Study Report SR475 [2022]

Investigating the impact of the 2019 BRANZ guide on multi-storey light timber-framed buildings

David Carradine

BRANZ
1222 Moonshine Rd, RD1, Porirua 5381
Private Bag 50 908, Porirua 5240
New Zealand
branz.nz

ISSN: 1179-6197

Preface

This study report describes background, methods, and results from BRANZ Levy-funded project QR14527 *The multistorey LTF guide – is there latent impact to unlock?*, which sought to investigate the impact and usefulness of *Multi-storey light timber-framed buildings in New Zealand – engineering design*, published in September 2019.

Acknowledgements

We would like to thank those who were willing to donate their knowledge and time to discuss the output from a closed research project with us to help better understand the impact of BRANZ research across the New Zealand building sector.

Investigating the impact of the 2019 BRANZ guide on multi-storey light timber-framed buildings

BRANZ Study Report SR475

Author

David Carradine

Reference

Carradine, D. (2022). *Investigating the impact of the 2019 BRANZ guide on multi-storey light timber-framed buildings*. BRANZ Study Report SR475. Judgeford, New Zealand: BRANZ Ltd.

Abstract

The BRANZ document *Multi-storey light timber-framed buildings in New Zealand – engineering design* was published in 2019 for structural engineers and consenting officials to provide guidance on designing light timber-framed (LTF) buildings outside the scope of NZS 3604:2011 *Timber-framed buildings* up to 6 storeys. This report addresses the questions around latent or untapped impact potential of this guide. Information was obtained from the list of people who had downloaded the guide, and contact was made with selected individuals across the building sector to get their input on the document and their use of it.

General impressions of the guide were very positive and it was seen as technically aimed at the right level for structural engineers using it for multi-storey LTF building design. Numerous suggestions for additions, improvements and follow-up activities were made and included for potential future revisions and further assistance with using the guide.

Lessons learned during data gathering and one-on-one discussions were valuable for future research projects and proposals. These findings and lessons are described in detail along with recommendations to share the learnings from this project.

Keywords

Light timber frame, LTF, multi-storey buildings, impact.

Contents

Executive summary

A BRANZ guidance document on the design of multi-storey light timber-framed (LTF) buildings was released into the public domain in September 2019 as a result of the BRANZ Levy-funded project SR0941 *Specific design of light timber-frame buildings*. The document *Multi-storey light timber-framed buildings in New Zealand – engineering design* (Carradine, 2019) was intended for structural engineers and consenting officials to provide guidance on designing LTF buildings outside the scope of NZS 3604:2011 *Timber-framed buildings* up to 6 storeys.

In order to determine whether this BRANZ guide has latent or untapped impact potential, a project was funded to answer these questions. Information was obtained from the list of people who had downloaded the guide, and contact was made with selected individuals across the building sector to get their input on the document and their use of it for design and other purposes. Direct discussions were held with selected individuals using a number of specific questions about their use of the document, how it has changed their work behaviour and if they have any suggestions for improvements.

Data gathered from the list of download emails provided some understanding of the range of individuals across the building sector who had interest in this type of document. There were difficulties in retaining and mining this information, which resulted in only an approximation of what industry areas were represented and how many from different areas. Additionally, a handful of structural engineers familiar with the guide were engaged in detailed conversations to help provide input on the guide, its usefulness and potential inclusions that would increase its impact.

From these discussions, the general impressions of the guide were very positive and it was seen as technically aimed at the right level for structural engineers using it for multi-storey LTF building design. It was seen as a positive step forward in guidance for these types of buildings and has resulted in some changes in design methods employed and designer behaviour. Numerous suggestions for additions, improvements and follow-up activities were made and included for potential future revisions and further assistance with using the guide.

The following lessons learned during the data gathering and discussions were considered significant and recommended for future research projects and proposals:

- Clearly identify digital data acquisition requirements including future needs.
- Stakeholder engagement and co-creation are critical before, during and following development of guidance documents.
- Supporting user behaviour change is possible and must include an understanding of end-user needs and methods of working.
- Follow-on activities can be used to increase uptake of guidance and provide better understanding of impact.

These findings and lessons are described in detail along with recommendations for future research projects and proposals in an effort to share the learnings from this project.

