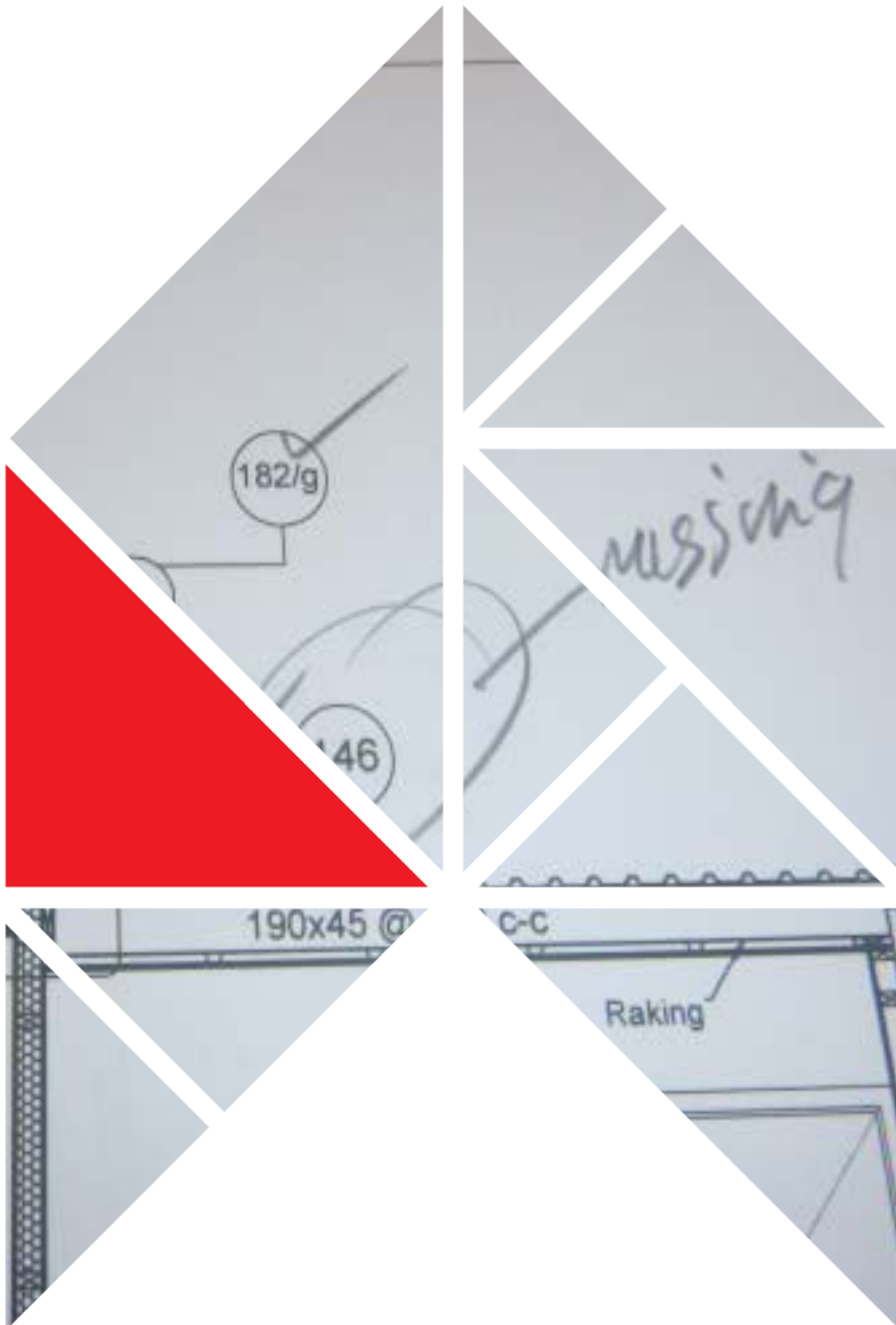


# Consent documentation quality for new housing

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## Preface

This is the third and final report on a study of new housing construction quality. In earlier work, the physical construction quality of new houses at various stages was inspected. This found a small percentage had a significant number of defects in both compliance and aesthetic details. These defects arose from a variety of factors including lack of skills, poor management and inadequate details on the drawings. In this project, it was decided to investigate the quality of the building consent documentation.

## Acknowledgements

This work was funded by the Building Research Levy.

# Consent documentation quality for new housing

## BRANZ Study Report SR355

### Author

Ian Page

### Reference

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### Abstract

This is the third and final report on a study of new housing construction quality. In this project, it was decided to investigate the quality of the building consent documentation. A total of 52 sets of drawings were inspected – about 50% on site and the rest in the office of the building inspectors. The two main categories of concern were readability and completeness. The on-site inspections also checked whether the details on the drawings were followed in practice. The project found that quite a high percentage of drawings did not have adequate or complete details.

### Keywords

New houses, quality, documents, drawings, specifications, variations

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## 1. Executive summary

This is the third and final report on a study of new housing construction quality. In this project, it was decided to investigate the quality of the building consent documentation.

The positive aspects from the inspections are that documentation for over 85% of houses had:

- clear spacing and easy to read drawings
- complex junctions that were well detailed
- drawings that followed a logical sequence related to the build
- bracing details provided.

The negative aspects were that over 30% of houses had documents with:

- not all necessary details provided
- drawings that referred to standards for details (i.e. details were not provided on the plans)
- no list of materials provided.

The building inspectors were asked to rate the documents, in an overall summary assessment, on a 1 = very poor to 5 = very good scale. The average score was 3.4. One house rated 1 and another rated 5.

Licensed building practitioners (LBPs) were the builders in charge on most sites visited. However, for 26% of the site inspections, the builder in charge was not an LBP. This raises questions about the quality of day-to-day work done without qualified oversight.

## 2. Introduction

This project inspected plans and specifications for 52 new houses in four locations. The aim was to quantify the level of detail supplied and document readability and completeness.

The work arose out of an earlier project that inspected 225 houses under construction in several locations around New Zealand. That project<sup>1</sup> found approximately 8% of houses had four or more Building Code compliance defects, and a similar percentage had finishing defects. The partial inspection of documents on site plus a postal survey of builders (see Appendix A) indicated that inadequate drawings and specifications was part of the reason for a quite high level of defects in new housing.

It was decided in this new project to concentrate on the drawings and specifications for new houses to obtain more detail about the quality of the documents. The documents were assessed for readability and completeness by building surveyors. The actual data provided was assessed against expected data using a tabular format, with space for comment, as the assessment method (see Appendix B). The inspections were carried out by Realsure Ltd, a firm of property inspectors, in five geographically spread territorial authorities.

