Date: August 2001			

BRANZ
THE RESOURCE CENTRE FOR BUILDING EXCELLENCE

STUDY REPORT

No. 99 (2001)

Design for Durability A Review of N.Z. Practice

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The work reported here was jointly funded by the Building Research Levy and the Building Industry Authority.

ISSN: 0113 3675

Preface

This report covers the findings of a survey of the building industry regarding durability issues in general, and the operation of Clause B2 (the Durability Clause) of the New Zealand Building Code in particular. The views represented have been provided by the survey sample and do not necessarily represent the views of BRANZ, the BIA, specific industry associations or professional bodies.

Acknowledgments

The Building Research Levy and the Building Industry Authority jointly funded this work.

Note

This report is intended for regulators, designers and researchers.

DESIGN FOR DURABILITY

BRANZ Study Report SR 99
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REFERENCE

KEYWORDS: Durability design; Performance-based codes; Buildings, NZBC

ABSTRACT

New Zealand has had a mandatory requirement for durability in its national building code since 1992. In theory, this should have resulted in an increased awareness of the issues behind achieving appropriate durability through the design process, and an active interest in the development of standards and methodologies that could facilitate good durability design.

This paper identifies which sectors of the construction industry are involved in 'design', and how formalised their role is. The response from each sector was analysed to determine their awareness of durability requirements (both regulatory and customer sourced), sources of durability information and knowledge of underlying durability principles.

The state of design for durability in New Zealand is summarised and areas where improvement is desirable are identified. Initiatives to advance in these areas are briefly discussed.

Contents Page

Figures

Page

Tables

Page

1. SUMMARY

With a seven-year history of mandatory durability requirements in the New Zealand Building Code, the NZ building industry could be expected to have developed considerable familiarity with design for durability. A review of the durability provisions of the New Zealand Building Code carried out in 1995, and a survey of the industry familiarity with the requirements showed that the general knowledge of Clause B2 DURABILITY was limited, and that compliance relied primarily on the Acceptable Solution.

Since five years had elapsed since that first review, it was considered appropriate to carry out a second review in 2000. As part of the review process, feedback from a wide variety of industry participants was required. The aim was to identify how durability issues are considered in the design and construction process, together with ways that the present code provisions could be improved.

It was found that almost all groups surveyed consider that they either choose or influence the selection of materials. Apart from Territorial Authorities (TAs) and Building Certifiers, well over half of each sector in the industry say they are involved in design and specification, while a sizable part of the former group exerts influence via advice. Architects are believed by the rest of the industry to be the most likely group to be making decisions on materials.

Most respondents believe that durability is very important to their decisions, with no one indicating that it is of low importance. The most common meaning put to the term durability was in line with that used in the Building Code, but many groups also considered several other meanings important.

The most common sources of information about durability used were trade literature, industry information and advice, and respondents' own experience. Only about half of the sample used the Code and NZ Standards as resources. Lack of reliable information (including experience of materials performance) was considered by most to be the biggest barrier to achieving design for durability, followed by the lack of appreciation of its importance.

Few considered that lack of knowledge of Clause B2 was a problem. Most of the sample considered that they had a general understanding of the Clause requirements, rather than detailed or low. Not surprisingly, knowledge and influence of Clause B2 was indicated as highest amongst building officials, followed by manufacturers. Architects, engineers and builders showed similar patterns with less than 10% considering their knowledge to be detailed and many admitting they had little. However the degree of influence was greater than the knowledge of the Clause, with nearly a third of these "front-line" groups considering that B2 exerted a high degree of influence over their decisions. Interestingly, among architects and engineers, the degree of knowledge and influence of the Code provisions did not correlate to their judgement on the importance of durability.

A third of the sample did not identify any problems with Clause B2, and about half made no suggestions on improvements to B2 or its Approved Documents. The most common problem identified was durability evaluation of materials or systems in a specific proposal, while the parts of the Clause thought to be most needing improvement were the particular life requirements of components, and the limits on application. For the Approved Documents, the areas highlighted for improvement were maintenance (both normal and scheduled), in-service history and similar materials, and the assessment of required durability (including the table of examples and the new corrosion requirements of NZS 3604:1999).

Data compiled includes:

- **A Postal Survey:** Responses were received to a variety of questions about how durability issues and Clause B2 are handled in normal work activities and how the present code provisions could be improved. Forms were posted to a selected sample reflecting a wide

cross-section of industry members spread over a variety of regions, and received back from approximately 60% of the sample.

- *Table 1: Sample Distribution*
- *Figure 1: Survey Response over Sectors*

- **Interviews:** Face-to-face discussions with about a quarter of the total sample of each sector sample were carried out in order to provide background information to support and explain the results of the postal survey.
  - *9.2 Interview List*
  - *9.3 Summary of Comments from Interviews*

Analyses carried out include:

- **Durability issues in general:** Identification of which sectors are involved in choosing materials, and which are thought by others in the industry to be involved, identification of the importance and meaning of durability to the industry, together with the sources of durability information and the barriers to design for durability that are encountered:
  - *Figure 2: Who Chooses Materials?*
  - *Figure 3: Who Do You Think Makes Decisions on Materials?*
  - *Figure 5: Importance of Durability*
  - *Figure 6: Meaning of Durability*
  - *Figure 8: Sources of information*
  - *Figure 10: Barriers to Durability*
- **Clause B2:** Exploration of issues related to the present durability provisions of the Code, including the knowledge and influence of the Clause within the industry, stages at which B2 is considered, and problems with the Clause:
  - *Figure 12: Knowledge of Clause B2*
  - *Figure 13: Influence of B2 on Decisions*
  - *Figure 18: When is Clause B2 Considered?*
  - *Figure 19: Problems with Clause B2*
- **Improvements:** Identification of areas in which the Code provisions could be improved:
  - *Figure 22: Improvements to Clause B2*
  - *Figure 23: Improvements to B2 Approved Documents*.

2. INTRODUCTION

Most societies have an interest in producing infrastructure that performs satisfactorily over its intended design life. Traditionally, this has meant that designers and owners have looked for ways to enhance the durability and longevity of buildings and other infrastructure. While this has resulted in an increased understanding of materials performance, societal, demographic and technological changes often result in a building becoming obsolete before it reaches the end of its useful life. The aim of the designer therefore is not simply to make a building last as long as possible, but also to ensure that it is capable of meeting the design life specified by the client and comply with any relevant regulations. To achieve this, there must be a consideration of materials performance in the design and materials selection process, as well as the provision of maintenance requirements to building owners.

Until 1993, building controls in New Zealand were prescriptive, and, while durability was implicit in the standards referenced by the regulations, no particular design life was specified. When the New Zealand Building Code (NZBC) was introduced in 1993, one of the unique features at the time was the provision of a durability Clause (BIA, 1992) that set default lifetimes for buildings and their components. The basic tenet of the regulations is that buildings must have a life of at least 50 years unless a lesser life is nominated. A 50-year life requirement applies to items that:

- ***provide structural stability***
- ***are difficult to access or replace***
- ***where failure would be difficult to detect.***

Easy to access and replace items have a five-year requirement, while those that are moderately difficult to access and replace, and where failure would be easily detected during normal maintenance, have a 15-year requirement. Applicants for building consents are obliged to provide reasonable evidence that their proposal will comply with the durability provisions. Some ways to provide acceptable evidence will be:

- ***showing compliance with B2 Approved Documents***
- ***using components and systems accredited by the BIA***
- ***proving history of use of the product or system***
- ***providing an expert opinion on the product or system.***

Given that eight years have now passed since the advent of the NZBC durability requirements, it might be anticipated that designers should now be familiar with designing for durability and that newly constructed buildings should have a high level of code compliance.

A review of the durability provisions was first carried out in 1995, and a survey of industry familiarity with the requirements showed that the general knowledge of the Clause was limited and that compliance relied primarily on the Acceptable Solutions.

BRANZ was interested in understanding how design for durability was handled by the New Zealand industry in order to target information and research most appropriately. Since five years had elapsed since that first B2 review, it was opportune for BRANZ and the BIA to collaborate on an industry survey that could feed into a BIA review of NZBC Clause B2 and provide valuable feedback to the BIA and BRANZ.

The survey needed to get feedback from a wide variety of industry participants to get a detailed picture of industry experiences with dealing with durability issues in general and Clause B2 in particular during normal work activities.

The aim was to identify how durability issues are considered in the design and construction process, together with ways in which industry felt that the present code provisions could be improved. This report presents the findings of that survey. The views and opinions presented have been provided by the survey sample and do not necessarily represent the views of BRANZ, the BIA, specific industry associations or professional bodies.

3. SURVEY

3.1 Survey Design

The main objectives of the survey were to establish:

- ***Which parts of the industry are involved in choosing or influencing the choice of building materials or systems?***
    - *How do those groups compare as to who is perceived to be choosing materials?*
    - *How important is durability to the industry?*
    - *What does durability mean to the industry?*
- ***How is NZBC Clause B2 compliance considered in the building process?***
    - *What is the level of knowledge and influence of B2 within the industry?*
    - *How much do groups rely on others for compliance?*
    - *At what stage of the building process is B2 considered?*
- ***What views do Territorial Authorities have on the operation of B2?***
- ***What tools and information sources (including NZ and International Standards) are used for design for durability?***
- ***What barriers to design for durability are encountered?***
    - *How can these barriers be overcome?*
- ***What problems are encountered with B2 and what areas could be improved?***

The survey involved a two-part methodology; a postal survey, plus face-to-face discussions with about a quarter of the total sample of each sector within the industry. These discussions aimed to provide background information to support and explain the results of the postal survey.

As well as the postal and interview surveys, an open invitation was made in trade journals and by correspondence with trade and professional representative organizations, to any interested party to send comments on durability directly to the organisers.

A database of approximately 12,000 industry members maintained by BRANZ for industry publications was used as the primary source for sample selection. The three largest centres were heavily represented in the sample, and several smaller and more rural regions were also included ensuring that feedback would reflect a wide cross-section of industry members.

Table 1 shows the spread of the sample across regions. For practical purposes, face-to-face discussions were limited to industry participants located in Auckland, Wellington and Christchurch.

Table 1: Sample Distribution

	Architects/ Designers			Engineers			Consultants & Advisers			Manufacturers & Suppliers			Construction Trades			TAs and Certifiers			Owners & Managers			**FINAL TOTALS**		
	initial	*Postal*	*interview*	*initial*	*postal*	*interview*	*initial*	*postal*	*interview*	*initial*	*postal*	*interview*	*initial*	*postal*	*interview*	*initial*	*postal*	*interview*	*initial*	*postal*	*interview*	**initial**	**postal**	**interview**
Auckland	*32*	12	4	*16*	6	2	*9*	2	2	*22*	6	6	*29*	12	4	*8*	3	2	*18*	4	2	***134***	**44**	**22**
Wellington	*13*	6	1	*13*	3	5	*11*	6	2	*5*	3	1	*15*	8	3	*7*	1	4	*12*	2	2	***76***	**29**	**18**
Christchurch	*7*	4	2	*5*	3		*2*	1		*7*		2	*9*	3	1	*5*	2	2	*4*	2	1	***39***	**15**	**8**
Dunedin	*3*	2		*1*			*1*			*1*			*3*	2		*1*			*1*			***11***	**4**	
Taupo	*2*									*1*			*3*	1		*1*						***7***	**1**	
Timaru	*2*			*1*	1					*1*	1		*3*	1		*2*	2					***9***	**5**	
Whangarei	*2*	2		*1*									*1*	1		*1*	1					***5***	**4**	
Taranaki	*2*	1											*1*			*2*	2					***5***	**3**	
Hawkes Bay	*1*												*1*			*3*	3					***5***	**3**	
West Coast	*1*	1											*1*	1		*2*	2					***4***	**4**	
Otago	*2*												*1*	1		*3*	2					***6***	**3**	
Hamilton										*2*	1					*1*	1					***3***	**2**	
Other Areas																*13*	9					***13***	**9**	
	67	**28**	**7**	***37***	**13**	**7**	***23***	**9**	**4**	***39***	**11**	**9**	***67***	**30**	**8**	***49***	**28**	**8**	***35***	**8**	**5**	***317***	**126**	**48**

Note: the split between the grouped category totals is as shown in Table 2: Survey Response

An initial letter was sent to the selected sample advising of the survey and inviting recipients to volunteer for a face-to-face interview. Following the response from the initial letter, additional businesses were identified and approached in order to achieve an appropriate number of interviews (refer Appendix 9.2 for a list of those interviewed). Those not booked up for interviews were then sent questionnaires. Appendix 9.2 provides a summary of comments from the interviews.

Once the questionnaires had been sent out, interviews in the three main centres were commenced. These were structured around the questionnaire format, with the interviewees encouraged to explain their responses and to add any further comments they wished to make. This allowed the questionnaire answers to be completed during and following the meetings, along with fairly detailed additional notes.

3.2 Survey Response

By the requested closing date in mid-September, the response rate was only about 30% of the target, so those who had not responded were sent another follow-up letter, which resulted in a final overall response rate of approximately 60% of the original total target (which is considered reasonable for this type of survey).

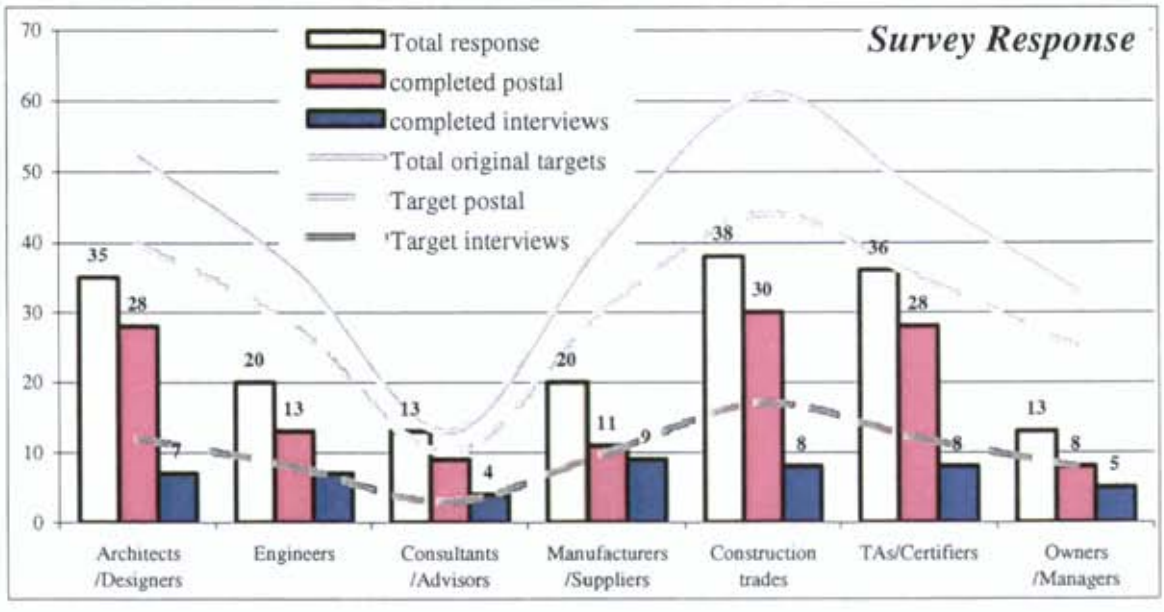
Table 2 gives the breakdown of response rates over each of the sectors in the sample.