1. Background and introduction

In September 2019, a BRANZ guidance document on the design of multi-storey light timber-framed (LTF) buildings was released into the public domain. The document *Multi-storey light timber-framed buildings in New Zealand – engineering design* (Carradine, 2019) was intended for structural engineers and consenting officials to provide guidance on designing LTF buildings outside the scope of NZS 3604:2011 *Timber-framed buildings* up to 6 storeys. The expectation was that engineers and other practitioners would use the document for designing 3–6-storey buildings to help them navigate the process of using specific engineering design methods that are not detailed anywhere else for New Zealand. The research project that developed this document is now closed.

There were activities and publications aimed at promoting the guide before and after it was introduced including webinars, inclusion within a roadshow and articles in *Build* magazine:

- A series of four webinars was provided by BRANZ in late 2018 and early 2019 introducing the topics in the guide while also delving into some of the more technical aspects that would be covered.
- A travelling roadshow sponsored by the New Zealand Timber Design Society included an overview of the guide and its impending release. Five centres around the country were visited during August 2019.
- In October 2019, a webinar hosted by Engineering New Zealand was presented specifically on the design example from the guide to walk engineers through the design process, albeit in a very abbreviated form due to the short time allowed.
- There have also been a number of presentations before and after the publication of the guide at such events as BOINZ conferences and the BRANZ Medium-Density Housing final workshop in March 2020.
- Three *Build* magazine articles have been published – two prior to the release and one following the release of the guide (Carradine, 2014, 2018, 2020).

As of April 2021, there have been 1,884 downloads of the guide from a wide range of professions. While the number of downloads of the document was considered encouraging, there was no way of knowing how impactful the guide was nor if users of the guide would have preferred something additional or different in order to maximise the usefulness of it and increase its impact. The BRANZ website was migrated to an updated format during 2020, so it has been challenging to extract up-to-date information on the number and emails of those who have downloaded the document.

The aim of this project is to determine if the BRANZ guide has latent or untapped impact potential. To answer this question, information was obtained from the download list and contact was made with selected individuals across the building sector to get their input into the document and their use of the guide. Information was gathered through direct discussions with selected individuals using a number of specific questions about their use of the document, how it has changed their work behaviour and if they have any suggestions for improvements. This report includes descriptions of the methods used to gather information on the guide and the results of the discussions with users of the guide. Recommendations are made around the guide itself as well as this project and future projects at BRANZ.

2. Evaluation methods

As of April 2021, there have been 1,884 downloads of the multi-storey LTF guide through the BRANZ website. It was initially proposed that the list of emails of individuals who had downloaded the guide could be used to contact some of them and get feedback on the guide and its use. This was intended to provide a better understanding of the range of people who had downloaded the guide as well as providing potential interviewees. This methodology proved to be more difficult than anticipated due to the migration of the BRANZ website between the release of the guide and the gathering of data for this project. This meant that a complete dataset could not be gathered on those downloading the guide with the most recent data being from April 2021. However, this still provided enough information to draw some conclusions about the range of individuals downloading the document.

There was also a concern around ethics raised in contacting individuals in a blanket manner – when the document is downloaded, the website states that email addresses are gathered to provide downloaders with information on future errata or revisions as opposed to contacting them to solicit information on the guide in the future. In order to get feedback on its impact, it was therefore decided to make use of other networks and stakeholder knowledge to contact a handful of individuals who were thought to have used the guide. Due to privacy and confidentiality concerns, the names and employers of these individuals are not provided in this report. The questions asked are provided in Appendix A.

3. Results

Following a review of the available downloaders' emails and conducting a series of one-on-one interviews with users of the multi-storey LTF guide, it has been possible to obtain a better understanding of who has downloaded the guide as well as valuable information on how it is being used and where improvements could be made. It is worth noting that, since it was published, there have been around six direct queries made to the author on technical issues as well as errata that need to be addressed. These errors have been minor, and none would result in unconservative designs or present a potential risk to life safety or property damage.

3.1 Range of downloaders

Even though information on who has downloaded the guide was only available up to April 2021, it has still provided a perspective on the range of downloaders. Because of this limited information, specifically, just an email address, it was not possible in many instances to know what part of the building sector individuals were associated with. This was due to email addresses often being personal ones from Google Mail or Yahoo. However, there were enough emails from identifiable sources to get some sense of the range of those who had downloaded the document.