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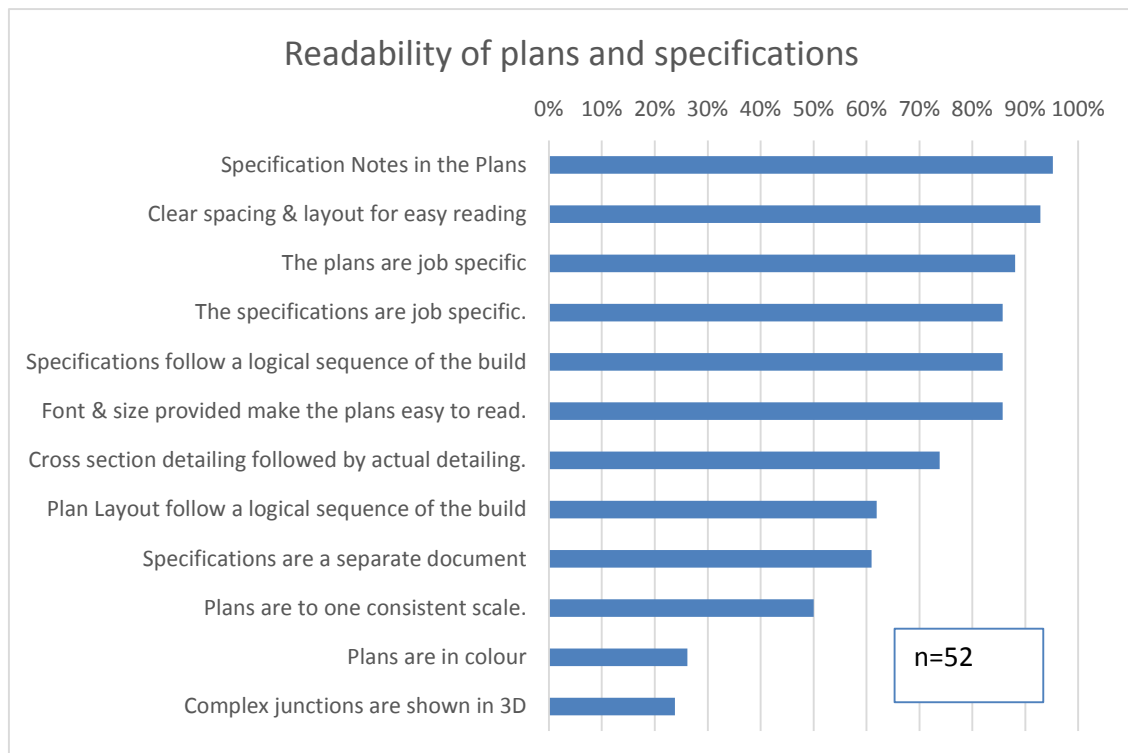
<sup>1</sup> Page, I. (2015). *New House Construction Quality Survey 2014*. Study Report SR335. BRANZ Ltd, Judgeford, New Zealand; Page, I. (2014). *New Housing Condition: A Preliminary Assessment*. Study Report SR316. BRANZ Ltd, Judgeford, New Zealand.

## 3. Detailed results

### 3.1 Readability and completeness

Figure 1 shows readability assessments – how user-friendly the drawings and specifications were.

Generally, the houses scored well on these criteria. However, there was still a proportion (around 10–15%) of houses where readability in terms of clarity, sequence and being specific to the job were not up to standard. The bottom bars in Figure 1 relate to scale, colour and 3D – ‘nice to have’ features but not essential and may not be necessary on simpler designs.



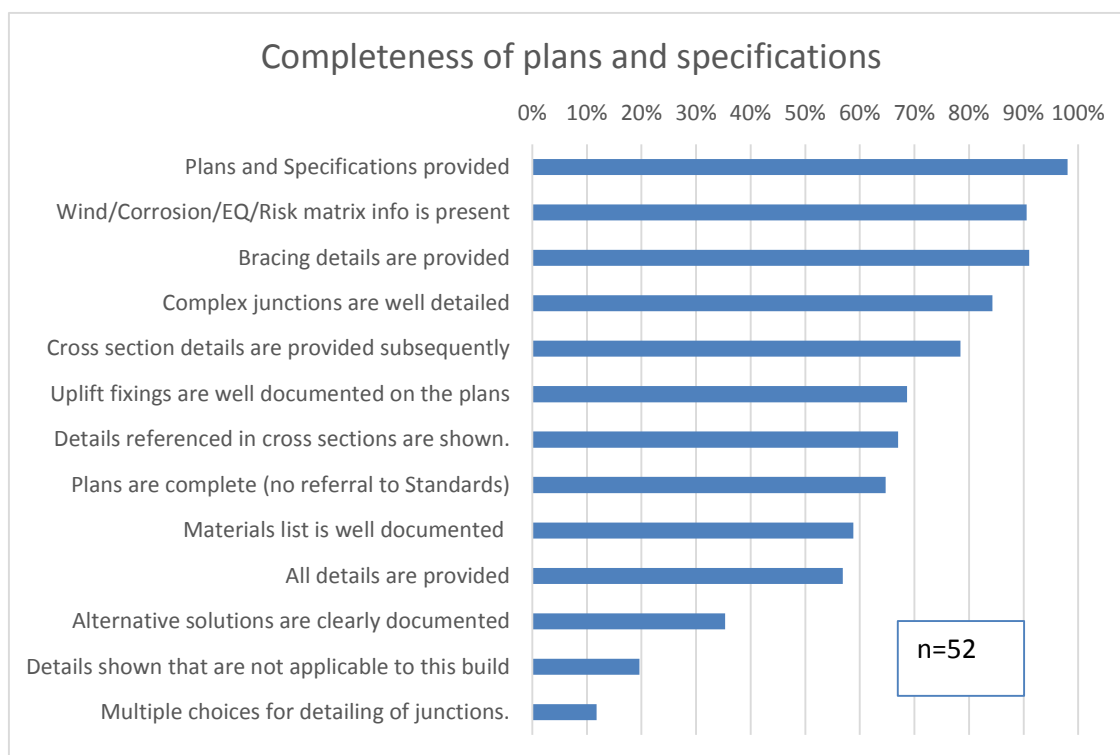
**Figure 1. Readability of consent documents.**

Figure 2 shows completeness assessments – were all the required details to build a house provided?

Again, the houses scored quite well on most of the criteria. About 85% of the houses had their complex junctions well detailed. Some of the houses were simple in layout without complex junctions, so this score is encouraging. Also, 91% had bracing details provided. The other 9% had reference to manufacturers’ bracing guides for the fixing details. This is inconvenient and is possibly ignored on site if the manufacturer’s guides are not immediately available.

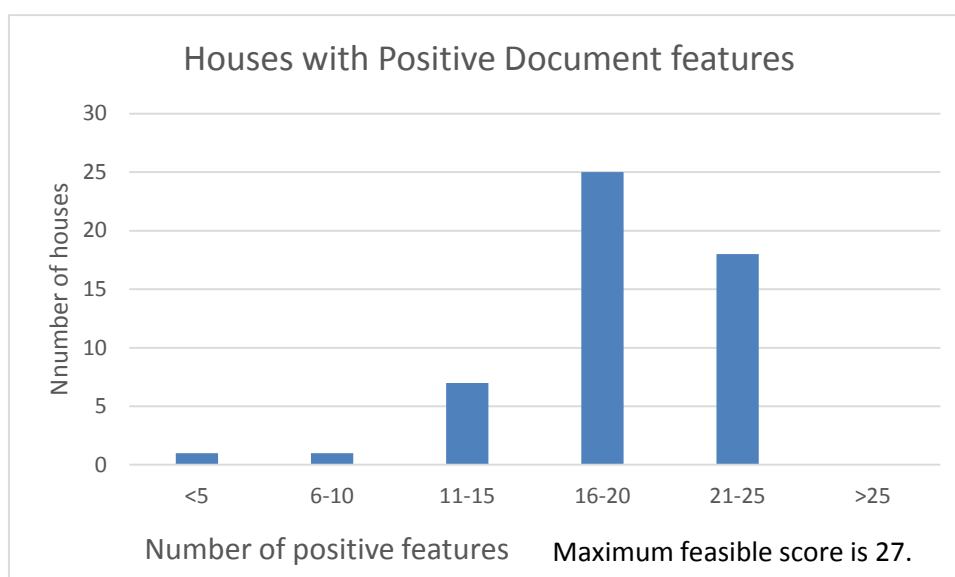
The completeness of bracing, junction and uplift fixing details were recorded separately. Uplift details were the worst, with over 30% of houses not having these details. Bracing and junction details were absent in 10–15% of houses. Taking the detailing together, 43% of houses do not have all details provided. This relates mainly to bracing, junction and uplift details and is matter of concern since the council inspector on site may not pick up the absence of these details.