Table 2: Survey Response

	Target Postal	*Target Interviews*	*Total Targets*	*Completed Postal*	*Completed Interviews*	*Total*	*% of targets*
Architects	20	6	**26**	15	7	22	***85%***
Designers	20	6	**26**	13	0	13	***50%***
Engineers	28	8	**36**	13	7	20	***56%***
Manufacturers	25	8	**33**	9	8	17	***52%***
Roofers	6	2	**8**	6	2	8	***100%***
Builders	25	8	**33**	17	5	22	***67%***
Plumbers	7	3	**10**	7	0	7	***70%***
Owners	25	8	**33**	8	5	13	***39%***
Consultants	10	3	**13**	9	4	13	***100%***
TAs & Certifiers	35	12	**47**	28	8	36	***77%***
Window Suppliers	6	2	**8**	2	1	3	***38%***
Painters	6	4	**10**	0	1	1	***10%***
TOTALS	213	70	**283**	**127**	**48**	**175**	***62%***
		Response rate from postal targets		***60%***			
		Response rate from interview targets			***69%***		
					Total response rate		***62%***

As shown, the highest returns were from architects, roofers, building consultants and Territorial Authorities, while the lowest were from painters, window suppliers and building owners. The response rate of other sectors shows at around 70% when these three groups are excluded; a rate that is considered satisfactory for a survey of this type. Figure 1 graphs the responses compared to the targets for grouped sectors within the industry.

Figure 1: Survey Response over Sectors



There were no postal replies from painters and paint suppliers, perhaps reflecting the low durability code requirements for paint finishes. However, an interview was held with one local paint manufacturer.

While the response from window suppliers appears low, it should be noted that an interview was carried out with the representative of the Aluminium Window Association who was able to present his members views on the issues raised. It should also be noted that many window suppliers are franchised sales outlets rather than manufacturers.

Based on the questionnaires received from those owners who did respond, and on comments from interviews, their low response rate probably shows that owners do not generally feel that they can make any relevant comments, as this is an area where they rely on their consultants' advice. Few appeared to take an active role in durability issues, and those who did tended to be building professionals with a background in the industry.

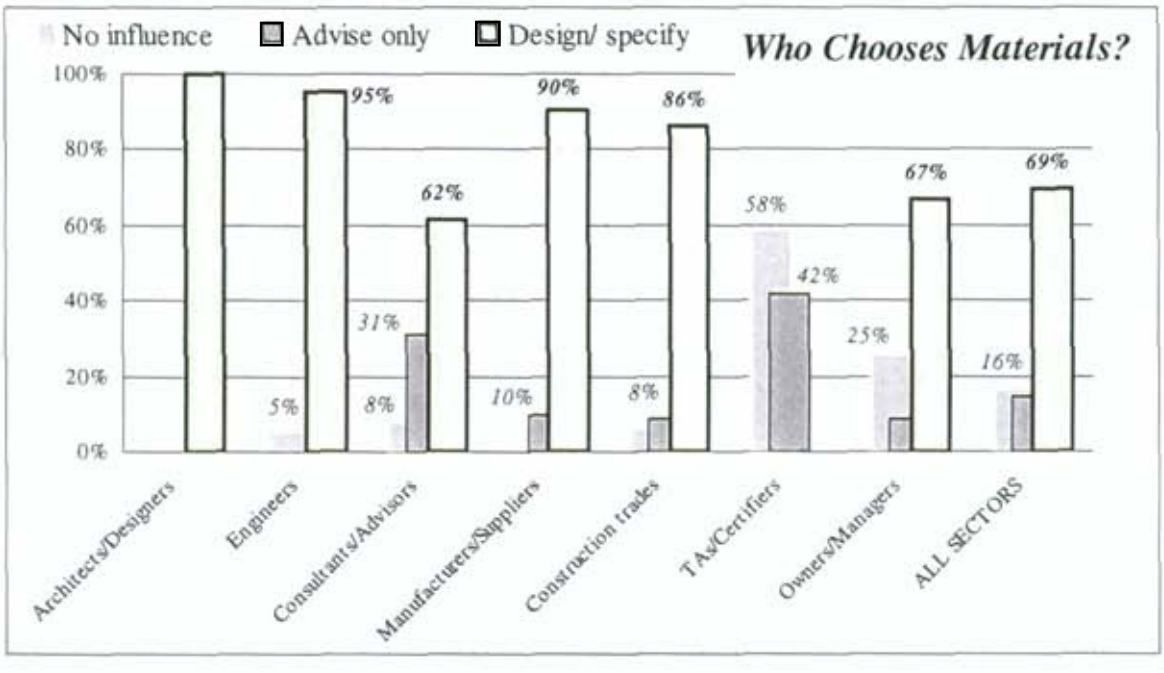
4. CHOOSING MATERIALS

4.1 Who is Involved in Specifying Materials?

One important aim of the survey was to identify who is involved in specifying building materials and systems. This has often been considered to be the domain of the designer, but feedback to BRANZ has indicated that a wide range of sectors are either choosing or influencing the choice of materials. If this is so, then it is unlikely that all of those sectors are familiar with performance issues.

With regard to building materials, respondents were asked to identify which part(s) of the building process they were usually involved in, and Figure 2 summarises the responses from each sector surveyed.

Figure 2: Who Chooses Materials?



As shown, well over half of each sector surveyed was involved in the design or specification of building materials or systems, with the exception of Territorial Authorities and certifiers. However, even this group appears to have more influence than would be expected from their role of ensuring code compliance, with more than 40% indicating that many provide advice and so influence decisions on materials or systems.

Not surprisingly, all architects and designers acknowledged that the choice of materials was part of their role. The high response from engineers (95%) is also not surprising given their traditional

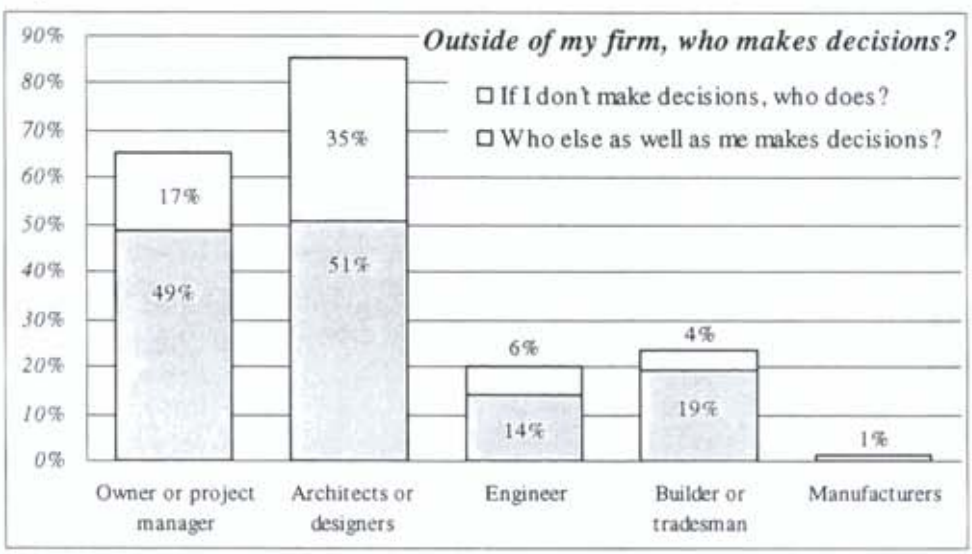
role in building design. Building consultants and advisers, with more than 60% noting their involvement in materials selection, cover a wide range of expertise and are often involved in advising owners on remedial work following investigation of building faults. The high level of involvement of those sectors normally considered outside the design professions may be in part explained by a variety of factors, including:

- ***Detailed Component Design:*** *Increasing role of manufacturers, builders and other trades in "design and build" elements where responsibility for detailed design, including the underlying support components, is made by the manufacturer or at the construction stage.*
- ***Potential Liability:*** *Shift in perceived legal liability due to inclusion of durability requirements within the NZBC leading to manufacturers becoming more involved in how products are installed.*
- ***Lack of Specific Design:*** *Most houses do not involve design professionals and are built to conform with NZS 3604:1999. Many are produced by housing development companies who produce a range of standard pre-approved designs that allow limited owner-selected options on materials, while others are built speculatively without a prospective owner.*

4.2 Who is Thought to Make Decisions on Materials?

There is a difference between having an **involvement** in or **influence** over the choice of materials, and making final decisions on their choice. That decision-maker may be someone either outside or inside one's own firm. Respondents were asked whom they thought made decisions outside of their own organisation and the answers from the sample are shown in Figure 3. Note that Figure 3 excludes those respondents within the sector specified by all other sectors as making decisions. If they made decisions on materials themselves, they were asked to specify who else as well as them also made choices. If they did not make decisions, they were asked to specify who did.

Figure 3: Who Do You Think Makes Decisions on Materials?



As shown, more than 80% of those who answered thought that architects were making decisions on building materials. It should be noted that the major portion of the total sector percentages apply to decisions made in conjunction with the respondent.

In the case of designers, the joint or team nature of decision-making is reflected – where the designer is working with others such as engineers, builders, consultants or owners. This also applies to the next highest group, where 66% of the other sectors specified owners or project managers as making decisions along with themselves. In other words, the respondent will be making decisions but, in the case of owners, those decisions will be in conjunction with or

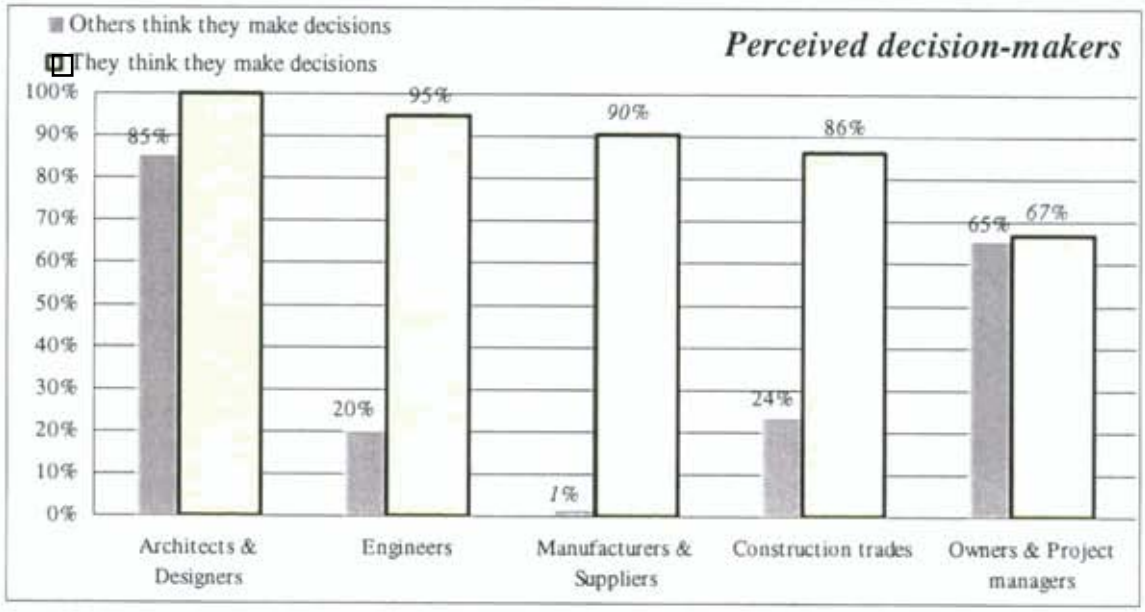
approved by their client. It is interesting to note the involvement of project managers as a named group in the decision-making process. As project managers work as owners' representatives, their numbers may be considered as part of those for owners.

It is surprising to note that only 20% named engineers as decision-makers. On checking those respondents, half were from construction trades, with the remainder evenly spread between designers, manufacturers and owners.

4.3 Perceptions of Industry on Decision-making

The responses by the industry groups on their own involvement in choosing materials were discussed in Section 4.1 and shown in Figure 2: Who Chooses Materials? In Figure 3: Who Do You Think Makes Decisions on Materials?, the sectors that are thought to be responsible for decision-making were looked at. As project managers work as owners' representatives, they have been included in the figures for owners in this analysis. Those who indicated their involvement in designing or specifying materials were then compared to the sectors thought to be making decisions, and the result is shown in Figure 4.

Figure 4: Actual Versus Perceived Decision-makers



It is interesting to note the differences between actual decision-making and the perception by others in the industry. In every case, the proportion of those sectors that considered that they made decisions on materials was greater than the percentage perceived by the rest of the industry to be making decisions. For architects and owners, the difference was not large, but for the other sectors it was very significant:

- ***Engineers**: 95% chose materials, whereas others perceived only 20% as doing so. There is likely to be a number of reasons for this difference. One is that many smaller buildings have little or no engineering input, meaning that other sectors have no contact with engineers. Another is that many engineers are secondary consultants, meaning that contact tends to be largely limited to the primary consultant and other groups may not be aware of the nature of decisions involved in the engineering input into the building.*
- ***Manufacturers and suppliers**: 90% chose materials, whereas others perceived almost none as doing so. This is likely to be due to other groups not considering the choices that go into the design and installation of manufactured products and systems. For instance,*

the other groups may think of a ceiling system as proprietary, whereas it is actually a designed system made up of a variety of components.

