIIC 42* described above, measured between what are two high-traffic ground floor areas of abutting dwellings, adequate and acceptable to residents in practice?

Consideration of these questions could help inform and shape the development of the next *Clause G6*.

REFERENCES

Compliance Document for New Zealand Building Code, Clause G6, Airborne and Impact Sound, Department of Building and Housing, 2006

Gardiner, J, 2015, *Determination 2015/007*, Ministry of Business, Innovation & Employment.

Mahn, J, Davy, J &Pearse J, 2011, *The Acoustic Requirements of Dwellings in New Zealand*, Forum Acusticum.

G4.5.2 CAN A CONNECTING DOOR BETWEEN TWO APARTMENTS BE COMPLIANT WITH CLAUSE G6?

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INTRODUCTION

A question recently arose as to whether a connecting fire door that had been added between a commercial space and a residential apartment was compliant with *ClauseG6* of the current *New Zealand Building Code*. The spaces were designed to be acoustically separate, the door was added by the builder during construction at the request of the new owner, who was to be the owner and occupier of both the apartment and commercial space. Does this arrangement comply with *Clause G6*?

DISCUSSION

Clause G6.2 of the code states *"Building elements which are common between occupancies, shall be constructed to prevent undue noise transmission from other occupancies, …, to the habitable spaces of household units". Clause G6.3.1* provides a minimum performance specification of *STC 55.*

"Occupancies" is not defined in *Clause G6*, or in the *Building Act 2004*. However in *Determination 2015/004*, it was noted that *"occupancy denotes a sense of ownership and not just usage"*. Occupancy does seem to be related to ownership, for example, one may refer to car "occupants" but to bus "passengers".

Not all apartment owners are occupiers, as in the case of absentee or investor landlords. In *Determination 2012/070*, consideration was given to building layout and facilities provided, and common ownership of the occupancies was not found to be a sufficient reason for non-compliance with the requirements of *Clause G6*.

In the case of two abutting occupancies (two spaces separated by a common wall or floor), consider the possible scenarios in Table 1.

Table 25: Possible scenarios for two abutting occupancies.

Ownership	Occupiers	Example	Compliance with G6 required?
Different owners	Different occupiers	Fully occupier-owned apartment block	Yes
Common owner	Different occupiers	*Long term* - investor owned apartment block, apartment above a retail	Yes

	shop	
	Short term - hotel, motel, boarding house	Not currently
	Short term – minor dwelling under a house for rent or "Airbnb"-type use	?
Same owner and occupier in both spaces	Apartment above a commercial space	?

The situation referred to in the *Introduction* would fall into the last case in the table above. The residential/commercial situation is close to that of a home occupation, and an argument could perhaps be made that in this case, the two spaces are not separate occupancies for the purposes of *Clause G6* (although in this case fire separation requirements may still apply).

CONCLUSION

To return to the question posed above, whether a connecting door between apartments can be compliant with *Clause G6*, there are two possible outcomes;

If the two spaces separated by the connecting door are judged to be a single occupancy, the provisions of *Clause G6* don't apply and the question is not relevant.

If the two spaces separated by the connecting door are judged to be separate occupancies, it is unlikely that without specialist design, a "typical" connecting door would meet the performance requirement of *Clause G6.3*.

Therefore the outcome depends on the legal definition and assessment of occupancies, which would be outside the area of expertise of most construction companies and acoustic consultants. Therefore, it would be prudent not to provide direct connection or access in any situations where *Clause G6* may be judged to apply.

This situation also highlights the importance of defining key terms such as "occupancies" in any future code revisions.

DISCLAIMERS

Expert legal advice should be sought to determine the applicability of *Clause G6* in all cases if this is in doubt.

Fire safety and separation issues apply and must be considered, these are outside the scope of this paper.

REFERENCES

Compliance Document for New Zealand Building Code, Clause G6, Airborne and Impact Sound, Department of Building and Housing, 2006

Gardiner, J, 2015, *Determination 2015/007*, Ministry of Business, Innovation & Employment

Gardiner, J, 2012, *Determination 2012/070*, Ministry of Business, Innovation & Employment

Building Act 2004, New Zealand Government, reprinted 1 January 2015

G4.6 Other examples pending

Several other examples are pending, still to be written up or investigated further including

G4.6.1 CHRISTCHURCH REBUILD IMPLICATIONS

Christchurch Acoustician's views on how the Christchurch earthquakes have impacted on acoustic design in the region including things like

- The move to not only build structures to meet structural requirements, but also to build in resilience so buildings are not a write off after earthquakes. Some methods conflict with acoustic requirements.