**Figure 2. Completeness of consent documents.**

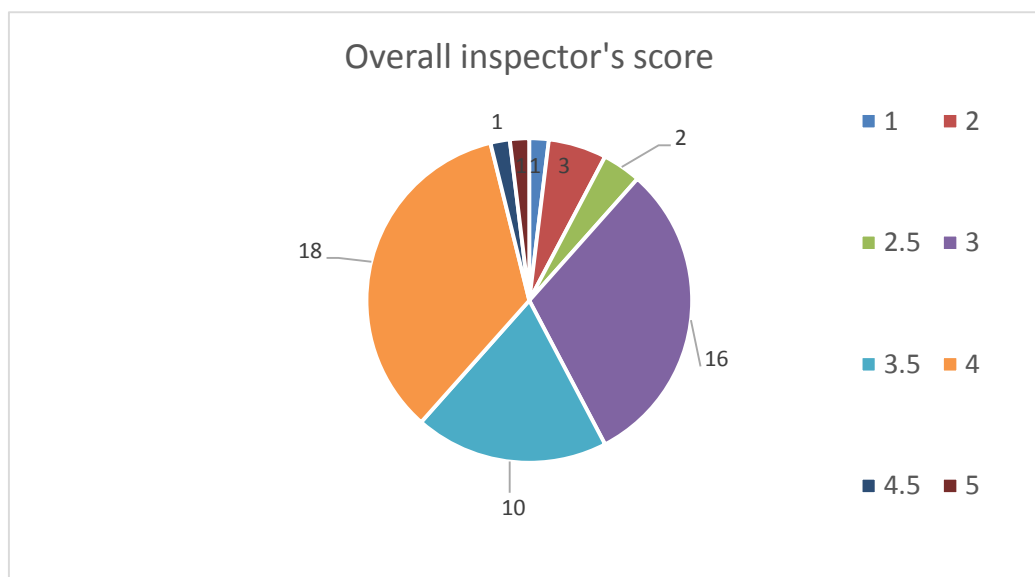
Summing the readability and completeness criteria gives a total of 27 questions. If all answered yes, this represents a perfect score in the survey. The average score was 18.4, and the range was from 5 to 25, i.e. there were no perfect scores but a significant number of houses were in the 21–25 range (see Figure 3). Note the chart items total 25 questions, not 27, because 2 questions were omitted from the charts as they were similar to others already included.



**Figure 3. Positive features in the documents.**

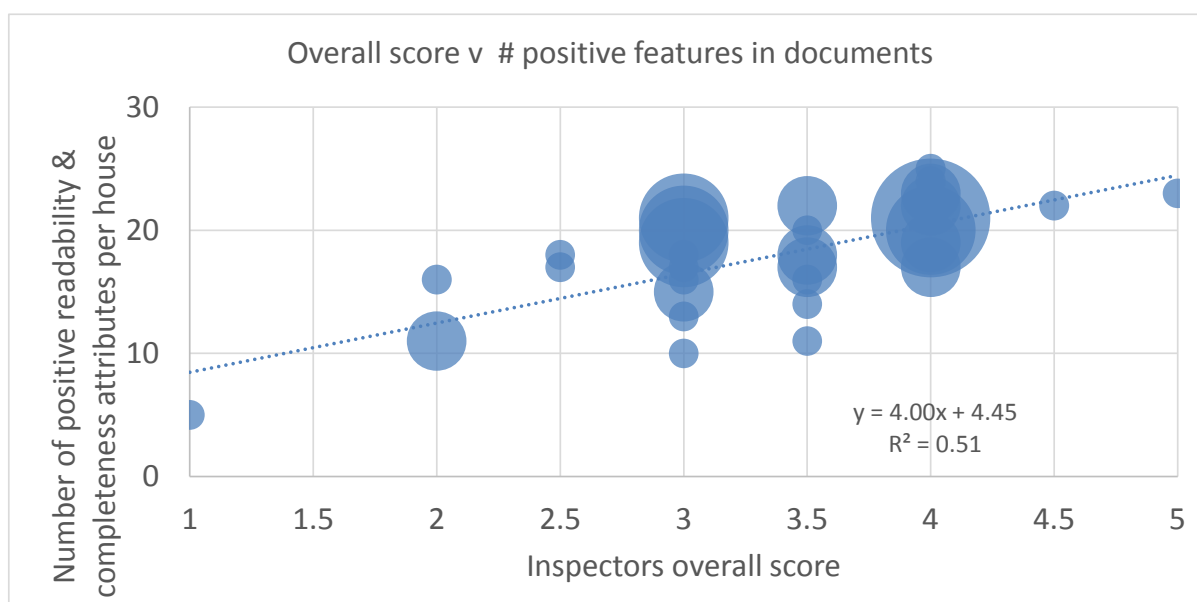
As well as checking various aspects, the inspectors were also asked to give an overall rating for the documents for each house on a 1–5 scale. The results are shown in

Figure 4. The average score was 3.4, and at the extremes of 1 and 5, there was one house for each.



**Figure 4. Inspectors' overall score – 1 (very poor) to 5 (very good) scale.**

We would expect there to be a relationship between the overall score and the number of positive document features. This relationship is shown in Figure 5 as a bubble chart where the size of the bubbles represents the number of houses at that point. For example, the largest bubble is at inspector score 4 and 21 positive document features per house, and the size of the bubble represents four houses with this combination. The smallest bubbles are for just one house.



**Figure 5. Overall score versus number of positive features in the documents.**

The R-squared value is 0.51, indicating some correlation between the two measures, which is to be expected. It is likely that some aspects of the documents weigh more than other aspects in the inspectors' assessment of the overall score. Hence, we would not expect there to be an exact relationship between the number of positive features and the overall assessment score.

## 3.2 Other measures

These other measures are specific to the on-site inspections and ask:

- Is the on-site work in accordance with the documents?
- Is there a process for recording variations?
- What is the builder's experience in years and are they an LBP?
- What is the builder's view on readability and completeness of the drawings?

One house out of the 27 inspected on site was found to be significantly different in that the slab layout and the wall cladding was different to that on the drawings. There was no record of a variation to the consent issued by the council for this house.

All the other houses complied with the drawings in layout, materials and details, but they were not all complete in documentation, with 52% incomplete in provision of the necessary details.

In 10 of the 27 houses inspected on site, the builder in charge said they did not have a process to document any variations.

Twenty of the builders in charge on site were licensed building practitioners (LBPs) and seven were not. The average experience of LBPs was 17 years and only 5 years for the non-LBPs. The overall rating scores between the two groups (LBPs and non-LBPs) were very similar (3.7 versus 3.6) as was the number of positive document features recorded in the inspections (20.1 versus 20.0), respectively.

The builders' views on the readability and completeness of the documents was close to those formed by the Realsure inspectors, for example, they were in disagreement on missing details for only three houses out of those inspected on site.

## 4. Method

The document assessments were done in two ways:

- In the office for 25 sets of documents sent by the territorial authority to the Realsure inspectors.
- Another 27 sets were inspected on site.

The document assessment checklist was mainly in tabular format with space for comment as needed (see Appendix B).

In the on-site inspections, the work was inspected to see if it conformed to the documents. The builder in charge was asked to fill out a short questionnaire on their experience and qualifications, (the first page in Appendix B). There were also brief questions on whether they found the documents readable and complete with the necessary details.

Details provided on the drawings were not checked for efficacy, i.e. they were not checked to see how well they would work, whether an alternative detail would be better or even whether they would work at all.

## 5. Discussion

The inspectors' overall score of an average of 3.4 suggests the quality of the contract documents is just above average (which is a score of 3.0) so there is some improvement required.

Particular areas of concern are that, in 43% of houses, not all details were provided, and in 31% of houses, the uplift fixing details were not provided. Provision of bracing details was one of the high scores, at 91% of houses, but that still leaves 9% of houses with no bracing details. The Realsure inspectors said that, for some of these missing detail houses, the builder would go back to the designer for the details. Alternatively, the drawings often had notes referring the builder to manufacturers' detailing. Often that literature was not on site or the particular detail to use was not clear. This suggests a high potential for the builders to get the uplift connection, wall junctions and bracing details wrong.