- ***Builders and tradesman**: 86% chose materials, whereas others perceived only 24% as doing so. The reason for the difference is likely to be similar to that for manufacturers; namely that many builders and tradesmen are involved in the support components that make up the system, whereas the other groups may not appreciate the decisions required in order to design the system.*

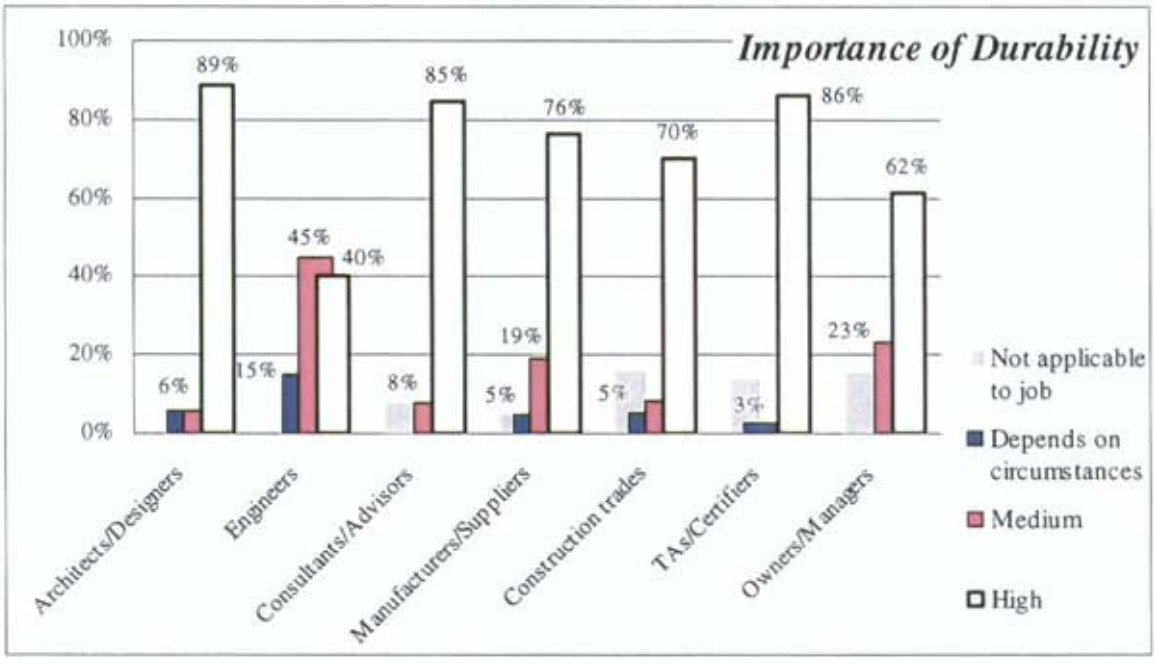
These differences support the comment made in Section 4.1, namely that specifying building materials and systems is often considered to be the domain of the designer rather than of other sectors whereas, in practice, many sectors are either choosing or influencing the choice of materials.

5. DURABILITY IN GENERAL

5.1 Importance of Durability

Figure 5 summarises responses as to the importance of durability. This was rated as an important issue by most of the groups surveyed.

Figure 5: Importance of Durability



Surprisingly, durability importance received the lowest rating from engineers who were split between considering durability as being of high or medium importance (although a notable percentage indicated that it depended on the circumstances). Engineers are in most cases involved in the structural design of a building and, while specific durability requirements were not mandatory in NZ prior to 1992, the client's expectation of the life of a structure has generally been in excess of 50 years. For many engineers therefore, the introduction of Clause B2 has had little effect on engineering design practice. Durability tends to be implicit in B1 Approved Documents without the need to be specifically considered.

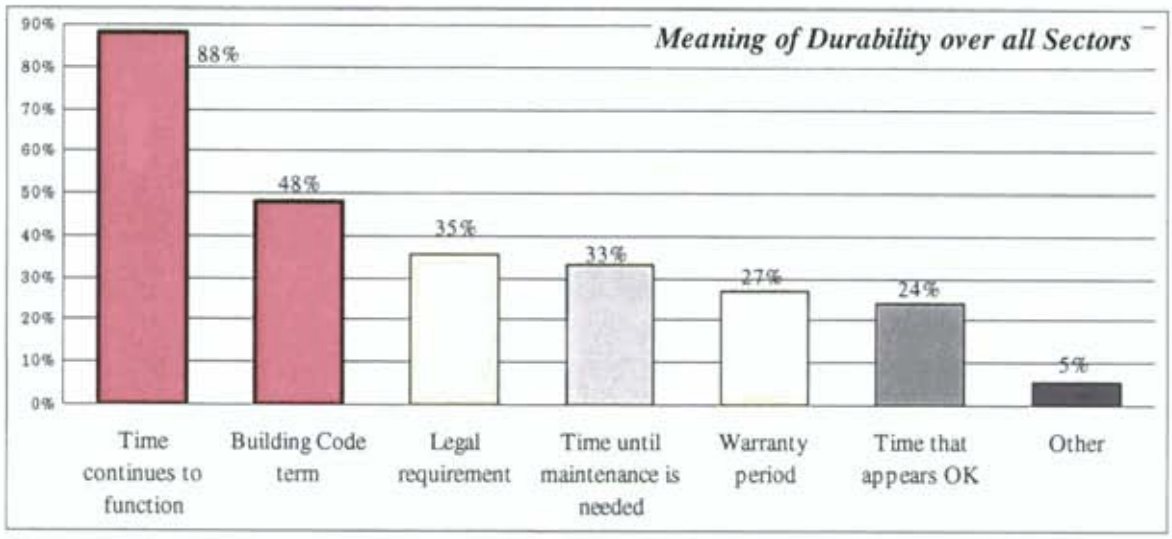
Comments from many of those interviewed indicated that durability issues have increased in importance since the introduction of the NZBC, with particular emphasis coming recently from the updated NZS 3604 (Standards New Zealand 1999), which has focused attention by including, for

the first time, a section that deals specifically with durability. As this is the most common standard used by house designers and builders, it is likely to directly influence these groups.

5.2 Meaning of Durability

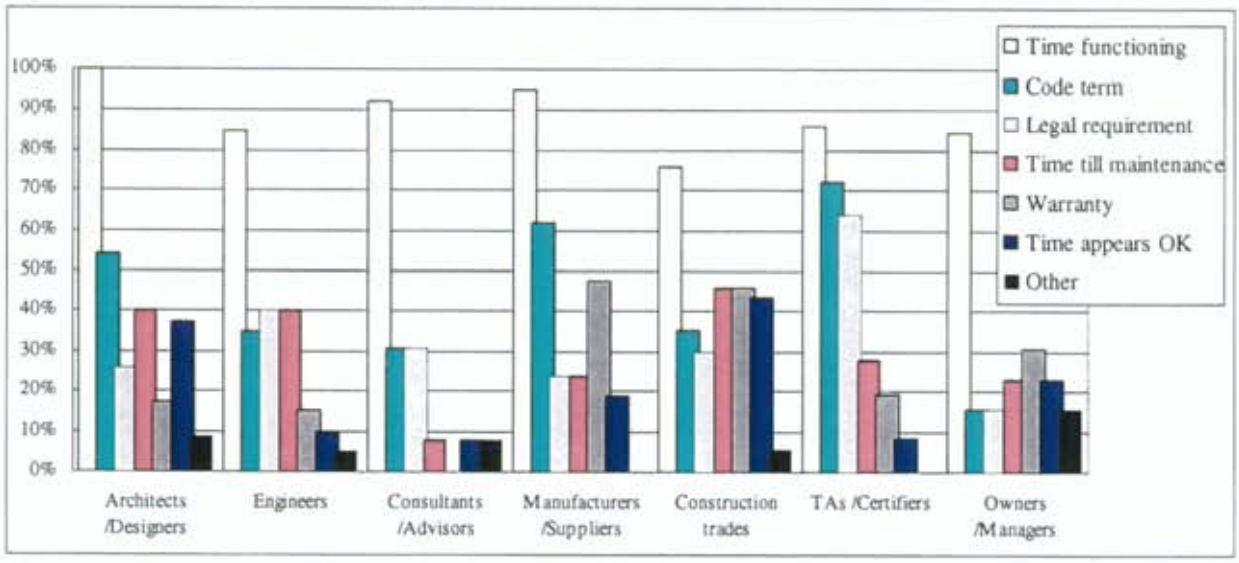
Those surveyed were asked what the term "*Durability*" meant to them. Respondents were able to choose any number of meanings from a provided list of options, and to add any others if wished. Figure 6 summarises the responses across all groups.

Figure 6: Meaning of Durability



As expected, the most common option chosen was "*Assuming normal maintenance, the time that a component continues to function*" (in line with that of the Building Code), with the next most common being "*A NZ Building Code term*". These two meanings are obviously related, so may be jointly considered. Not surprisingly, all Territorial Authorities, certifiers, manufacturers, engineers and architects chose one or both of these meanings. However it is interesting to note the other meanings that were considered relevant to other groups, and Figure 7 shows the results by sectors.

Figure 7: Meaning of Durability by Sectors



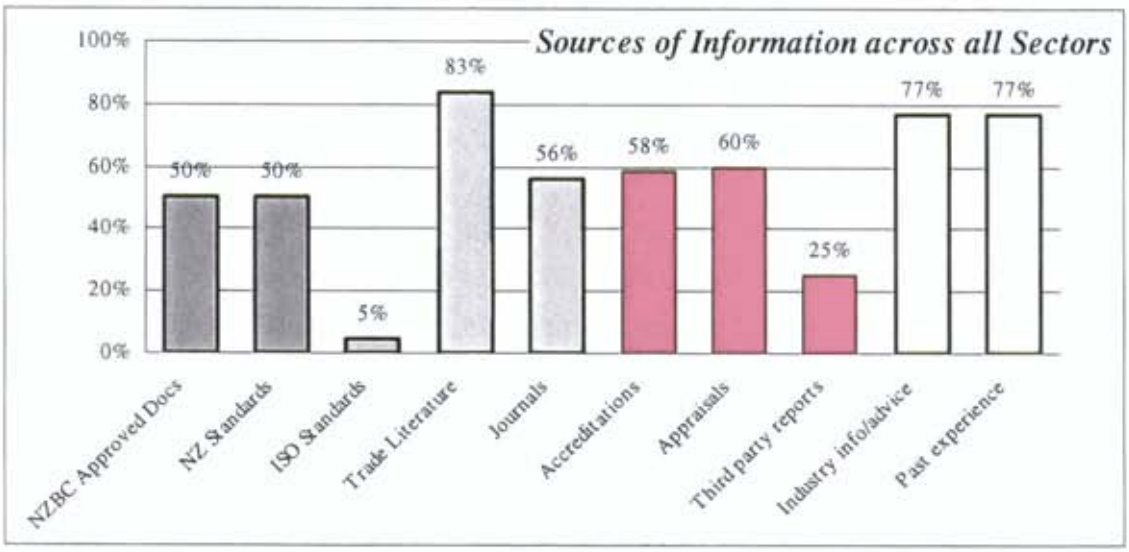
As expected, the term durability meant different things to different sectors. Respondents were able to choose any number of meanings from a list of options provided in the questionnaire, and to add more meanings should they choose to. The main points arising from this analysis are:

- ***Legal requirement:*** *more than a third chose this as one of the meanings, with more than 60% of TAs and certifiers, and 40% of engineers. As mentioned earlier, there appears to have been a shift in perceived liability since the inclusion of durability requirements in the code, and interviews have revealed this to be a major reason for the inclusion of this as one meaning – particularly on the part of TAs.*
- ***The time before maintenance is needed:*** *a third of the sample chose this as one meaning, with design professionals and construction trades being the most likely groups to include this meaning. When questioned on this during interviews, architects and engineers argued that with good maintenance a building's life could be extended indefinitely, and so maintenance was a prime requirement for durability with more emphasis needed on its role.*
- ***Warranties*** *were a meaning that was particularly important to owners, manufacturers and the construction trades. To owners, this is presumably because they receive the warranties and regard them as a "certificate" of durability, while to the others it appears to be because they bear the liability.*
- ***Durability of appearance*** *was important for architects and builders. The explanation given during interviews was that this is what would first prompt owners to think that something was wrong and to seek remedial action.*

5.3 Sources of Information

Survey participants were asked about where they got their information on durability. They were able to choose any number of sources from a list of options and to add more should they choose to. Figure 8 summarises responses as to the sources of information about durability, aggregated over all sectors.

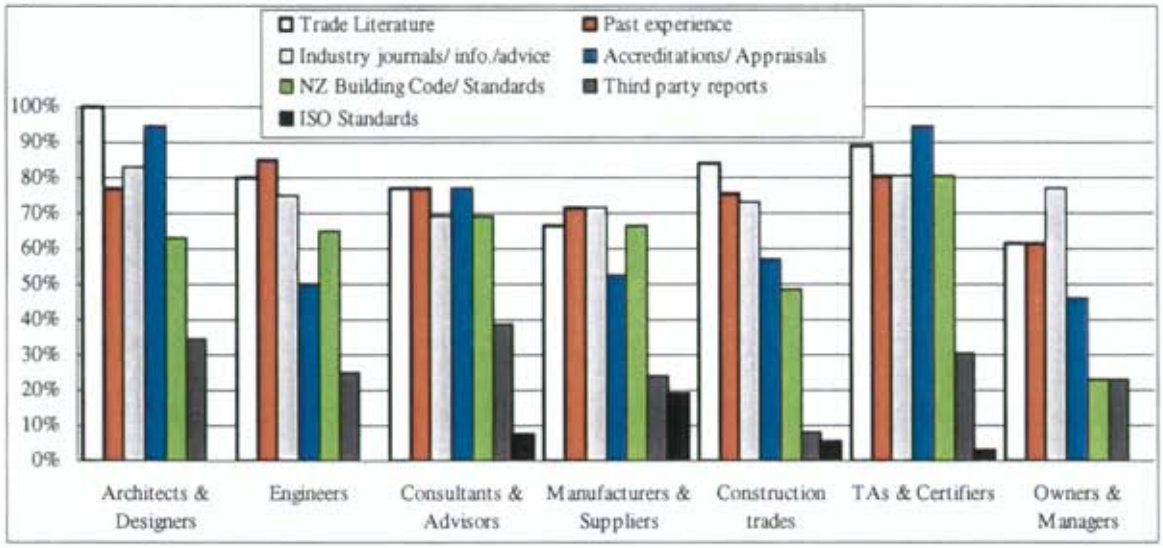
Figure 8: Sources of information across all sectors



The most common sources were trade literature, industry information and past experience. The least common source was ISO product standards with very few of those surveyed listing these as a tool or source of information. Manufacturers and suppliers were the only sector showing any significant level of use of ISO standards.