By far the majority of those who downloaded the multi-storey LTF guide were consulting engineers from across the spectrum of multi-national consultancies to small engineering firms with only a handful of employees. The second-greatest proportion came from architects and presumably architectural designers. Building consent officials also formed a sizeable proportion of the downloaders that could be directly identified by email address. Other parts of the sector represented in the download list included academic researchers, building and construction professionals and timber component manufacturers, including those from prefabrication companies. There were also a handful of overseas downloaders, mostly from Australia but also from Italy and the UK. There were also a few downloads from individuals at MBIE, EQC and other agencies within New Zealand.

3.2 Question responses

A list of questions was developed (Appendix A) to structure the conversations with individuals who would likely have some familiarity with the document. In some cases, it was necessary to get a reference for someone who was using the guide within an organisation. Individuals from amongst the groups represented in the download email list were contacted through various networks, and in the end, it was only the structural engineers who were using the guide with enough regularity for further enquiry to be useful. The other groups expressed some familiarity or had heard of the guide, but it was either not relevant enough for their work or was too technical and engineering based to be of use. It was also found that, even amongst structural engineers, there were instances of either not being aware of the guide or of knowing about it but not having any projects that required such solutions.

Six structural engineers and one software developer employed by a structural engineering consultancy to develop structural design spreadsheets were contacted to provide input on the guide. One of the structural engineers was not a building designer but used the guide for reverse engineering and solving structural issues as part of his regular work for a product manufacturer.

The design engineers were mostly senior level and from medium and large consultancies, both national and international. The smallest firm had around 15 employees and the largest was a multi-national firm with hundreds of employees around the world.

For those engineers familiar with the guide and willing to discuss it, the questions provided in Appendix A were used as an outline for the discussion. Because the conversations were done by phone or online meeting, the questions helped to structure the discussion but were not always directly asked, depending on the way things went during the interview. It is also noted that some questions, such as the number of times the guide had been used, didn't necessarily provide useful answers because different engineers use the guide for different things. A couple of items that could be errata within the guide were noted and are being investigated. The answers and feedback on the guide are presented in the following sections.

3.2.1 General impressions and technical suitability

Overall feedback on the guide was very positive and it was seen as technically aimed at the right level for structural engineers using it for multi-storey LTF building design. No one commented on it being too technical or not technical enough. And it was therefore determined to be successful in that sense. One specific comment was, "The document is clear and easy to follow." It was also noted that the guide provided an excellent starting point for engineers to be able to speak a common language and rationally discuss multi-storey LTF building design from a shared perspective. The methods in the guide have been noted as appearing in peer reviews that engineers are receiving, and one respondent mentioned that they suggest the guide to other engineers who are not as familiar with the design of LTF buildings in order to increase their knowledge on it.

One engineer commented that, while the methodology provided was good, in many cases, it would be difficult to apply it on a regular basis. This was mostly due to the limitations of the reliance on plywood as the material used in conjunction with light framing to create lateral load-resisting shear walls. In reality, the sheathing material could be based on many factors ranging from material supply to client perceptions, and it would be rare to start a preliminary design using plywood shear walls. It was understood that the rationale for doing this in the guide was because the design could be done using knowledge of engineered wood product performance using NZS 3603:1993 *Timber structures standard* and that further information on proprietary products and building systems was needed to be able to design in materials other than plywood for multi-storey buildings.

3.2.2 Useful additions and missing information

The comments on what was potentially missing and what could be included within the guide were extensive and very valuable in terms of how it could be improved. This has helped in learning more about the needs of the target audience and indicates there is much to be gained from co-creation with key stakeholders during the scoping of the project and the follow-up activities. There was also value in understanding what might potentially make it more useful and appealing to a wider audience moving forward.