The brief to the inspectors did not ask whether the detail was likely to work in practice so we may have missed possible shortcomings in the drawings. We know that, in some sets of drawings, the details were copied from other projects. Some of these may not work on the new project, and this is also a potential source of defects in construction.

The scores for the documents were very similar between LBP and non-LPB sites. We would not necessarily expect a difference in score since the builder's involvement in producing the documents is nil. However, it was hoped that LBPs could be more assertive and demand better documentation from the designer and request missing details as required. LBPs are better qualified and more experienced than non-LBPs to request this information.

The use of previously used drawings was quite common and can cause confusion. For 20% of inspections, some of the drawing details were not applicable. In some but not all cases, the detail was stamped 'not applicable'. Cross-sections often had numbered references to a detail, but the actual detail was not found in 33% of inspections. Designers need to generally take more care with their drawings, ensuring that all relevant detail is included, and exclude non-relevant details. Examples of deficiencies in documentation are shown in Appendix C.

The on-site inspections were quite small in number at 27, so to draw many conclusions is somewhat unwise. However, there is an issue that seven out of the 27 builders in charge were non-LBPs, and it could be that these people are making significant decisions on a day-to-day basis for which they are not qualified. In these cases, a company LBP will visit as required to sign off various stages, but the amount of their day-to-day oversight is uncertain.

## Appendix A: Builders' postal questionnaire

Problem areas in new housing construction																
BRANZ is interested in getting your views on problem areas in housing construction generally, not only this house but other projects you have done.																
Component	Foundations	Wall	Roof	Bracing	Windows	Roofing	Insulation	Wall	Drainage	Wall	Claddings	Wall	Roof	Connectors/ straps	Other	No problems in my experience
		Framing	framing					underlay	cavities				flashings		(state)	
<b>Problem areas</b>	tick boxes that are applicable in your experience in the last year															
Lack of construction details	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cannot interpret drawings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cannot build as per drawings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Requires special on-site skills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sub-contractor's work is poor (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Material installation instructions are inadequate / not provided.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Specifications are unclear	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Services clash/ difficult to install	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Any other problems? (state .....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thank you. Please fold with New Dwelling Survey and return to BRANZ. (1) What sub contractor? .....

We will add another lotto ticket or voucher for this completed form.

See Study Report SR335, in footnote 1, for the detailed results of this postal survey.

## Appendix B: Document assessment checklist

Date	<input type="text"/>		
Region	<input type="text"/>		
Number of years building	<input type="text"/>		
LBP	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Licensing category	<input type="text"/>		
Most experience in	<input type="checkbox"/> Residential construction	<input type="checkbox"/> Mix of commercial/residential	
	<input type="checkbox"/> Labour only	<input type="checkbox"/> Full contract	<input type="checkbox"/> Mix of both
Readability of plan	<input type="checkbox"/> Good	<input type="checkbox"/> Average	<input type="checkbox"/> Below average <input type="checkbox"/> Poor
Missing details?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Comments	<input type="text"/>		
Do the plans flow and follow a logical sequence (way the building built)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Comments	<input type="text"/>		
Are the specifications house specific?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Are the plans at a consistent scale?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Are the plans and specifications in a font type and size that is easily read?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Do you have a process of documenting any variations to the plans or specifications?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If no, would it be beneficial if a process accompanied each set of plans?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	



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**Plan review sheet in-office**

<b>Client:</b>	BRANZ	<b>Site address:</b>	
<b>Date:</b>			
<b>Stage of construction:</b>	Plan review	<b>Project number:</b>	

**Scope:** To review plans for residential buildings:

- Clear and easy to read.
- Details generally in accordance with Building Code.
- Correct details present for the building materials used.
- Sufficient detail is present for the joinery, bracing, roof and complex details.

Readability	Yes	No	Comments: (N/A if not applicable)
1. Are the plans job specific with a contents page?			
2. Are the specifications job specific with a contents page?			
3. Does the plan layout follow a logical sequence of the build?			
4. Do the specifications follow a logical sequence of the build?			
5. Are the specification notes also on the plans?			
6. Are the plans to one consistent scale?			
7. Does the font type and size provided make the plans easy to read?			
8. Is there clear spacing and layout for easy reading?			
9. Does the position of the cross-section detail lead on to the actual detailing?			
10. Is there a clear and logical connection between the cross-section details and the actual detail shown on the subsequent pages?			
11. Are the plans in colour?			
12. Are complex junctions shown in 3D?			



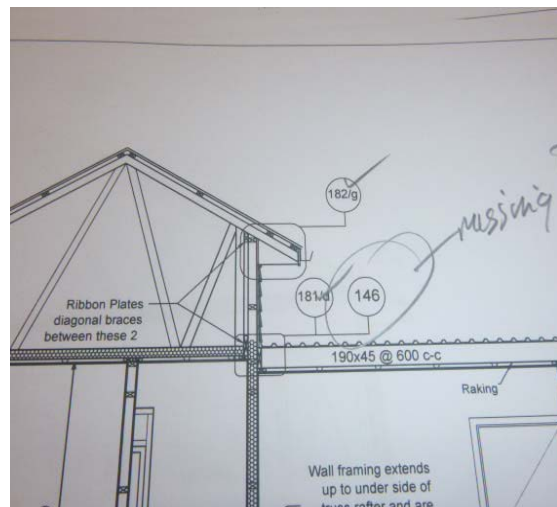
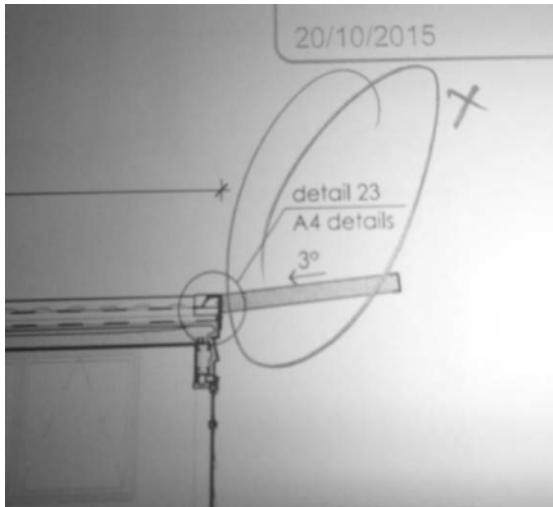
Completeness	Yes	No	Comments: (N/A if not applicable)
1. Plans and specifications provided?			
2. Are the design bases present? <ul style="list-style-type: none"> <li>• Wind zone</li> <li>• Earthquake zone</li> <li>• Corrosion zone</li> <li>• E2 risk matrix</li> </ul>			
3. Are the plans complete or do they just reference another standard or document?			
4. Are all the details shown on the cross-sections actually within the plans?			
5. Do the plans include the bracing details or do they just reference proprietary systems in another document?			
6. Is the actual cross-section detail on subsequent pages?			
7. Are there missing details?			
8. Are Alternative Solutions clearly documented?			
9. Are there multiple choices for the way to detail one junction?			
10. Are there details shown that are not applicable to this build?			
11. Are complex junctions well detailed?			
12. Are the uplift fixings well documented on the plans or is the reader sent to another document or proprietary system?			
13. Is the material list well documented and in a way that it can be easily checked?			

On site	Yes	No	Comments: (N/A if not applicable)
1. Builders' questionnaire completed?			
2. Does the builder have a process of documenting variations to the build?			
3. Does the on-site layout match the plans and specifications?			
4. Do the materials used match the plans. If no, has there been a variation to consent document noted?			
5. Has the detailing on the plan been followed?			