In order to be able to see how the sectors differed, Figure 9 shows the information sources used for each sector.

Figure 9: Sources of Information for Each Sector



It is probably to be expected that architects, engineers and builders should see trade literature as being the most important source of information, particularly on new materials and products. It was more surprising that those responsible for enforcing the Building Code (Territorial Authorities/building certifiers) also found it important, and interviews revealed that more detailed information was sought from manufacturers than in the past, with recommendations as to maintenance often being kept as part of the compliance documentation. The reason given for this was the increased risk of liability in regard to durability issues.

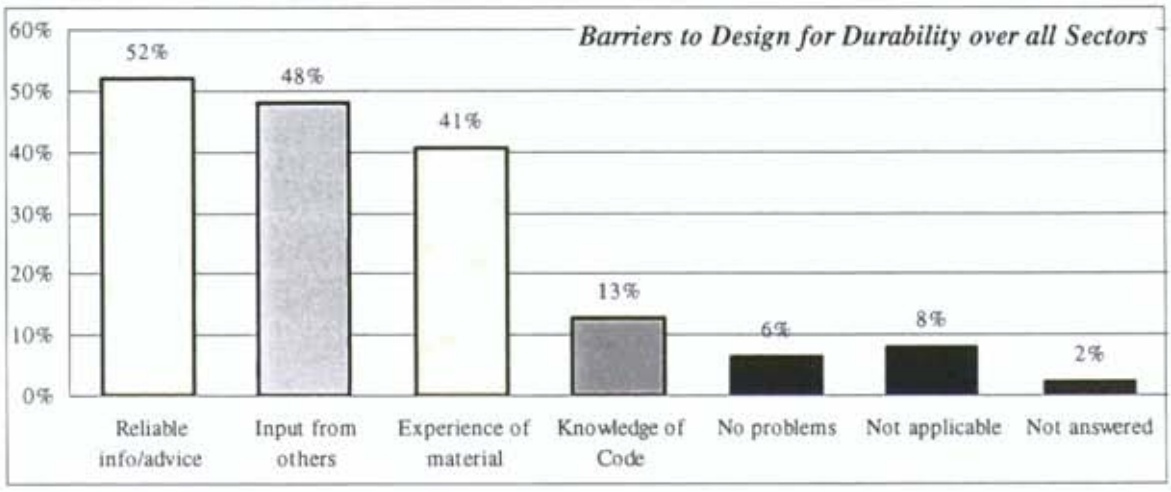
Not surprisingly, Territorial Authorities also listed the NZBC and New Zealand Building Standards as important sources of information on durability. However this was not so in the other sectors, with less than 60% listing these as usual sources. Well under 40% of architects and designers regularly used the NZBC and relevant standards in relation to durability issues, although all of them rated durability as being very important. During interviews, the main reason given for this possible inconsistency was that they had always treated durability as very important, and that legislation did not affect that. Durability issues were treated in the same way as they were before the Building Act came into force, and that their design aims were well above the minimum levels set by the Code.

5.4 Barriers to Design for Durability

Respondents were also asked to identify what problems they had in handling durability issues. The most important barrier related to the lack of information, whether in the form of actual experience of the performance of materials, or reliable objective information for choosing materials or considering substitutions.

This is not surprising when related to the sources of information shown in Figure 8, as trade literature, industry information and past experience were the most important sources identified by industry sectors. Interviews revealed that there is less trust in test results than in actual local use over a long period of time. It appeared from the interviews, that the more experienced the respondent, the more conservative was the approach to new materials and systems. A common comment was that they did not want to act as guinea pigs, and were old enough to have learned from being burnt in the past. Figure 10 summarises the results across all groups in the sample.

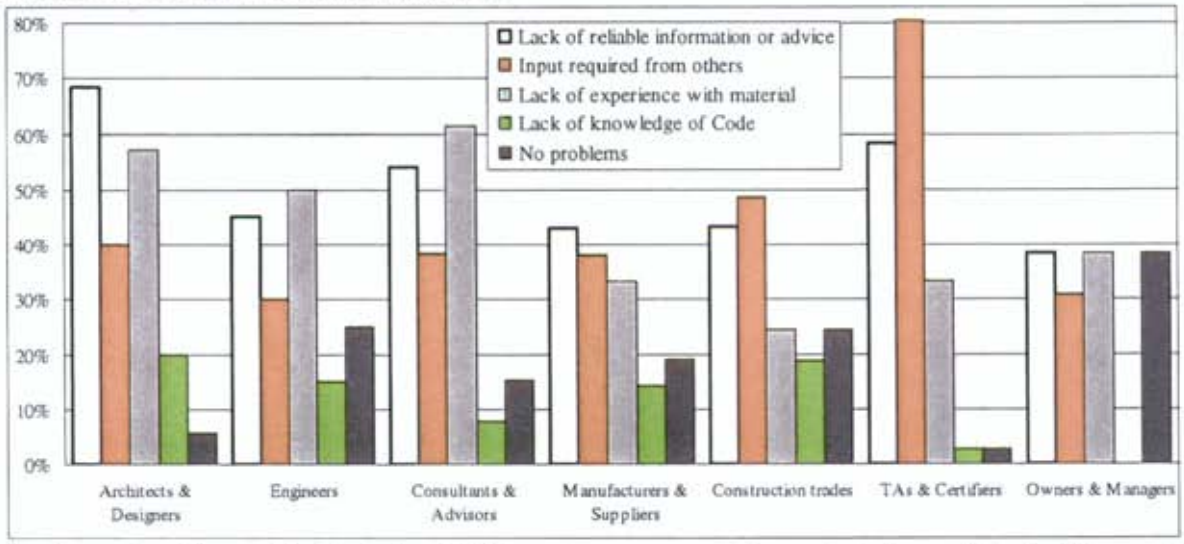
Figure 10: Barriers to Durability



There is also limited reliance on the objectivity of information supplied by those who are trying to sell a product. While BIA accreditations, BRANZ appraisals and third party reports should be objective and reliable, they were not listed as the most important sources of information. From comment by interviewees, this appeared to be due to the limited number of these that are available relative to the large numbers of materials and products on the market. In particular, access to third party reports appeared to be a problem because these are usually confidential.

It is notable that few respondents listed lack of knowledge of the code requirements as being a barrier to designing for durability. It is also interesting to note that 15% of the respondents believed that they had no problems in handling issues of durability, or that the question did not apply to their job, or they did not answer this question. Figure 11 shows the barriers identified by each sector.

Figure 11: Barriers to Durability by Sector



As shown in Figure 11, the lack of information was most important for architects, TAs, and consultants, with comments made in interviews on the proliferation of new products into the market over the past 10 years. It is not surprising that these sectors are particularly concerned with this barrier. Architects are required to be familiar with all of the products used in a building, rather than the more limited range handled by engineers. Likewise, TAs are required to assess all of these products for compliance purposes. Consultants and advisers are often involved in specialist reports on failures, where the lack of information can be a problem in assessing the situation.

The other important barrier identified was the lack of appreciation by others (input required by others) of the importance of durability. As shown in Figure 11, this particularly applies to TAs and certifiers, with more than 80% seeing this as a problem. This would appear to indicate that officials perceive a high degree of apathy throughout the industry or that they have a higher level of expectation of what is reasonable evidence that B2 requirements will be met compared to other sectors. However, this perception seems to be at odds with the industry's responses on the importance of durability as shown in Figure 5.

Another reason for the apparent disparity could be related to the nature of this survey, as it may be argued that those in the industry who are indeed apathetic form a major part of the 40% who did not respond to the questionnaire. However, it may also relate to the possibility that, although designers consider durability important, they do not necessarily appreciate the importance of communicating their durability decisions to the TAs. More industry education about code requirements, along with improved communication between those responsible for enforcing these requirements and those sectors specifying materials is needed to overcome this particular barrier.

The provision of more durability information to those involved in specifying materials is an obvious next step to help further design for durability. Documents published (ISO, 2000) and in preparation for the ISO 15686 series on "Design life" will provide guidance for those assessing durability, and these may have a place within the Approved Documents. The ISO series will not, however, provide details on the durability of specific materials, nor even prescriptive methodologies for determining durability. The building industry will need to ensure that resources are made available to develop more specific guidance documents which will take into account materials' properties, their uses, and the environments within which they are used.

6. CLAUSE B2

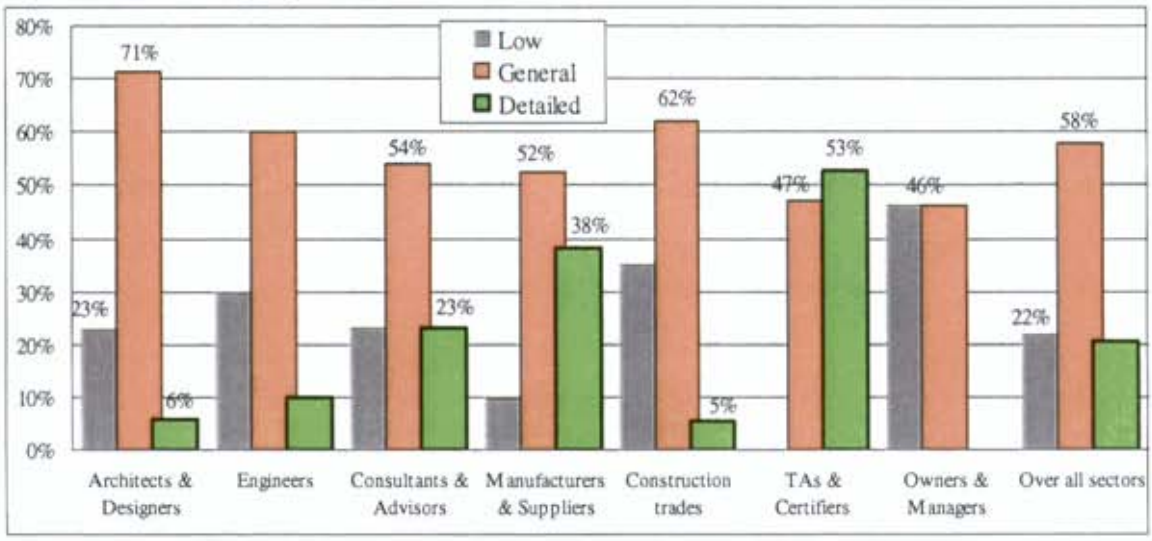
The following part of this report moves from general issues relating to durability towards issues relating to the durability provisions of the Building Code.

In order to be able to judge the effect of Clause B2 on the day-to-day activities of the different groups involved in the building industry, the questionnaire posed a series of questions covering the respondents' knowledge of the requirements, the influence of the latter in their normal work, the reliance put on other sectors for compliance, and the stage(s) at which the provisions are considered. The questionnaire then sought responses on particular problems with, and suggested improvements to, the Clause.

6.1 Knowledge of Clause B2

Respondents were asked to assess their knowledge of the requirements of Clause B2 and the associated Approved Documents, and their answers are summarised in Figure 12.

Figure 12: Knowledge of Clause B2



The most popular answer was that respondents considered their knowledge to be general, rather than detailed or low. As shown, only 22% of the total sample considered that they had a detailed knowledge of the provisions, as compared to 58% indicating a general knowledge, and 20% with a low level of knowledge of the requirements.

This would seem to be surprising, considering the length of time since the Clause's introduction. However, people tend to gain as much knowledge as is necessary for their normal activities and not seek further detail unless it is called for. This was supported by the interviews where many commented that they knew where to find more detail if they required it, but felt they had sufficient information for their normal activities.

The main points arising from Figure 12 are:

- **TAs and certifiers:** As expected, Building Officials had the largest number who indicated detailed knowledge – although surprisingly, only around half assessed themselves as such.
- **Manufacturers:** Of the other groups in the industry, manufacturers appeared to have the highest level of knowledge of B2, although it was obvious from comments in interviews that this particularly applied to those who had struck some type of problem in the past. Several commented that they had no choice but to gain a detailed understanding as TAs were requiring an increasing level of support documentation. Most commented that their knowledge had increased over the past few years and that they were increasingly aware of their potential liability for ensuring that their products complied.
- **Consultants & Advisers:** This group had the next highest level of detailed knowledge, although it was still less than 25%. However, it must be remembered that this group contains a variety of specialists, some of who are unlikely to require detailed knowledge, e.g. project managers, quantity surveyors etc.
- **Design Professionals:** Rather surprisingly, given their high level of involvement in decisions regarding materials and systems, very few architects and engineers considered themselves to have a detailed knowledge of B2. 23% of architects and 30% of engineers considered that their knowledge was low. Possible reasons for the high percentage of architects and engineers who indicated a low influence of B2 were revealed during the interviews, and are discussed further in 6.3. However all of those interviewed commented that they had as much knowledge as they considered necessary, and knew where to find more if it was needed.
- **Construction Trades:** Among the industry groups, these respondents showed the lowest level of knowledge of the Clause, which is perhaps not surprising given the limited nature of their role in design and specification. Over 60% considered that they had a general knowledge.