The following list provides improvements and suggestions made for increasing the usefulness of the guide:

- Inclusion of more shear panel materials instead of just plywood such as plasterboard, fibre-cement panels and other proprietary rigid air barrier panels.
- Inclusion of more worked examples using different materials such as cross-laminated timber (CLT) floor diaphragm systems and use of steel members to carry greater forces.
- Inclusion of hybrid lateral load-resisting systems such as steel or mass timber portal frames.
- Inclusion of typical diaphragm chord, floor and wall connection details beyond those provided in the guide.
- Inclusion of more worked examples of the methods described, including incorporation of a mass timber floor system as this is becoming a more commonly used way of doing diaphragms in multi-storey timber buildings.
- Inclusion of diagrams showing hierarchy of strength for different elements. This is described in the guide, but adding some diagrams could make this clearer for users.
- Inclusion of more information on how to model large openings and irregularity in diaphragms in order to calculate stiffness and load demands of these systems.
- Creation of a similar guide for architects, which would also be useful for engineers of different levels.
- Creation of a similar guide for mass timber (CLT and glue-laminated timber).
- Inclusion of a direct displacement-based design to compare with the force-based design in the guide.
- Inclusion of more interim steps for some of the more-complex equations including more information on the variables used and their source.
- Inclusion of more information on fire-resistant design, acoustic design and design of non-structural services.
- Inclusion of a flowchart of the design process with accompanying Building Code clauses and equations.
- Inclusion of an example summary report and builder summary on design example.
- A better design example than the one included and possibly a simpler one.
- Inclusion of carbon calculations for some typical buildings.
- Future workshops or webinars on the following topics:
  - A high-level overview of the guide and the intended audience.
  - More-detailed, step-by-step design examples on a range of buildings, including a very simplified building so that each step can be followed and transparent.

These suggestions were made by different respondents, but similar suggestions were amalgamated as there were overlaps among responses. A few engineers wanted to know if a revised version of the guide would be coming out and, if so, whether it would include these suggestions and reflect the shift from the current timber design standard NZS 3603:1993 to the proposed one, NZS/AS 1720.1, which is poised for publication during 2022.

3.2.3 Changing behaviours and methods of working

Engineers who have been actively using the guide were asked about the way they design multi-storey LTF buildings and if the BRANZ guide had changed their behaviour around this kind of work. Some were using the guide more as a reference or means of double-checking the in-house methods they already employed and therefore didn't feel that it had significantly changed their ways of working. This outcome suggests that some behaviours may not need to change as the user is already doing the "right thing".

Other feedback was that the guide provided a refresher on how to use traditional methods of designing multi-storey structures that don't necessarily rely so much on outputs from structural design software. This allowed them to rethink and refine the way they design these buildings in timber. One engineer noted that the guide presented a strength hierarchy method and included some factors that they had not previously included and therefore they were now doing things slightly differently in their designs.

One engineering consultancy was using the guide in conjunction with a number of international methods for designing multi-storey LTF buildings to develop their own series of complex spreadsheets to design up to 6-storey buildings.

3.2.4 What could be done differently

The suggestions made in section 3.2.2 indicate there are a number of things that could have been done differently that would have increased the impact of the guide.

Stakeholder engagement was done throughout the development of the guide, and it was peer reviewed both internally at BRANZ and with an external engineering consultancy. The questions and suggestions made during those processes were incorporated as much as they could be within the document, but clearly there are more topics that other engineers would like to have seen included.

It was acknowledged during the interviews that some of these aspects were beyond the scope of the document and would be more suited to a separate publication. Because the general feedback on the LTF guide has been possible and there has not been any overtly negative impression of it, the conclusion is that it has been a successful first step towards providing specific engineering guidance for designing LTF buildings up to 6 storeys.

4. Findings

This project has provided valuable follow-up information on the BRANZ multi-storey LTF guide published in September 2019. These findings were derived from the previously described interviews with engineers who have been using the guide as well as a software developer employed by an engineering firm to design spreadsheets for multi-storey building design. The interviews were an effective means of understanding how the document is being used, how it has changed the way people are designing LTF buildings and what could improve its usefulness and impact. Included in these findings is feedback from engineers who have discussed the guide since its publication, including requests for clarification and further information.

4.1 Effectiveness of guide

Based on the range of feedback provided, the guide is considered to be an effective document that describes methods for designing Code-compliant LTF buildings up to 6 storeys in New Zealand. Several examples of buildings designed using the guide have been mentioned by engineers, with some still being designed and others under construction. Design methods from the guide are making their way into peer reviews of specifically engineered design solutions, and some already consider it a valuable reference for these buildings.