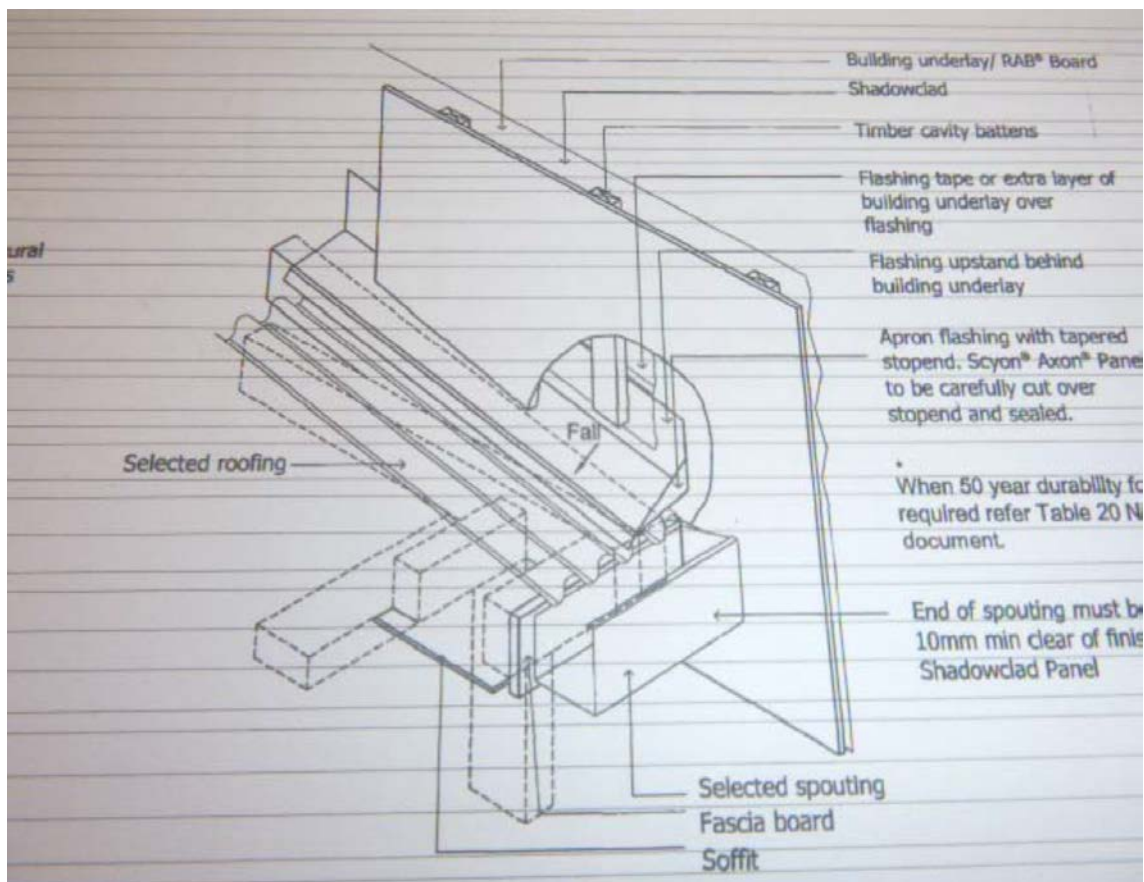
**Overall rating:** 1 (very poor) – 5 (very good)

## Summary

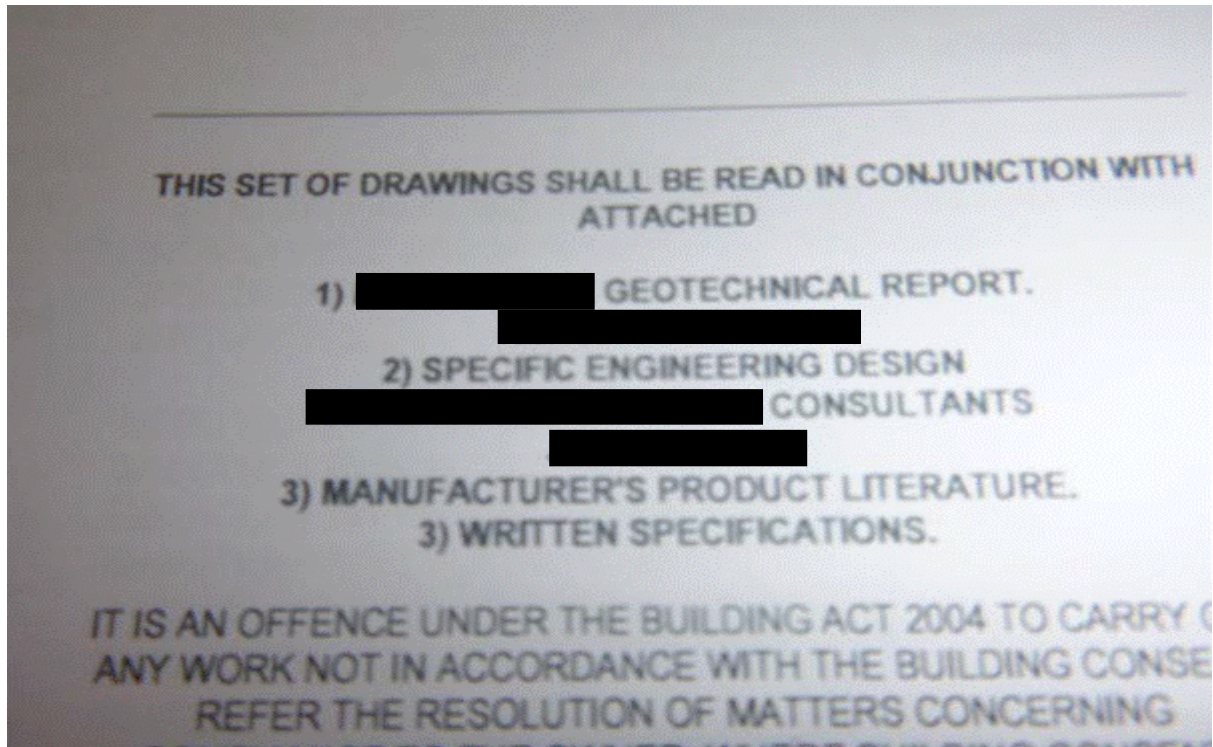
## Appendix C: Deficiencies in documentation



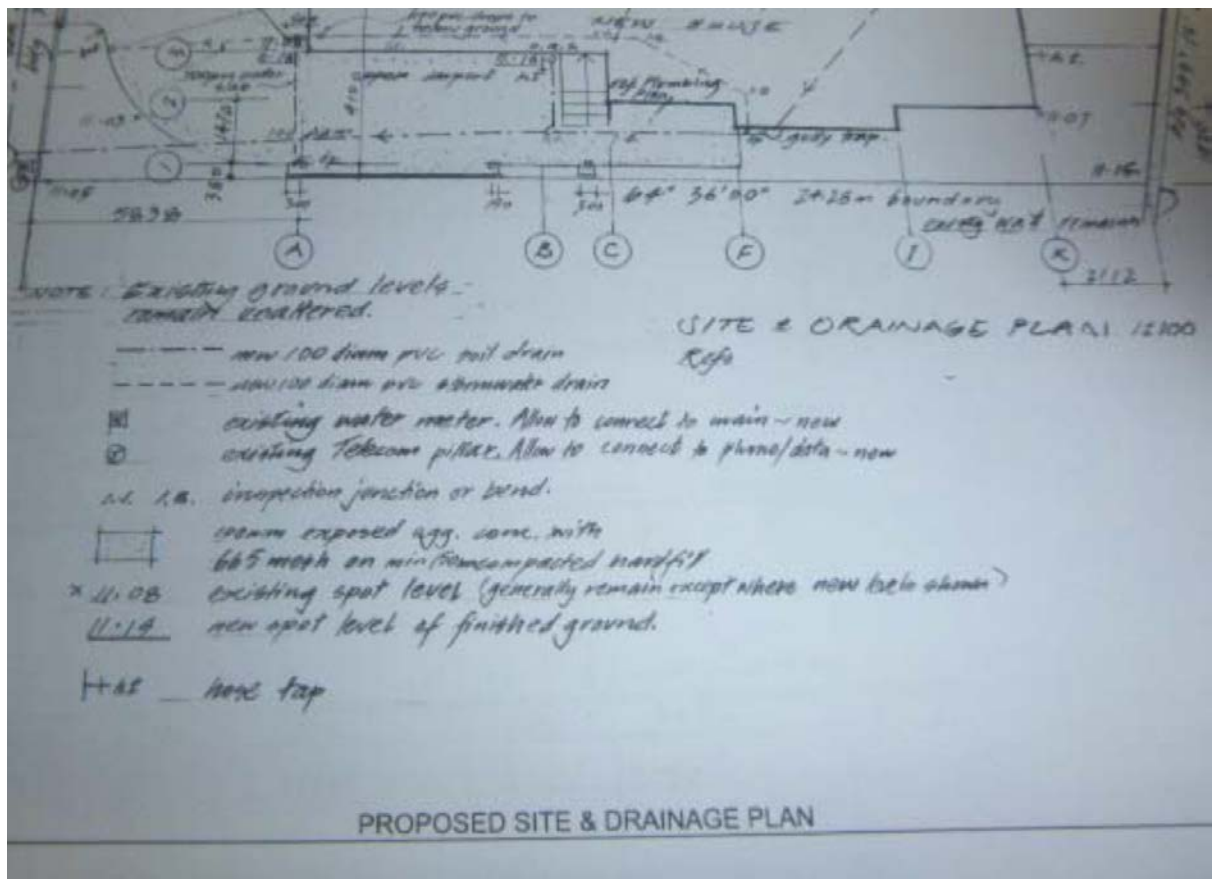
**Details are referenced but are missing or are not applicable.**