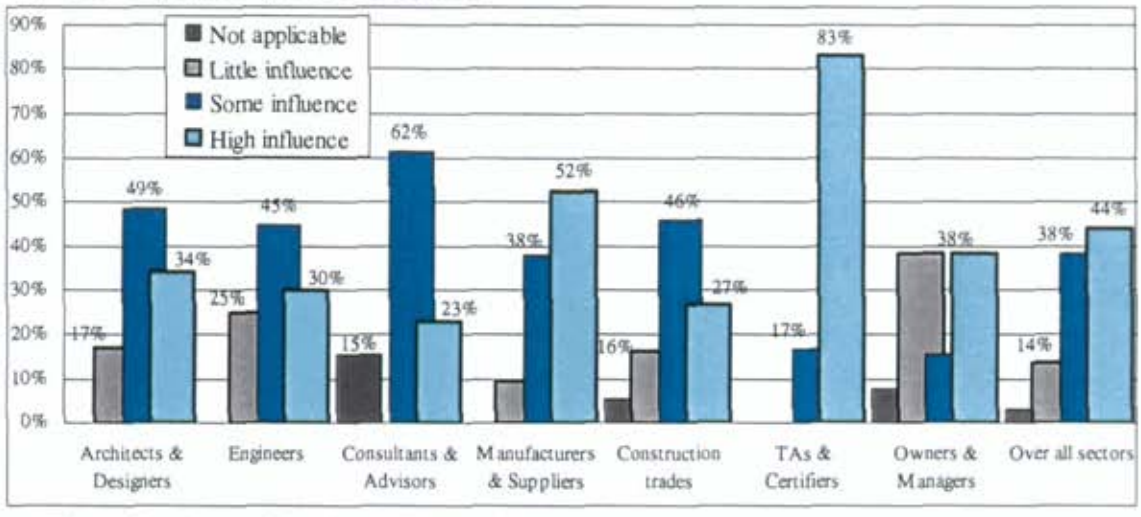
The disturbing point however, given their influence over many homeowners' decisions, is that more than a third assessed their awareness as low.

- **Owners:** No owners or managers considered that their knowledge was detailed, and more than 45% assessed it as low. This is to be expected, as most owners tend to rely on their design consultants for such matters. Comments from interviews supported this, and it was clear that owners generally expected their consultants to ensure that all relevant regulations were complied with. It is perhaps more surprising that half of the owners considered that they had a general knowledge, although this is probably due to the owners in the survey being professional property managers of commercial buildings, rather than homeowners.

6.2 Influence of Clause B2

Respondents were asked to assess the degree to which the requirements of B2 usually influenced their decisions regarding design or choice of materials and the results are shown in Figure 13.

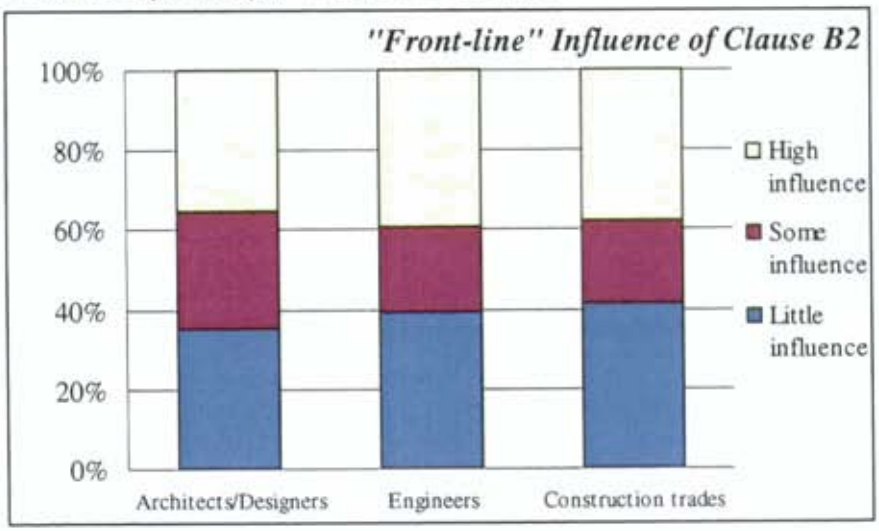
Figure 13: Influence of B2 on Decisions



- The main points arising from Figure 13 are:
- **TAs and certifiers:** As expected, TAs and certifiers had the largest number who indicated that B2 had a high level of influence. The remainder indicated that B2 had some influence, with none indicating little or no influence.
- **Manufacturers:** Of the other groups in the industry, manufacturers appeared to be influenced the most, and it was obvious from comments in interviews that this was steadily increasing, as TAs were requiring an increasing level of support documentation. Most commented that the influence of B2 had increased over the past few years (with a number being particularly affected by the recent durability requirements of NSZ 3604:1999) and they were becoming increasingly aware of their potential liability for ensuring that their products complied.
- **Consultants & Advisers:** The majority of this group indicated a medium degree of influence. From comments during interviews, it appears that the influence depends on the type of work done and the relevance of the Building Code to the particular project. Many consultants were involved in investigation of faults that often related to pre-NZBC work, where B2 was irrelevant. Also, recommended remedial work tended to be well over minimum B2 levels, as owners required durability issues to be treated as critical in order to avoid future problems. Others were involved in project management or quantity surveying where their input was of a non-technical nature.
- **Design Professionals and construction trades:** Similar patterns emerged from these "front-line" sectors, and are shown in Figure 14. As shown, about 60% indicated that the influence

of B2 was either high or medium, with around 40% noting the influence as low. Possible reasons for the high percentage of architects and engineers who indicated a low influence of B2 were revealed during the interviews, and are discussed further in 6.3.

Figure 14: B2 Influence for "Front-line" Groups

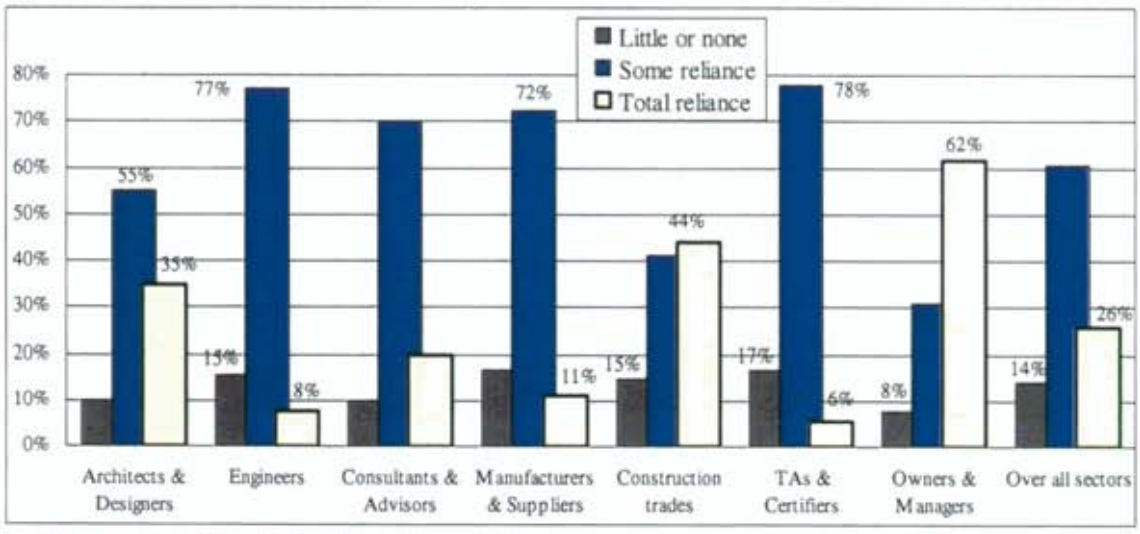


- **Owners:** A third of the owners indicated that the influence of B2 was high, which initially appears at odds with the lack of knowledge indicated previously. However, when the four particular owners who had chosen this option were investigated, it was found that two were property managers of institutional buildings, while one was a professional property maintenance expert who specialised in buildings with problems. Comments from interviews implied that most owners expected their consultants to ensure that all relevant regulations were complied with, which explains the 50% of owners who indicated that B2 had little influence or was not applicable to their roles.
- **Over all sectors:** Approximately 85% of the sample indicated that B2 exerted either some or a high level of influence over their decision in regard to design or choice of materials in their day-to-day work. When considering this in conjunction with the fact that almost 80% indicated a general or detailed knowledge of the requirements level of knowledge (see Figure 12), this would seem to suggest that the industry is becoming more familiar with, and knowledgeable about the use of the requirements.

6.3 Reliance on Others for B2 Compliance

Following on from the answers given as to the knowledge and influence of B2, it was interesting to discover which groups relied on others to ensure that the code requirements were complied with. It would be reasonable to assume that those who had little knowledge of, and were little influenced by Clause B2 would be those who relied on other groups. However, as shown in Figure 15, this is not necessarily the case.

Figure 15: Reliance on Others for Compliance



- The main points arising from Figure 15 are:
- **TAs and certifiers:** Almost 80% of TAs and certifiers had some reliance on others for ensuring that durability requirements were met. This was explained by comments made during the interviews. In their case, "others" generally referred to architects, engineers, builders and manufacturers of specified products. Where these had a good history and reputation in regard to performance and lack of problems, then more reliance could be placed on the quality of the proposal and less time spent on seeking assurance. As was explained during one interview, in practical terms, no one could ever be totally sure that a proposal complied with NZBC in all respects. Time constraints therefore made it sensible to concentrate on the risk areas, and to put the effort into those rather than one that could be considered as low-risk. Of the two who said they placed total reliance on others, at least one of those was a manager who was probably referring to others inside his organisation.
- **Manufacturers:** More than 70% of manufacturers placed some reliance on others. It was obvious from comments during interviews that this tended to be related to materials or suppliers used in the manufacturing of their products. Those manufacturing products or components that used a limited range of known and trusted suppliers or installers were able to place a lot of reliance on these. It was also pointed out that once the product with its installation instructions left their control, reliance had to be placed on those next in the line (including maintenance by owners). Less than 20% placed little reliance on others, while only about 10% were able to place total reliance on others. The latter were mainly large firms using a limited number of known materials and trusted suppliers.
- **Engineers:** This group showed a similar pattern to that of TAs and manufacturers, with more than three-quarters placing some reliance on others. This appears reasonable, as most engineers are secondary consultants on building projects and must rely on other consultants to do their own part of the work according to code requirements, and for manufacturers to supply according to specifications. Comments from interviews support this conclusion, but also indicate that the amount of reliance depends on whom they are dealing with in terms of history and reputation, and is also tempered by knowledge of generic qualities of materials in question. Several also indicated that reliance varied depending on whether the firm was acting as primary or secondary consultant.
- **Architects & Designers:** Interestingly, in view of the comments from engineers, this group appeared more trusting, with more than a third totally relying on others to ensure that requirements were met, and only 10% having little or no reliance on others. However, comments indicated that those who totally relied on others tended to work with a limited

number of trusted consultants, builders and suppliers – so would rely on these groups to do their parts of the project according to requirements and specifications.

- **Consultants & Advisers:** The answers given by this group depended on their background and the type of work that they undertook. For instance, the two who indicated that they had total reliance on others for compliance had jobs with limited technical input (one was a project manager and the other a quantity surveyor) while the 30% who indicated little or no reliance were mostly involved with fault investigation and remedial work where all aspects were questioned.
- **Construction trades:** Of the technical part of the industry, this group had the highest level of reliance on others at well over 40%. In this case, that high level tended to be in line with the low level of knowledge of B2 as shown in Figure 12. From comments in interviews, it seems that those builders who rely on others use a limited range of trusted suppliers and subcontractors, assume that design consultants have complied with the code and that products are as claimed by the manufacturers.
- **Owners:** As expected, owners had the highest level of reliance on others for code compliance at more than 60%, which is generally in line with their low level of knowledge of the Clause. This was supported by evidence from the discussions, as owners interviewed were clearly of the opinion that compliance was the responsibility of their consultants.
- **Over all sectors:** 60% of the sample indicated that they relied to some extent on others in regard to compliance with Clause B2, depending on who and what they were dealing with. More than a quarter placed total reliance on others, but this section of the sample was largely made up of owners and builders.

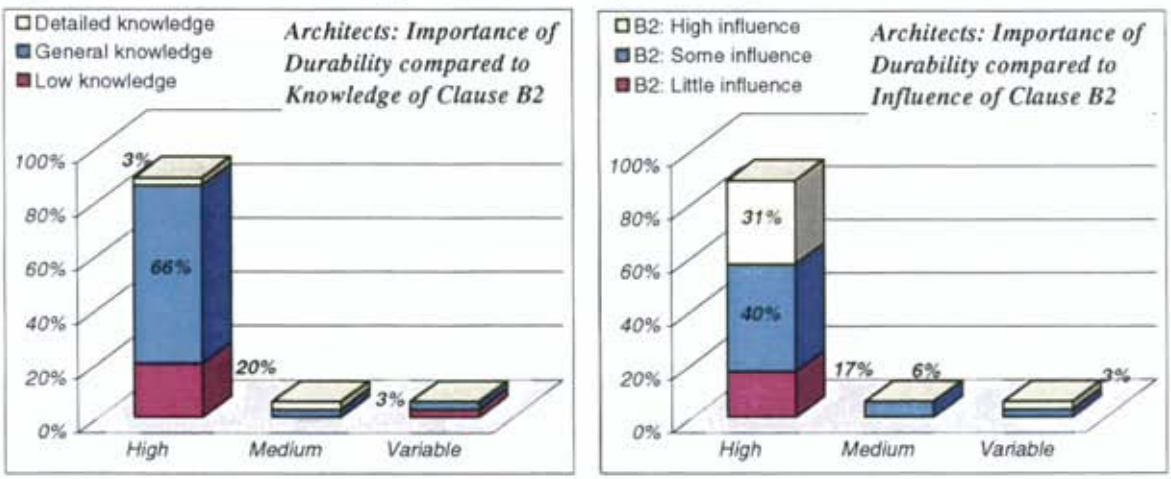
6.4 Clause B2 for Architects & Engineers

As raised earlier in Sections 6.1 and 6.2, it seems surprising that, given their high level of involvement in decisions regarding materials and systems, architects and engineers generally assessed themselves as having only a general or low level of knowledge of Clause B2, as shown in Figure 12. These groups also indicated that the Clause exerted only a limited level of influence over their usual activities. This seemed particularly surprising when almost 90% of architects indicated that they treated durability as very important, and 85% of engineers treated it as of medium or high importance. Because of this, further analysis was done in order to relate their answers on the importance of durability to their answers on knowledge and influence of B2.

6.4.1 Architects

The relationship between the importance of durability, and the knowledge and influence of B2 is explored in Figure 16.

Figure 16: Architects: Knowledge/Influence Compared to Importance



Those who assessed durability as important are split into those who considered that their knowledge of B2 was detailed, general or low, and those who considered that the influence of B2 was high, some or little. The same was done for those who assessed the importance of durability as medium (no one assessed the importance as low).