More than one engineer noted that inclusion of other materials for shear wall design beyond plywood would have increased the effectiveness and potential of the guide and made it more applicable across a wider range of buildings. This included comments related to hybrid LTF buildings. As noted in previous sections, there were also numerous specific additions to the guide that would be useful, and some follow-on activities were noted as potentially contributing to greater impact.

4.2 Impact on user behaviour and work

The behaviour changes around the publication of the multi-storey LTF guide are primarily related to different ways of designing these types of buildings due to having a resource to base designs on. Several engineers noted that they already had methods for designing multi-storey LTF buildings but still felt it was valuable to have a documented method available as well as being able to refer other engineers to the guide in order to get them familiar with a documented method. This suggests that the guide is considered by these engineers to be a resource worthy of consideration for structural design purposes even though they already use established methods.

Other engineers cited specific technical methods from the guide that they now incorporate within their designs, which is a change in behaviour that would not likely to be seen without the guide. Another identified behaviour change relates to engineers relying more on basic structural engineering principles rather than relying solely on outputs from structural analysis software. This is because the guide provides a first-principles approach to design and incorporates current design standards that engineers can refer to in addition to an extensive list of technical references in the event that designers need more information than the guide provides. One engineer described the guide as being a great way of applying learnings from university into a practical application that could be followed easily but uses those same principles that can be difficult to relate to real-world scenarios at times.

It is possible that other changes in behaviour have occurred, but these were unable to be identified from the interviews with engineers using the guide.

4.3 Possible improvements

A list of potential inclusions and follow-on activities that would increase impact of the guide are discussed in section 3.2.2. Implementing even some of these suggestions would be a significant effort and, depending on which ones, could require additional funding and resources from BRANZ. In addition to the suggestions provided, there have also been several contacts made from other engineers with minor corrections to the guide that would be ideal to implement either through a revision of the guide or by sending out a list of corrections to those who downloaded it. The latter option could be difficult as described elsewhere.

4.3.1 Published guide

The published document could be improved either through some minor revisions or a major overhaul. The latter probably isn't necessary based on the findings of this research on impact, but if additional information on fire, acoustic or non-structural services design were to be included, this could alter the scope of the existing document and would require engagement with additional subject matter experts. It is also feasible that other documents external to BRANZ may already address some of these issues and could be referenced for multi-storey building designers.

It is suggested that users of the guide and the public be aware that this guide is a living document and that there are some corrections that need to be included. This will need to be discussed within BRANZ to determine the best way forward. It is also important to note that, because the guide was developed as a revision to the New Zealand timber design standard was under way, it was not feasible to incorporate all design criteria from the new standard, which is slated for publication during 2022. Ideally, with the publication of the new timber design standard, the BRANZ multi-storey LTF guide should be reviewed and any changes made to keep the guide aligned with the most current building standards.

Since the publishing of the BRANZ guide in 2019, there has been considerable change in the climate of the New Zealand building sector, which is now focusing very heavily on carbon sequestration and reducing the emissions of greenhouse gases within the built environment. This provides additional opportunities to consider using timber for larger buildings and may result in increased interest for guidance on multi-storey timber building design. A revised version of the guide could be reintroduced and publicised to address this change in landscape, which is likely to further increase the impact of the guide by responding to changes rather than remaining static.

4.3.2 Peripheral activities

Opportunities for additional activities to promote further use of the multi-storey LTF guide exist for the current version of the guide but might be more likely to be well attended if there was a revised version of the guide to consider. These activities would most likely be webinars or workshops aimed at different parts of the building sector to further share what the guide covers and how it can and is being used through New Zealand.

The current version of the guide could be the topic of additional webinars that discuss the discovered errors and show how they can be corrected. Based on the interviews

with engineers, it would also be possible to go through either the included design example in a step-by-step manner or do a different design example based on the feedback received. One type of example would be a simplified building, almost to the point of being unrealistically simple, but could allow for detailed explanations of each design step and possible areas of iteration. Another design example could be more complex and include suggestions for detailing, more-exhaustive attention to diaphragm design or possibly the inclusion of a mass timber floor like CLT. A more high-level overview webinar could also be done as an introduction for those not yet familiar with the guide, which would allow engineers to understand where they could be using it and also provide some information for architects and other less-technical parts of the sector to understand what types of structural systems are available as they are considering lower-carbon structural systems.