**Helpful 3D detail, but clarity is adversely affected by the horizontal lines.**

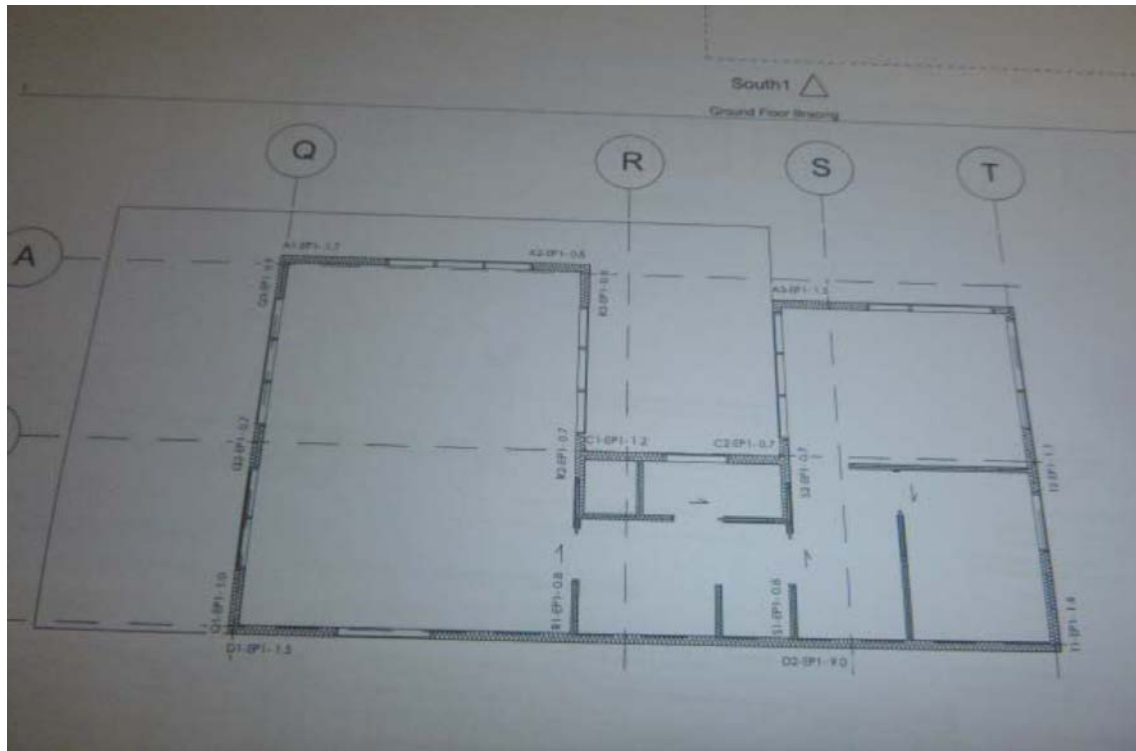


Not all of these references are helpful to the builder: What part of the geotechnical report does the builder need to read? What manufacturer's product literature applies?

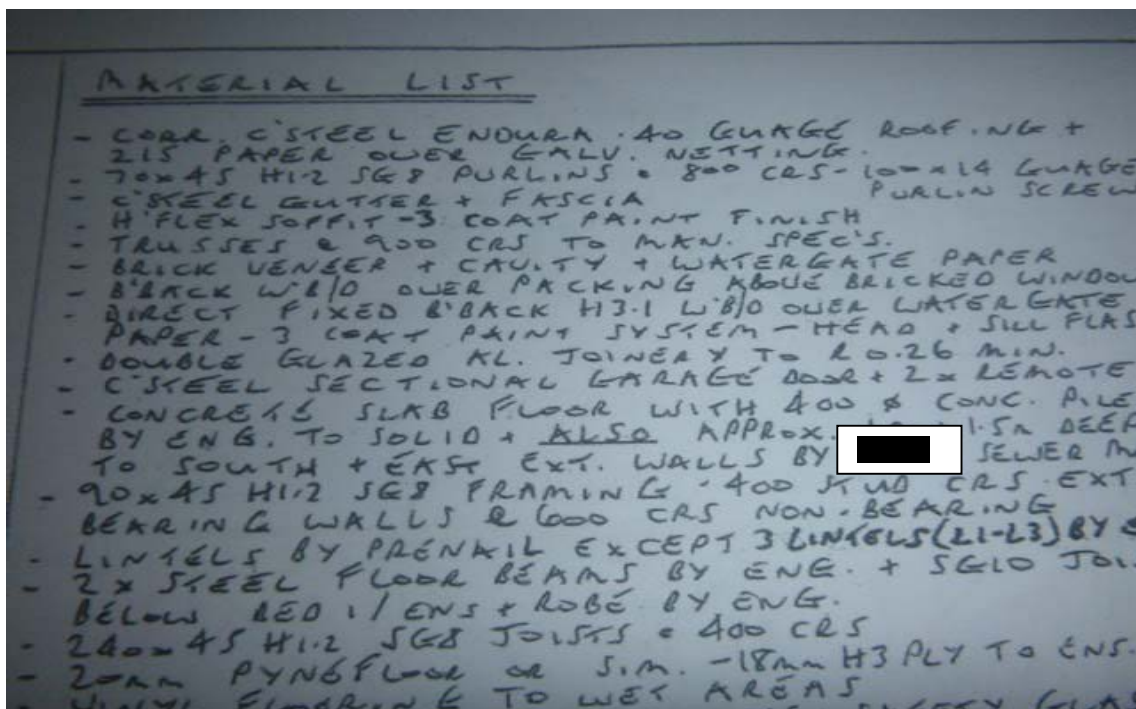


Handwritten notes can be difficult to read.