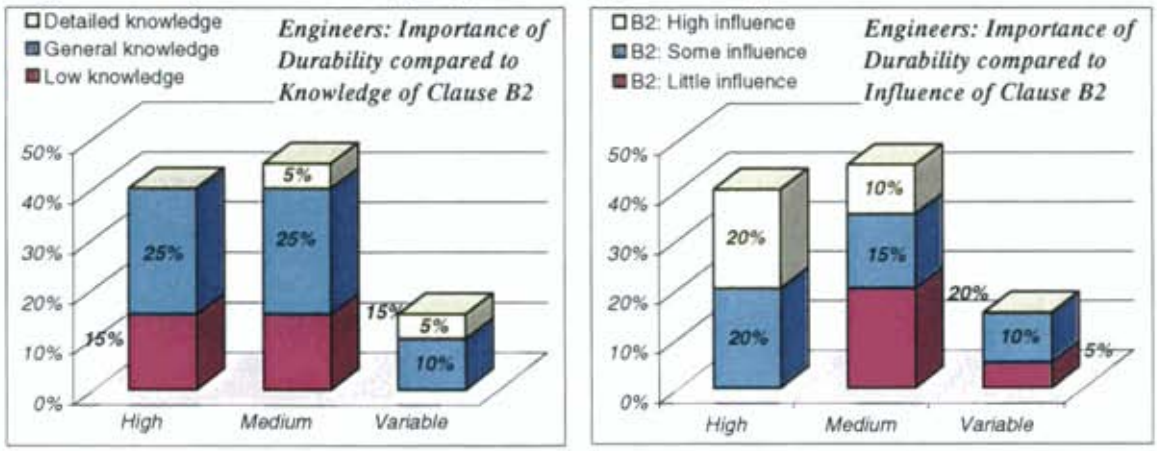
As shown in Figure 16, while almost 90% of architects considered durability to be very important, this is not reflected in the assessment of their knowledge of the code provisions, or in influence of B2 on their work. Only 3% considered that they had a detailed knowledge, and less than a third were highly influenced by the requirements. However, on further consideration, these results are not necessarily inconsistent, as revealed by the comments made during interviews. While these comments vary according to the size and type of practice, they tend to show a common theme and are summarised as follows:

- ***Durability has always been important:*** *Issues of durability are not associated with minimum code requirements. Durability has always been important, and the advent of the Building Code has not affected that importance. It is treated in the same way as it always has been, from pre-code days.*
- ***Reputation:*** *Architects who have practised in the same area for a long time rely on their reputation for further work and cannot afford many problems, and these will come back to them for sorting out anyway. Such problems are learned from and future choices amended accordingly.*
- ***Conservative in use of materials:*** *Durability is considered extremely important and proposals are always well over minimum levels needed for compliance. Firm does not aim to push boundaries for materials, so B2 is incidental to the ways in which decisions are made.*
- ***Influence, not control:*** *Durability may sometimes by influenced by, but is not governed by, the code requirements. It is a matter of appropriate choice of materials and systems to suit the circumstances of site, purpose, proposed lifetime, environment etc. Type of client is also important in terms of their continuing ownership – institutional clients are more concerned and involved with long-term durability and maintenance issues.*
- ***Matter of balance:*** *May sometimes be necessary to balance durability against costs (both capital and maintenance costs), with some compromises made – but these compromises rarely bring levels down to minimums.*
- ***Well over minimums:*** *Knowledge of the Clause is not detailed, but are able to find more information if necessary. Because of importance of durability, projects are always well over minimum levels and so rarely have problems with TAs requiring additional information.*
- ***Changes to 3604:*** *Up until recently the influence of B2 would have been low, but the recent amendments to NZS 3604 have meant that the influence has increased to a medium level.*

6.4.2 Engineers

The relationship between the importance of durability, and the knowledge and influence of B2 is explored in Figure 17.

Figure 17: Engineers: Knowledge/Influence Compared to Importance



Those who assessed durability as important are split into those who considered that their knowledge of B2 was detailed, general or low, and those who considered that the influence of B2 was high, some or little. The same was done for those who assessed the importance of durability as medium. As shown, while 40% of engineers considered durability to be very important, this is not reflected in the assessment of their knowledge of the code provisions, or influence of B2 over their work. No engineer considered they had a detailed knowledge, and only 20% were highly influenced by the requirements. For those who regarded durability as of medium importance, 20% considered that B2 had little influence over their decisions. However, on further consideration, these results make sense when the comments are considered.

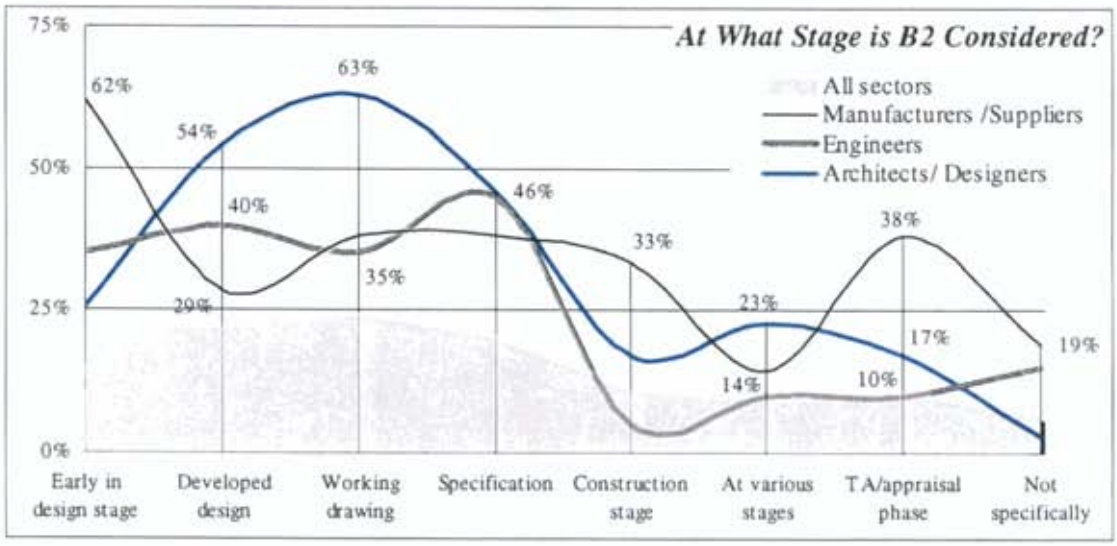
While the interview comments vary according to the size and type of practice, they tend to show a common theme and are summarised as follows:

- ***Rarely need detailed knowledge:*** *B2 is not particularly influential so have never needed detailed knowledge. Know where to found details if necessary to refer more deeply – but do not usually need to.*
- ***Structural requirements simple:*** *Only have general knowledge, as the requirements for structural elements are simple at 50 years. Issues of durability are covered in normal professional way throughout the design and detailing, but not in terms of the Clause.*
- ***Aiming for more than minimums:*** *Durability is considered as it has always been since pre-code days – B2 is really incidental as it gives the bare minimum requirements. It is therefore of little relevance.*
- ***Traditional good practice:*** *B2 is necessary as an underlying safety net – but it has little influence on the type of work done. Issues are handled in a traditional manner. Durability tends to get built-in according to good engineering practice.*
- ***Conservative in use of materials:*** *Tends to be conservative in choice of materials with known durability performance, so Clause is largely incidental to the type of work done.*
- ***Variable influence:*** *The influence can be variable depending on what part of the structure is being considered, and where the site is in terms of corrosion risks. Claddings are most influenced, while closed-in structural elements are least influenced.*

6.5 Stages at which Clause B2 is Considered

Those respondents who indicated that they were involved in specifying materials were asked to identify at which stages in the building process they took the implications of Clause B2 into account. The results are shown in Figure 18.

Figure 18: When is Clause B2 Considered?



This question was particularly aimed at designers and manufacturers so, although some in other groups answered, the analysis excludes these as the numbers involved were too few. All responses were included in the totals for all sectors. They have however been included in the totals for all sectors. The major points highlighted by this analysis are:

- **Architects & Designers:** Most consider B2 during the detailed design and the working drawing/ specification phases of the project, with fewer doing so during construction. More than 20% noted that the stage of consideration depended on the client requirements (for instance, if the budget became a problem, material choice could be revisited), and less than 20% said that it was only if the TA required more information.
- **Engineers:** Similarly, most engineers considered B2 prior to construction, although the pattern differed. From comments during interviews, it appeared that durability is generally considered early in the design process as part of the initial selection of materials. These are chosen as appropriate to the project and are then revisited at later stages for various detail and specification needs (including B2). Few revisited requirements during construction or found it necessary to supply more information to TAs. A notable percentage did not specifically consider B2 and indicated in interviews that durability was handled in a normal professional manner which did not relate to B2 requirements.
- **Manufacturers:** The pattern was somewhat different – with more than 60% giving emphasis to initial design, and less during subsequent phases. A third considered B2 during the manufacturing or installation phase (far more than architects and engineers). Another big difference is the high percentage of manufacturers who are involved at the Appraisal or the TA phase where the manufacturers' technical literature along with Producer Statements are used as supporting documentation.

6.6 Problems with Clause B2

Section 5.4 considered possible barriers to design for durability, and showed that few considered a lack of knowledge about B2 to be a problem in handling durability issues. This section now focuses on the Clause itself, and respondents were asked to highlight any problems that they have. Figure 19 shows the results over all sectors.

Figure 19: Problems with Clause B2

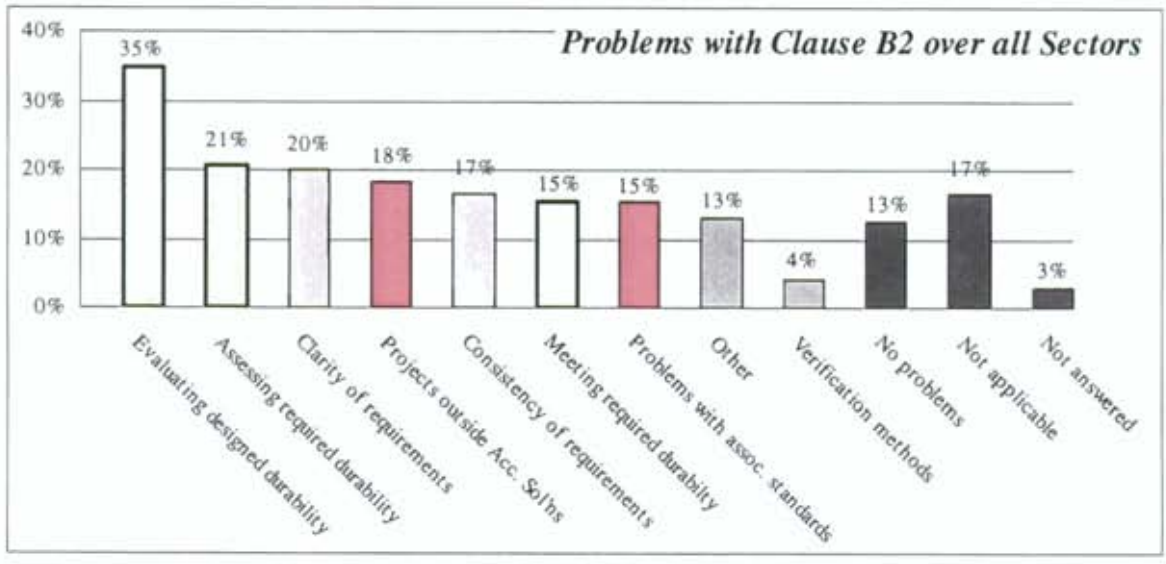
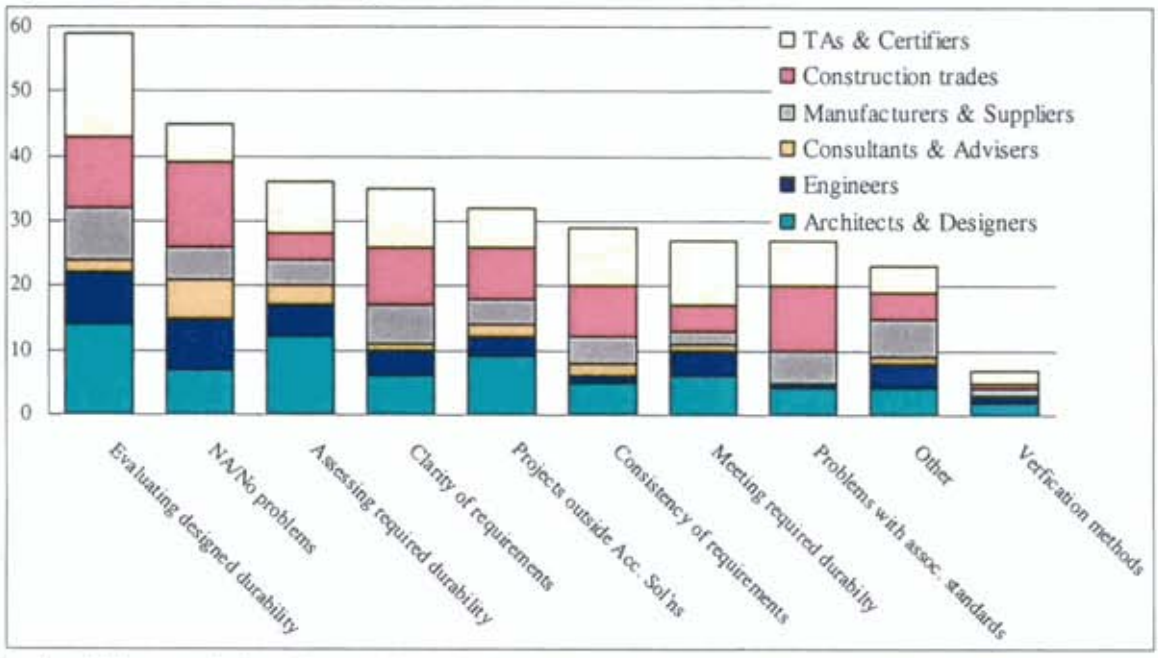


Figure 20 shows the problems experienced with B2 for each sector.