A revised version of the guide could be the topic of similar webinars or workshops as the current version but the changes could be highlighted and elaborated on. The most appropriate format would depend on what sort of revision was undertaken – a single update webinar or a longer series of webinars going into detail on the added aspects.

Regardless of the revision status of the multi-storey LTF guide, there are ample opportunities to share it with a wider audience through presentations or workshops. As noted, this would require resources within BRANZ that need to be discussed. These activities would also need to be carefully designed in terms of content and ability to provide adequate time for detailed presentations and interactions with the audience.

4.4 Summary of findings – what are the lessons learned?

A number of lessons have been learned through this small but effective project seeking to uncover some of the impact as well as potential impact of other BRANZ projects where guidance documents are published. These lessons include:

- digital data acquisition considerations
- stakeholder engagement
- supporting user behaviour change
- follow-on activities to increase and better understand impact.

Digital data acquisition considerations

An important lesson is to develop a means of effectively understanding who is downloading a document and what part of the building sector they are coming from. It is also important to keep future options open – for example, it would be a good idea to include a statement when downloading that requests permission to potentially contact the downloader in the future with questions around their use of the document as well as possible surveys. This would reduce any ethical issues and provide a clearer pathway for analysing download data and would not be likely to dissuade anyone from downloading unless their interest was very superficial.

A robust method of storing and being able to retrieve this information is also vital to any project that wants to analyse download user information in any meaningful way. Events such as changes in website platform and format should be considered at the outset of data gathering to ensure data can be obtained for a reasonable duration following the release of a document. This may require consultation with BRANZ staff familiar with website operation and development, which could also cultivate inter-team understanding that would benefit future projects and research.

Stakeholder engagement

The project on multi-storey LTF buildings was begun at a time when stakeholder engagement was not such a high priority for research work at BRANZ compared to what it has become in recent times. There was a degree of engagement and co-creation with engineers through interactions with the New Zealand Timber Design Society and a survey conducted to provide input on the development of the guide, including the format and issues to be addressed. The impact of a design guide is contingent on it being considered and adopted by the professionals doing the designing, so end users need to be consulted early in the process in order to get their input on what would be useful as well as what is already available. The success of the guide is attributed in part to the fact that engineers were consulted and included as contributing authors in order to keep it relevant. This success is seen with the appropriate technical level of the guide as well as the clarity of explanations, as articulated during the interviews with engineers. However, there is value in considering more co-creation of such guides in the future so user needs are addressed and buy-in increased.

Supporting user behaviour change

A valuable lesson is to provide enough detail in a design document so that engineers have the formulae and understandings behind the design methods to implement and ground them in practice. Guidance is often provided as high level and generalised to an extent that implementation can be difficult without extensive further investigations. This is somewhat unique to engineers and other practitioners who require a high level of computation to be able to complete a design, but this can also be required for other parts of the building sector. It is therefore important to engage with critical stakeholders, especially end users, early and often throughout the development of design guidance documents. This current project allowed for post-project stakeholder engagement, which has provided valuable information on the guide and its impact.

Worked examples are considered a necessary inclusion for technical guidance documents such as the multi-storey LTF guide, which is intended for structural engineers who are working outside the scope of Acceptable Solutions. High levels of detail, description and visualisation are critical for creating understandable and criticisable design methods. Attention to detail also has potential for developing useful references and common understandings of structural concepts and design methods. Providing references that users can consult as well as being available to answer questions on the technical methods were useful in building a better understanding of the design methods and provided opportunities to engage with users of the guide.

Follow-on activities to increase and better understand impact

Workshops and webinars presenting a range of topics related to a design document have the potential for increasing the uptake of the document and associated behaviour change, but this can also provide additional information and design examples that users can learn from. They also serve as an opportunity to interact with those already using the guide who may have questions about it. The overall sense from the interviews was that doing some additional follow-up workshops would increase the impact of the guide and help designers use it. A single webinar was conducted very soon after the release of the guide, and while it was well attended (virtually and in person), from the questions posed, it seemed few in the audience had an opportunity to go over the guide in any detail.