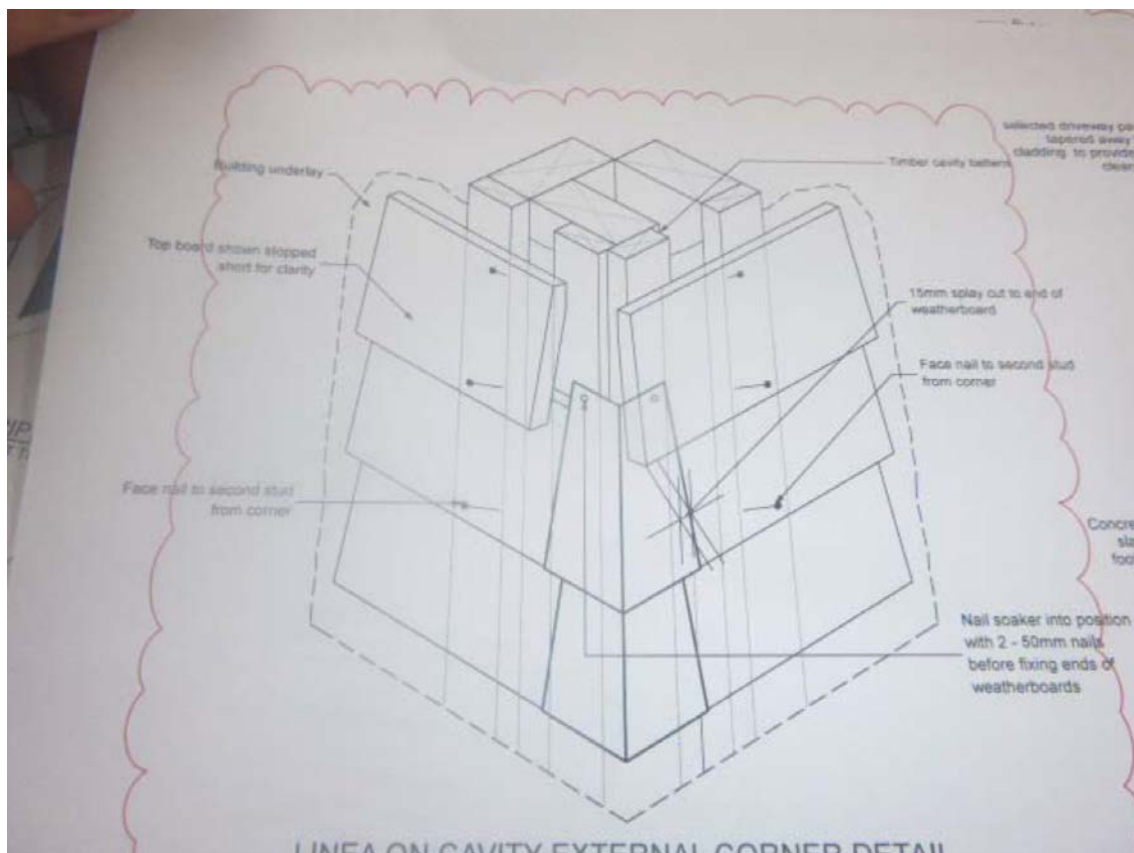
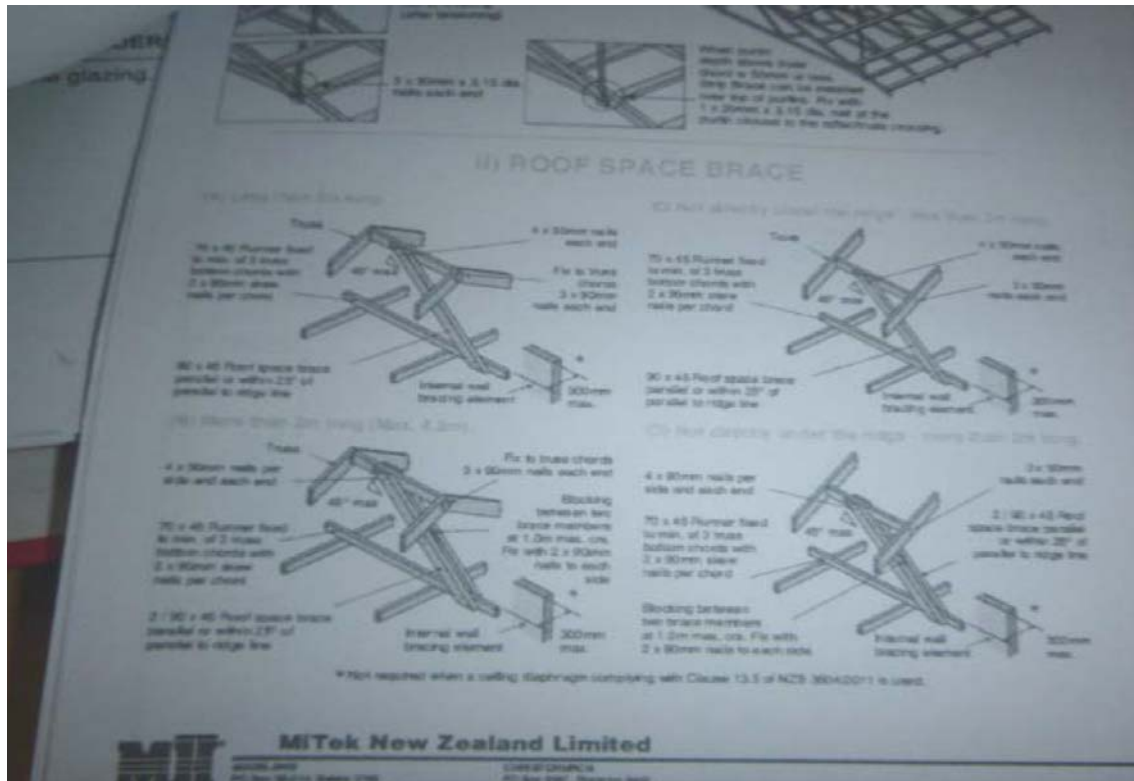




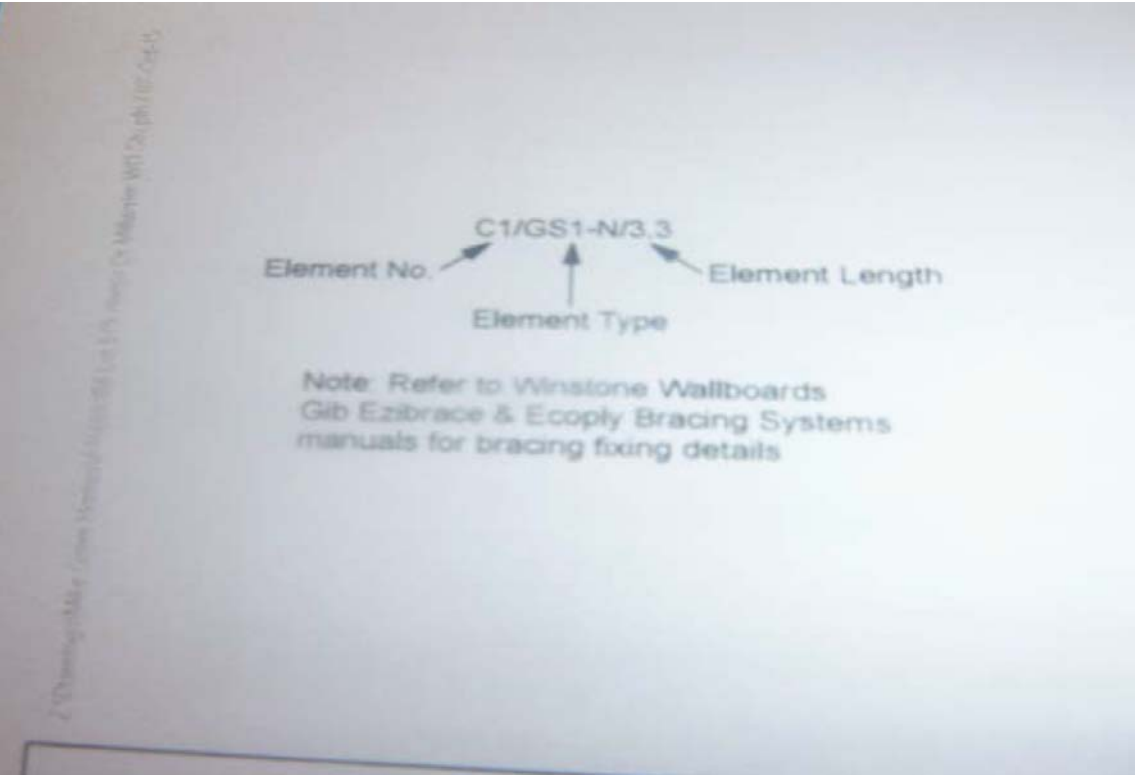
Bracing plan has no key to the bracing type.