Figure 20: Problems with B2 by Sector



It should be noted that Figure 20 excludes owners, as the majority of these considered that the Clause was not applicable to their roles. Only two owners identified any problems – both noted that they had problems in assessing the durability of materials and systems contained in building proposals. Also, the categories of "no problems", "not applicable" and those who did not answer (which amounted to a total of almost a third of the sample) have been combined in order to simplify the analysis. The main points arising from these analyses are:

- **Evaluating designed durability:** This was the most common problem over all industry sectors, and relates to the lack of reliable information and experience as identified in Section 5.4: Barriers to Design for Durability. TAs and certifiers were particularly concerned with this, which is not surprising given their role in checking proposals for compliance.
- **Lack of problems:** It was interesting to note that almost a third of the sample did not identify any problems with the Clause. This may be due to the length of time that it has now been in force, and may indicate that many in the industry have either adapted to the requirements, find them irrelevant to the type of work that they do, or even possibly ignore them.
- **Assessing required durability:** While the requirements appear simple, it seems that some components are difficult to classify. Examples of this were decks, building paper, cladding as bracing etc.
- **Clarity and consistency of requirements:** This mainly seemed to be related to assessing required durability as discussed above, as the same type of examples were commented on during the interviews. However, some comments also related to the Acceptable Solution being over-simplistic, as it treats all elements as being the same in terms of ease of replacement, or in terms of their structural function. For instance, all non-structural cladding only requires 15yrs, yet some types are far more difficult than others to replace, e.g. weatherboard compared to stucco. Another example is the comparison of the ease of replacement of windows in a house compared to a multi-storey building.
- **Projects outside Acceptable Solutions:** From comments in interviews, this appeared to be related to the difficulty of handling the processes involved in getting a project through the compliance approvals. Comments were made that it was not the requirements that were the problem, but rather proving that the project met them. It was also said that the trouble involved tended to stifle innovation and encourage designers and engineers to stay with

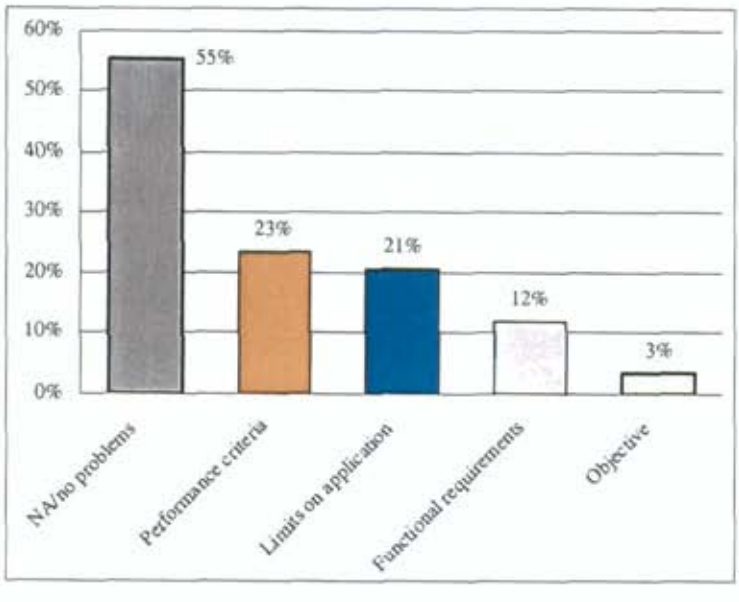
conservative, and so easily-supported solutions. Another problem that was raised by a number of people was the inconsistency of dealing with various TAs.

- **Meeting durability requirements:** Interestingly, only around 15% identified this as a problem, and the largest contribution was by TAs and certifiers. During interviews, a number of people maintained that the requirements were actually too low.
- **Problems with Standards quoted as Acceptable Solutions:** As expected, there were a number of people who identified the new durability requirements contained in NZS 3604 (Standards New Zealand, 1999) as being a problem, in particular the corrosion requirements and associated zones. The group most represented in regard to this were builders, with more than a quarter of that sector identifying it as a problem. However, there were also some in other sectors who commented during interviews that the new requirements have clarified matters. The main complaint appeared to be that the history of use of most of the components affected did not warrant the stricter requirements. NZS 3602 (Standards New Zealand, 1995) was also raised, in regard to permitting untreated timber to be used in dry situations. Some advisers were already investigating cases of decay caused by moisture reaching the timber, and concern was expressed about many potential future durability problems.
- **Other:** Half of the non-official sectors that identified other problems raised the issue of problems in dealing with TAs. The major issue raised was inconsistency of interpretation, which was particularly apparent within and around the main centres where an applicant may deal with a number of neighbouring Authorities. There were also concerns about inconsistencies within larger TAs. Comments were also made that insurers are settling too many disputes out of court with the details therefore not open to the public. The problem is that this practice is limiting the gathering of precedents and legal guidance on areas of contention. At the same time the growing concern with potential legal liability is increasing TA requirements for documentation, which then leads to some of the complaints of the industry on the time and cost of dealing with compliance issues.

6.7 Improvements to Clause B2

As shown in Figure 21, respondents were asked to suggest in what ways the Clause could be improved.

Figure 21:Improvements to Clause B2 over all Sectors



As can be seen, more than half the sample fell into the categories of *"no problems"*, *"not applicable"* and those who did not answer.

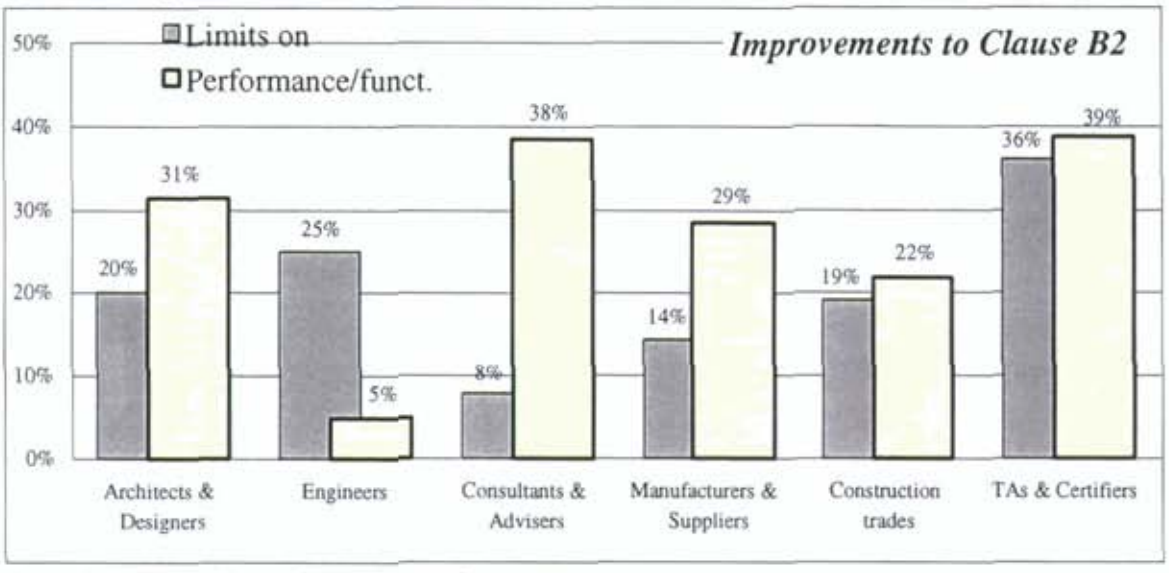
Few had problems with the objective of the Clause. However, more than 20% of the sample considered that the performance criteria and/or the limits on application could be improved.

As functional requirements are directly related to those for performance, these two sections are combined in the next analysis.

The resulting two issues were further broken down in order to consider the sectors that

contributed towards the totals. The result is shown in Figure 22. It should be noted that Figure 22 excludes owners, as no one in this group suggested any improvements.

Figure 22: Improvements to Clause B2



The main points arising from these analyses are:

- **Lack of problems:** Well over half of the sample did not identify any areas for improvements of the Clause. This may be due to the length of time that it has now been in force, and may indicate that many in the industry have either adapted to the requirements, or find them irrelevant to the type of work that they do.
- **Functional & performance requirements:** It is interesting to note that no engineers suggested improvements to the performance criteria. This is likely to be due to the nature of engineering input as discussed previously in Sections 5.1 and 6.4.2. The structural durability tends to be built into the earthquake requirements rather than being specifically considered. Also, the requirements are considered simple at 50yrs, and most engineers are aiming beyond that minimum level.
- The main groups who suggested that improvements could be made to this area of the Clause were consultants/advisers and TAs/certifiers at almost 40%, and architects and manufacturers at about 30%. Builders followed at more than 20%. Comments from interviews which related to this area of the Clause included the following:
    - ***Architects:*** *The functional requirement can be open to misinterpretation if not read together with performance criteria.*
    - ***Architects, Engineers:*** *Buildings can have an indefinite life if maintained well, whereas B2 seems to limit such concepts by giving the maximum period as 50 years. While it is understood by the industry that this is only a minimum life for adequate durability, too many buildings are designed down to minimum code levels as a matter of cost saving. At the same time, most owners assume that compliant buildings will be to a "good" standard and would be dismayed to realise that they may be designed to last only 50 years. Maintenance is a big issue. Start concentrating on maintenance issues and then work from there – look at what is needed to extend life.*
    - ***Architects, Consultants/Advisers:*** *Targets are too low from a client's viewpoint. No part of a new building should last as little as five years. Such targets do not encourage design for durability, but rather encourage work that is designed down to the minimums.*

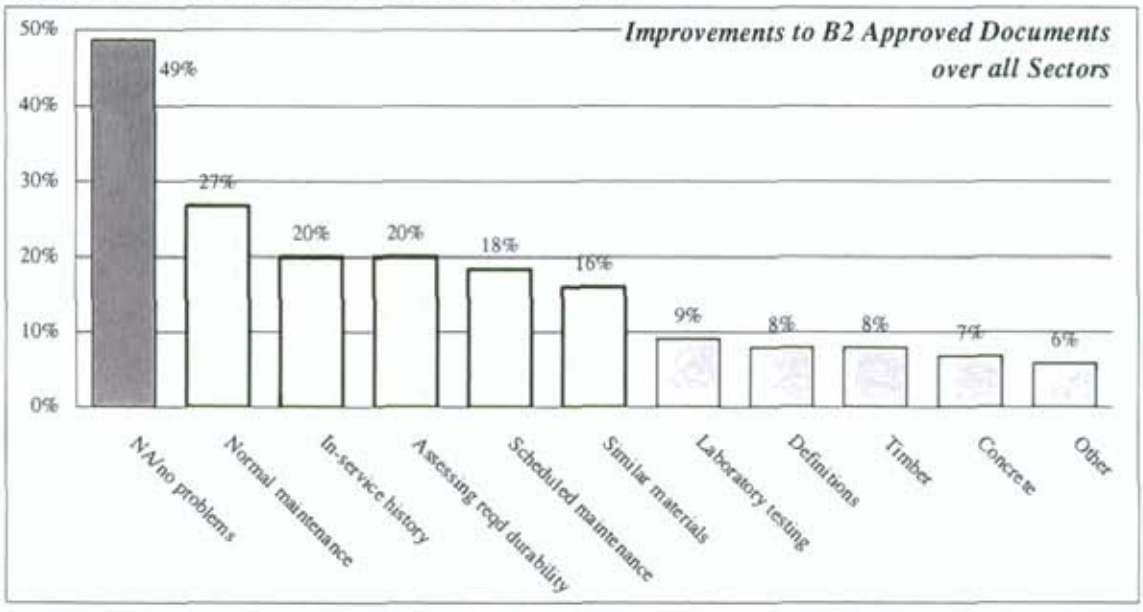
- ***Manufacturers, Consultants/advisers, TAs/certifiers:*** *Why 5, 15 and 50 years? These periods should be revisited and reconsidered and the rationale behind them justified.*
- ***TAs/certifiers:*** *Periods should start from installation, not from the date of the compliance certificate that can sometimes be years after the initial installation.*
- ***Manufacturers, Consultants/advisers:*** *Need to look at the consistency of requirements for different materials within the same category, and to check that all items are covered. Need to consider systems rather than just components, as the combination is critical.*

- **Limits on application:** More than a third of TAs/certifiers considered that the limits on application could be improved, followed by a quarter of engineers, around 20% of architects and builders and 15% of manufacturers. Comments from interviews which related to this area of the Clause included the following:
  - ***Architects:*** *Intended life should be viewed sceptically – an example of this are temporary classrooms that are still used after 50 years.*
  - ***Engineers, Manufacturers, Builders, TAs/certifiers:*** *Believe that the code goes beyond adequate levels of durability for health and safety for some types of buildings. Need some restrictions on the type of building that the Clause should relate to – should consider different classes of buildings to indicate different levels of compliance. Then, certain types such as farm sheds and lightweight garages would be the lowest level.*
  - ***TAs/certifiers:*** *Problems are not so much related to the Clause itself, but more to the practical application necessary to make it work.*

6.8 Improvements to B2 Approved Documents

Respondents were asked to suggest improvements of the Approved Documents, and the answers aggregated over all sectors are shown in Figure 23. It should be noted that the categories of *"no problems"*, *"not applicable"* and those who did not answer (which amounted to a total of almost half the sample) have been combined in order to simplify the analysis.

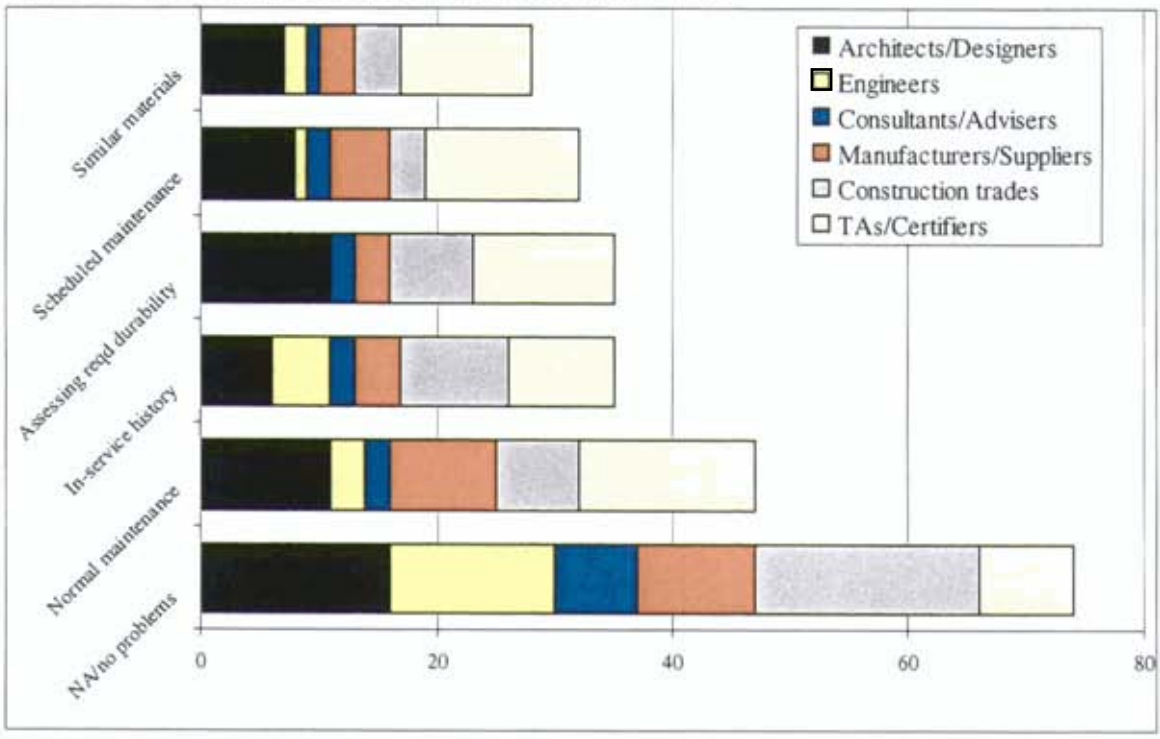
Figure 23: Improvements to B2 Approved Documents



As can be seen, almost half of the sample did not identify any improvements, while some areas attracted little attention. Those areas, which were identified by more than 10% of the sample, were

further broken down in order to identify the makeup by the various sectors (excluding owners as none suggested any improvements), and the results are shown in Figure 24.