4.5 Next steps/recommendations for the future

Any additional work on the BRANZ multi-storey LTF guide would require funding and resource allocation. It is certainly worth considering implementing some revisions of the guide based on the feedback received as well as some follow-up activities such as workshops or seminars. Section 3.2.2 lists a number of potential inclusions and actions that could augment the impact of the guide.

4.5.1 Next steps for this project

Next steps for this project include publishing of this report and sharing it with the wider audience at BRANZ. This could include an article in *Build* magazine, a presentation at an upcoming staff forum, a 'brag book' story and discussions around possible revisions to the guide and follow-up activities. Levy funding would be a possible source of resource to implement these options for further publicising and improving the impact of the multi-storey LTF guide.

4.5.2 Lessons learned for other projects

While this research has provided important insight into the usefulness and improvement of the BRANZ multi-storey LTF guide, it also has taught some lessons about how future BRANZ research projects can be done more effectively. In summary, the following lessons should be considered by researchers at BRANZ prior to preparing proposals for funding:

- **Digital data acquisition considerations:** Ensure that the technology to be used to disseminate project outputs is consistent with immediate data acquisition needs as well as future needs. Access to data, regardless of changes to platforms and websites, should also be considered.
- **Stakeholder engagement:** Engage early and often with critical stakeholders and end users to understand the best types of outputs they need and the scope of the research they need to achieve their goals as well as what information already exists. To achieve this, co-creation should also be considered to develop project proposals, depending on the nature of the project.
- **Supporting user behaviour change:** Align the technical detail in the project output to the communication and learning needs of the user. For example, for engineers, if a publication requires calculations, make sure to include a practical design example that can be followed step by step and includes references to formulae and equations.
- **Follow-on activities to increase and better understand impact:** Where needed, include funds and resources to follow up on the release of a guidance document to elaborate on the work, determine the effectiveness of the guide and seek opportunities for improvement and post-project stakeholder engagement. In this way, we can progressively improve what we do.

This project has been a unique opportunity to discover latent impact of research work that has been closed for over 2 years. Projects like this have the potential to grow relationships between researchers and stakeholders while also providing valuable input into BRANZ research outputs.

References

Carradine, D. (2014). Guidance multi-storey timber buildings. *Build*, *141*, 78–79. https://www.buildmagazine.org.nz/articles/show/guiding-multi-storey-timber-buildings

Carradine, D. (2018). Guidance for taller timber buildings. *Build*, *168*, 87–89. https://www.buildmagazine.org.nz/articles/show/guidance-for-taller-timber-buildings

Carradine, D. (2019). *Multi-storey light timber-framed buildings in New Zealand – engineering design*. Judgeford, New Zealand: BRANZ Ltd. https://www.branz.co.nz/shop/catalogue/multi-storey-light-timber-framed-buildings-in-nz-engineering-design_748/

Carradine, D. (2020). Multi-storey LTF guidance. *Build*, *176*, 78–79. https://www.buildmagazine.org.nz/articles/show/multi-storey-ltf-guidance

Appendix A

The following questions were used as a guide to assist during the interviews of individuals who agreed to have a discussion on the multi-storey LTF guide.

1. Since downloading the document, how many times have you used it or referred to it for design input?
   a. Less than 5 times.
   b. 5–10 times.
   c. More than 10 times.
   d. Very frequently, hard to say how many.

2. How are you using it?
   a. Design work.
   b. Consenting.
   c. Something else.

3. Is it pitched at the appropriate level of technical detail?
   a. Too technical.
   b. Not technical enough.
   c. Can you explain why you think so?
   d. Any examples of this?

4. What would be useful to include that isn't already there?

5. Has the guide resulted in any changes in your methods of work or how you do things?
   a. Can you explain how?
   b. Can you provide an example?

6. Would additional information or guidance help clarify things?
   a. Webinar?
   b. A worked example?
   c. Elaboration of specific parts of the document?
   d. Another type of outreach?

7. Have recent moves by government around densification of housing made the guide more relevant or important for your work?

8. Any general suggestions?
   a. What could we do better?
   b. What could we do with this publication that would allow you to do your work more effectively?