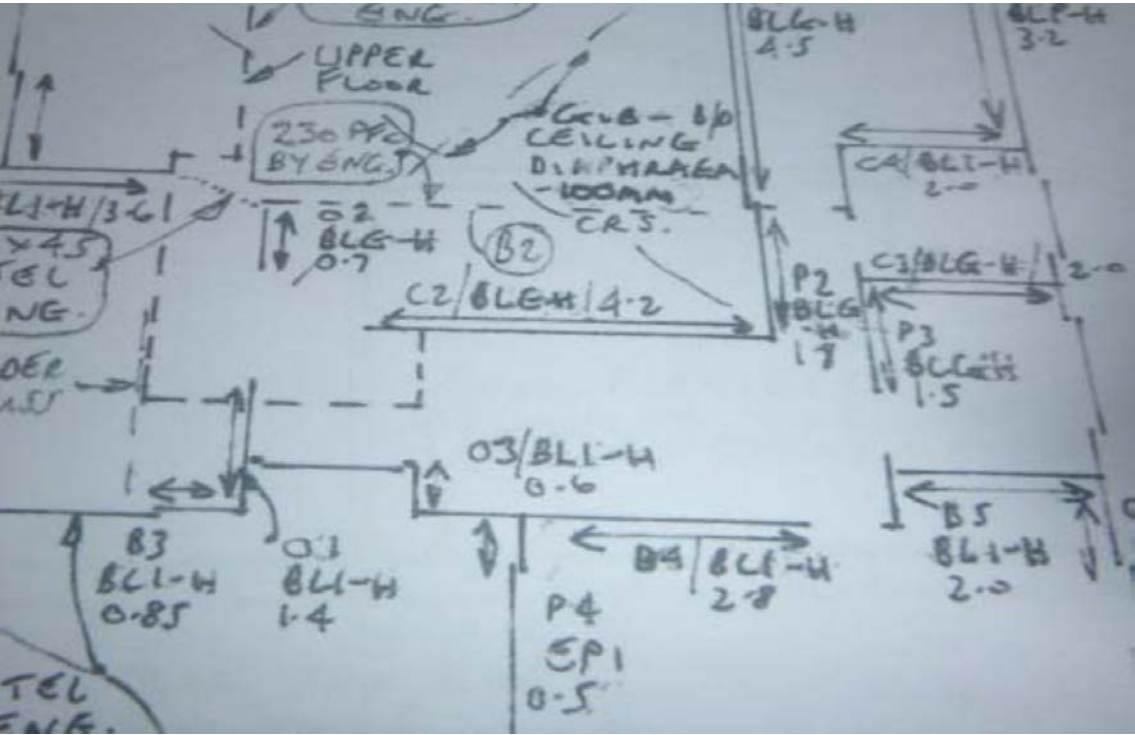
A materials list is good to have but can be difficult to read.



Typical examples of use of manufacturers' details – not all details are relevant for this house.

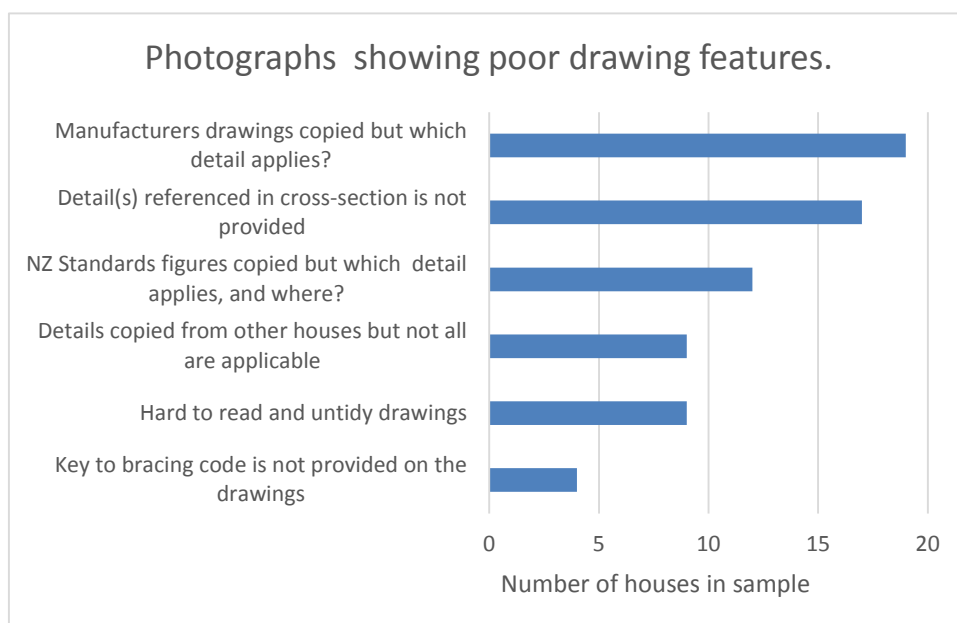


Typical example of reference to manufacturer’s literature for construction details.

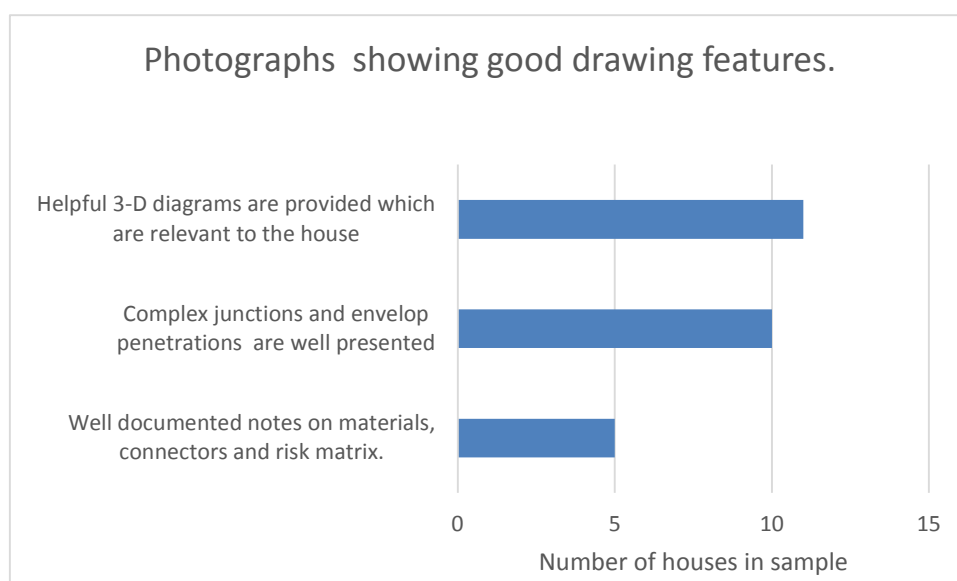


Bracing plan is very difficult to read.

The Realsure inspectors took photos of drawings showing items of interest, and some of these photos are reproduced above. Examination of all the photos indicate that designers often provide a lot of information, but not all of it is relevant. For example, whole pages of manufacturer's installation literature with many diagrams is sometimes copied onto the drawings. It is not immediately clear which detail is relevant to the house. Similarly, whole figures from NZ Standards are copied showing several details, and the one to use is not always apparent. On the positive side 3-D diagrams from manufacturers and the NZ Standards are increasingly being inserted onto the drawings, and can be very helpful. A summary of a scan through all the drawing photos is in Figure 6 and Figure 7.



**Figure 6. Analysis of drawing photos – poor features.**



**Figure 7. Analysis of drawing photos – good features.**