G4.6.2 CHRISTCHURCH HNZ EXAMPLES

Examples from HNZ developments in Christchurch. Choice of concrete vrs light timber frame for various project, and positive outcomes from earlier integration of acoustic considerations. Use of thicker floor concrete slab for apartment, advantages for acoustics but also had other knock on effects.

G4.6.3 VENTILATION REQUIREMENTS

MDH is often planned in higher noise zones (eg near traffic corridors and local suburban centres to aid urban planning), so external noise levels are generally higher. To maintain reasonable average internal noise levels (as per WHO guidelines, district plan requirements etc) this can usually only be achieved by closing windows/doors for much of the time.

To ensure air quality and temperature this requires good HVAC systems to be in place, either active or passive. This is required not just for acoustic reasons but also may be required for energy efficiency, to avoid moisture build-up (windows closed) and to provide good air quality (eg high traffic areas).

A services engineering company example of the added costs were as follows

Satisfying the Auckland Unitary Plan acoustic requirements is most economically achieved by the provision of a heat pump in the main living space and mechanical ventilation to the bedrooms. The approximate cost for achieving these provisions is as follows:

Studio/Bed Sitting Room Apartment
$5,000 - $6,000

Single Bedroom Apartment/Terraced Housing
$7,500 - $8,500

Two Bedroom Apartment/Terraced Housing
$10,000 – 11,000

Three Bedroom Apartment/Terraced Housing
$11,000 – 12,000

On large projects, this could account for a considerable cost: so the costs associated with implementing the acoustical design of the Auckland Unitary Plan can be significant on both an individual unit and multi-unit basis. The extent of areas that the Unitary Plan now requires to have acoustically treated ventilation also appears to cover a much wider range of areas from local centres upwards. So on an Auckland-wide basis, the impacts could be considerable

G5 CONCLUSIONS

The consultation phase changed slightly from the original plan, with a larger online survey undertaken and less formal interviews and case studies. The industry survey has generated a large amount of valuable data on industry opinions, both quantitative and qualitative. The graphs presented demonstrate needs in some of the core areas and comments show the wide range of issues and concerns across industry. Formal interviews have added to the depth of understanding and practical examples help to demonstrate various points.

This information, along with the literature review for stage 1, provide a good basis for Stage 3 where we will look at developing recommendations for BRANZ in relation to providing technical information related to noise control in MDH to industry.

This section proves a broad summary of findings and areas of consideration as we head to Stage 3 .

G5.1 Industry consultation summary of findings

Overall the discussions and results backed up the areas of consideration highlighted in Stage 1.

The overriding feature from the consultation was that industry wants better understanding and participants felt the topic is underrated given the importance it has for the long-term success and adoption of MDH. Knowledge of acoustics across industry is considered to be low and even where some areas have strengths, gaps in the chain through lack of knowledge lead to poorer outcomes than could be otherwise be achieved (for example even if there is a good design, it can be let down by poor construction and vice versa).

There is seen to be a need for better baseline understanding of acoustic implications from urban planning all the way through design and construction to final installation of services. Without a broader level of understanding people don't know what they need to be aware of, of where they need to get help. A central hub for information was thought to be a good idea, but not as a replacement for expert advice for checking details which was still felt important.

Education and training at all levels was therefore highlighted as a key first step to increase the baseline level of understanding, before tackling specific issues. General information is available but harder to find, with the most readily available information coming from suppliers. Though this material was often well appreciated, people would also like access to more independent material which they know does not include an inherent bias towards specific products or structure types.

A better base understanding would also allow more informed decision making of products and system to use. There was a strong feeling too that we should be learning from overseas efforts rather than reinventing the wheel.

There was a desire for more information on how to practically address specific issues but just as importantly they wanted to know how to combine solutions to achieve MDH that meets all requirements (e.g. acoustic but also structural, fire, ventilation, thermal). Most issues, such as noise transfer generally (airborne, impact and flanking through walls/floors), reduction of external noise transfer etc., can only be addressed in combination with other aspects of design. Expert help was usually seen as valuable but at the same time being able to utilize approved solutions for predictability and risk reduction for compliance was important.

The need for generic solutions for common structures types, elements and details (e.g. junctions) that integrate all MDH design requirements (meeting code for acoustic, fire, structure, thermal etc.) was strongly highlighted – ideally with good / better / best options. BRANZ and MBIE together were seen as the key source to provide this. Overall this was seen to enable more certainty in design, reduced cost through less detailed design requirements and reduced risk.

More generic solutions could also allow more competition in the supplier market, and options for choice of manufacturers. Clarity for acceptance paths for new solutions was also highlighted to allow the import of good existing ideas and systems from elsewhere and to encourage innovation.

Because MDH is reasonably new to NZ, the effect of inexperience was seen to have a significant effect on outcomes - with lack of awareness from consumers, developers as well as those in design, construction and supporting groups. Various aspects of awareness were raised including: considering acoustics from the outset; end user needs; effects if done badly; benefits and limitations of noise control methods. MDH is developer rather than consumer driven so developers driving the process were felt to need good awareness to understand the benefits of addressing this for the long-term benefit of positive acceptance of MDH.

It was noted the code minimum (G6) is most often taken as the goal for most acoustic design (except sometimes for mid to high end developments). Some thought the minimum criteria was satisfactory to meet most occupants needs, and that the market will drive any needed up take above this, while many others thought a change / increase was advisable – either with additional categories covered or an increase in minimum criteria. The exact purpose of the code was also raised – should it be just what is required for health and safety, or to provide a good level of amenity for all? There would be costs associated with increasing the code criteria, so understanding the broader benefits is important for industry buy-in.

There is lack of clarity around the success or otherwise of the current performance criteria since feedback is not always straightforward. Outcomes can depend on so many facts including but not limited to: occupier factors such as age / noise sensitivity / expectations; number of occupants; neighbour's behaviour; quality of design / construction; construction type; background noise levels; … even furnishings.

Compliance with code is also seen to be patchy – QA methods vary considerably in different regions – so even if a dwelling is predicted to comply there is not always testing or checks for actual compliance / suitable performance. Uncertainty of performance and risk of failure were highlighted as reasons for being wary of testing. Some fear there may be a period of MDH built with poor quality noise control, with poor outcomes for occupiers putting people off MDH.

End users are reliant on developer decisions for what they can buy as an end product. As acoustic quality is an 'invisible' feature, subjective in nature and not as easy to market as other features (e.g. tapware, kitchen, even cost savings from thermal insulation), it is often given a lower priority.

There was considerable support for the idea of some form of rating system for consumers to understand the actual acoustic performance of an apartment for making informed decisions on purchasing and incentivise higher standards, though some reservations on implementation. Transparency of the achieved standard is seen as useful – whether just ensuring compliance acoustic test results are available in council information or as an actual rating system on its own. Practical means of demonstrating different levels of performance would also be useful.

Many noted awareness is growing as more people experience MDH living and the implications of noise control measures for peace, privacy and general wellbeing. It was thought that even when people want the advantages of living in close proximity, they don't necessarily want to feel crowded in their own home – sound is what conveys that sense of proximity to others.

An addendum too was that although the focus here is new MDH, the same principles need consideration for standalone and high density, and that as more people experience good noise control, there may become a demand for improvement to existing housing stock – e.g. retro-fixing of older existing MDH for better performance. [Looking at the performance of places identified for attention could be a useful exercise]

G5.2 Towards Stage 3

Going into Stage 3, it is apparent that there are several core areas to address to enable quality / affordable / desirable MDH in relation to noise control:

Education: Industry wants to boost base level knowledge of noise control for MDH (for those involved in all steps in the production of housing). It is also clear that early consideration and better integration can produce more cost-effective results. To support this it is important to have independent information readily available for reference.

Cost Benefit: There is a cost associated with providing better quality, so you need to be able to clearly demonstrate the benefits in order to justify additional costs (both for setting minimum levels and aiming above them). Better information on and raised awareness of the benefit, costs and limitations of incorporating good noise control is needed. This includes better understanding of post occupancy needs and outcomes at different levels from code minimum upwards and is needed for developers, designers, and even for consumer awareness.

Design / Compliance: core to design is understanding what level to achieve. Regulations set base levels and compliance is a core concern but also understanding how to achieve a range of outcomes to meet needs. Information on solutions to meet outcomes is critical – and not having to reinvent the wheel for different scenarios critical to cost effectiveness. Having robust, tested, compliant solutions that meet multiple requirements and can be easily matched to a project's needs is seen as key.