Figure 24: Improvements to Approved Documents by sector



- The main points arising from these analyses shown in Figure 23 and Figure 24 are:
- **Lack of problems:** Almost half of the sample did not identify any specific areas for improvement of B2's Approved Documents. As commented earlier, this may be due to the length of time that it has now been in force, and may indicate that many in the industry have either adapted to the requirements, or do not find them relevant to the type of work that they do.
- **Maintenance:** More than a quarter of the sample identified Normal Maintenance as an area to be improved. Engineers and consultants contributed the least at around 15%, while TAs/certifiers and manufacturers contributed the most at more than 40%. More than 30% of architects, and almost 20% of builders also considered that this section could be improved. Although fewer identified Scheduled Maintenance as needing improvement, the two sections are related and comments made during interviews referred to both, and included the following:
    - ***Architects, Engineers, Manufacturers:*** *Maintenance needs to be clarified, and needs far more focus and explanation. Buildings can have an indefinite life if maintained well, whereas B2 limits such concepts to 50 years. Concentrate on what is needed to extend life.*
    - ***Architects:*** *The wording used is hard to pin down – determining requirements is one thing, doing anything with the information is something else. Needs to be clear as to where the information should end up – staying on file will not achieve anything.*
    - ***Manufacturers, Builders:*** *Maintenance should be revisited and redefined in more detail. If a substrate material is maintained ideally, then its life can be extended almost indefinitely. That maintenance includes the recoating of the finish at appropriate intervals. The question still remains as to what "normal" maintenance is, and this section does not adequately define that.*

- ***Engineers, Manufacturers, TAs/certifiers:*** *Investigate warrants of fitness, maintenance schedules etc. to form the core of any serviceability requirements. Make maintenance the responsibility of a building owner – with manufacturers clearly stating what must be done and how often. This is particularly important in regard to coatings. The requirements for stainless steel fixings can be unnecessary where galvanised would be fine if maintained properly – such components require maintenance schedules. Owners generally need more guidance and education.*
- ***TAs/certifiers:*** *There are too many arguments around what is "normal", and this section does not adequately define that. Manufacturers seem to be increasingly using maintenance requirements in order to opt out of their obligations for durability. Scheduled maintenance could relate better to marine environments as set out in NZS 3604.*

- **In-Service History:** 20% of the sample identified this section as needing improvement. TAs/certifiers, builders and engineers were most concerned, with about a quarter considering this needed improvement, while the other sectors were less although still significant. Comments made during interviews included the following:
  - ***Engineers, Builders:*** *The ability to prove the performance history of a product or material in place in a certain environment should be made easier. At present the process is far too bureaucratic, expensive and time-consuming. It is simpler just to spend money on the higher requirements rather than to waste time by trying to establish the history – the cost of expert opinions can outweigh the possible benefit and it is often just not worth following the process through.*
  - ***Engineers, Manufacturers:*** *Are concerned about the reliability of being able to consistently assess durability as there are too many unknown and potentially influencing changes, with no national monitoring or feedback to the industry being done. So, even with conventional structural materials like steel, cannot be sure that durability performance is really known or can be proved. Have concerns that traditional materials like copper that have an assumed long life do not have to go through the type of proper testing that other materials may have to go through.*
  - ***TAs/certifiers:*** *The difficulty is the level of proof required to establish the history of use of a product with the required documentation to support this.*
- **Assessing required durability:** 20% of the sample also identified this as an area needing improvement. A third of architects and designers, along with more than 30% of TAs/certifiers considered that this section should be improved. In line with the results for improvement to the Clause as discussed previously, no engineers suggested improvements to the section assessing required durability. This is likely to be due to the nature of engineering input as discussed previously in Sections 5.1 and 6.4.2. Around 15% of the other sectors indicated that this section could be improved. Comments made during interviews included the following:
  - ***Architects:*** *The descriptions are too confusing and should be better related to the three categories used in the wording of the Clause.*
  - ***Architects, Consultants/advisers:*** *Targets are too low. No part of a new building should last as little as five years. Such targets do not encourage design for durability, but rather encourage work that is designed down to the minimums. Table 1 implies durabilities that are too low – 15-year items will not be replaced, so why limit them to 15 years. The periods need to be revisited and reassessed to ensure that they are fully justified.*
  - ***Builders:*** *In relation to NZS 3604 corrosion requirements, better acceptable solutions are needed.*

- ***Consultants/advisers:*** *Need to investigate the consistency of the requirements for different materials within the same categories, e.g. stucco compared to weatherboard cladding.*
- ***Manufacturers, Builders, TAs/certifiers:*** *Table 1 should be revisited and components such as decks covered better. Also, there is a question of whether the table should form part of the Approved Documents, as the links back to the Clause seem dubious for some components. Table 1 also causes a problem with structural cladding. This means that cladding has to last 50 years even if the building is likely to be replaced within that time. This is not practical for pre-fabricated buildings where bracing is visible and easily maintained, and replaced if necessary without risking the structural integrity.*

- **Similar materials:** More than 15% of the sample considered that this section should be improved, but more than half of these comprised TAs/certifiers (at more than 30%) and architects (20%). The other sectors were 15% or less. Comments made during interviews included the following:
  - ***Architects:*** *This section can be a problem in regard to on-site substitutions.*
  - ***Manufacturers:*** *Some flooring timber species are not covered in NZ timber Standards – need reference to acceptable overseas standards as well.*

7. CONCLUSIONS

As discussed in Section 3.1: Survey Design, the main objectives of this survey were to establish:

- ***which parts of the industry are involved in choosing or influencing the choice of building materials or systems?***
  - *How do those groups compare to who is perceived to be choosing materials?*
  - *How important is durability to the industry?*
  - *What does durability mean to the industry?*
- ***how is NZBC Clause B2 compliance considered in the building process?***
  - *What is the level of knowledge and influence of B2 within the industry?*
  - *How much do groups rely on others for compliance?*
  - *At what stage of the building process is B2 considered?*
- ***what views do Territorial Authorities have on the operation of B2?***
- ***what tools and information sources (including NZ and International standards) are used for design for durability?***
- ***what barriers to design for durability are encountered?***
  - *How can these barriers be overcome?*
- ***what problems are encountered with B2 and what areas could be improved?***

7.1 Which Parts of the Industry are Involved?

Most sectors of the building industry play an important role in the selection of materials used in New Zealand buildings, either by specifying or by contributing towards the specification of building materials. Every sector appears to have some influence on choices made.

As discussed in Section 4: CHOOSING MATERIALS, it was found that all groups surveyed consider that they either choose or influence the choice of materials to some extent. Apart from building officials, well over half of each sector in the industry says they are involved in design and specification. However, even Territorial Authorities and certifiers appear to have more influence than would be expected from their role of ensuring code compliance, with more than 40% indicating that they provide advice – and so influence decisions on materials or systems.

There is a high level of involvement from sectors normally considered outside the design professions, and a variety of factors may explain this. First, there is an increasing role of manufacturers, builders and other trades in "design and build" parts of a building, where they are responsible for detailed design and the underlying support components. There is also a shift in perceived liability due to the inclusion of durability requirements within the Code. This has led to manufacturers becoming more involved in how their products are installed. In housing, there has always been a limited involvement from design professionals, as most houses are built to conform with NZS 3604 and do not involve specific design. Many are produced by development companies that allow a limited range of owner-selected choices from a range of standard pre-approved designs.

7.1.1 Industry Perception of Decision-makers

Apart from, or as well as, themselves, architects are believed to be the most likely group to be making decisions on materials. In the case of architects and designers, the joint or team nature of decision-making is reflected – where the designer is working with others such as engineers, builders, consultants or owners. This also applies to the next highest group, where more than 40% of the other sectors specified owners or clients as making decisions along with themselves. In other words, the respondent will be making decisions but those decisions will be in conjunction with, or will be approved by, their client.

In every case, the proportion of those sectors that considered that they made choices was greater than the percentage perceived by the rest of the industry to be making decisions on building materials. For architects and building owners, that difference was relatively minor, but for the other sectors it was significant. It appears that specifying building materials is often considered as the domain of the architect, whereas the reality is that other sectors are also heavily involved.

7.1.2 How Important are Durability Issues?

No sector identified durability as being of low importance, with more than half rating it as being very important to their decisions in regard to building materials. It appears that the importance has been increasing since the advent of the NZBC, and more so since the introduction of new durability requirements in the most commonly used building standard (NZS 3604) referenced by the Code.

7.1.3 What Does Durability Mean?

More than 90% of those surveyed included continued functional performance as being the prime meaning of durability, although less than half of the non-regulatory sectors included durability as also meaning a New Zealand Building Code term. It seems that 'generic' meanings of durability are most important to the practising sectors of the building industry, with maintenance requirements, warranties and appearance being popular meanings for these groups.

7.2 How is NZBC Clause B2 Compliance Considered?

As discussed in Section 5.1, most sectors in the industry believe that durability is very important to their decisions, with no one indicating that it is of low importance. However, this is not necessarily reflected in the way in which B2 is considered.

7.2.1 Knowledge and Influence of B2

As expected, knowledge and influence of Clause B2 was indicated as highest amongst building officials, followed by manufacturers. Most of the sample considered that they had a general understanding of the requirements of Clause B2, rather than detailed or low.

Architects, engineers and builders showed similar patterns with less than 10% considering their knowledge to be detailed and many admitting they had little. However, the degree of influence was greater than the knowledge of the Clause, with nearly a third of these "front-line" groups considering that B2 exerted a high degree of influence over their decisions. Interestingly, among architects and engineers, the degree of knowledge and influence of the Code provisions did not correlate to their judgement on the importance of durability.

7.2.2 Reliance on Others for B2 Compliance

As expected, building owners showed the highest level of reliance on others for code compliance with interviews indicating that compliance was considered to be the responsibility of their consultants. The construction trades were higher than other technical groups in relying on others. For both of these groups, the level of reliance was, as expected, generally in line with their limited knowledge of B2 requirements.

It would be reasonable to assume that those who most relied on other groups for compliance would be those who had little knowledge of, and were little influenced by Clause B2. However, this was not so for the other groups, most of who had some reliance on others. It appears that most work with a limited number of builders, suppliers or other consultants who, depending on their history and experience, could be relied on to ensure that B2 requirements were met.

7.2.3 Stage at which B2 is Considered

Most architects and designers consider B2 during the detailed design and the working drawing/ specification phases of the project, with fewer doing so during construction. Similarly, most engineers considered B2 prior to construction, although the pattern differed. More emphasis appeared to be given at the early design stage, with less during working drawings. Emphasis then increased again during specification, with around 45% considering B2 at this stage. Few revisited requirements during construction or found it necessary to supply more information to TAs. A notable percentage did not specifically consider B2.

For manufacturers, the pattern was somewhat different – with more than 60% giving emphasis to initial design, and less during subsequent phases. In contrast to architects and engineers, a third considered B2 during the manufacturing or installation phase (far more than architects and engineers). Another big difference is the high percentage of manufacturers who are involved at the Consent or the TA phase, which reflects comments made earlier in this report.

7.3 Views of Territorial Authorities

The views of Building Officials are covered throughout this report along with views from other industry sectors, but the nature of their particular role merits individual note. In terms of most questions of durability, in general their answers have been as would be expected. However, in terms of barriers to design for durability, answers differed from others in the industry. The proportion of officials who regarded the lack of appreciation of the importance of durability as a problem was almost twice that of any other sector. This would appear to indicate that officials perceive a high degree of apathy throughout the industry. However, this perception appears to be

at odds with the industry's responses on the importance of durability as shown in Figure 5: Importance of Durability. This apparent disparity could be related to the nature of this survey, as it may be argued that those in the industry who are indeed apathetic form a major part of the 40% who did not respond to the questionnaire. However, it may also relate to the possibility that, although designers consider durability important, they do not necessarily appreciate the importance of communicating their durability decisions to building officials. There was also a growing concern with potential legal liability that is increasing TA requirements for documentation, and this may be adding to Tas' perception of a lack of appreciation of problems on the part of applicants who are less familiar with the difficulties associated with durability.

As expected, the knowledge and influence of the Clause was substantially higher than in other sectors. However, there was still almost half who considered their knowledge to be only general. As discussed in Section 6.3: Reliance on Others for B2 Compliance, most officials also had some reliance on others for compliance with the Clause. This was explained by comments made during the interviews. In their case, "others" generally referred to architects, engineers, builders, and manufacturers of specified products. Where these had a good history and reputation in regard to performance and lack of problems, more reliance could be placed on the quality of the proposal and less time spent on seeking assurance. As was explained during one interview, in practical terms, no one could ever be totally sure that a proposal complied with NZBC in all respects. Time constraints therefore made it sensible to concentrate on the risk areas, and to put the effort into those rather than one that could be considered as low-risk.

The most common problem building officials identified with the Clause was that of assessing the durability of designs. This is not surprising given their role in checking proposals for compliance. Interestingly considerably more officials considered that meeting the requirements was a problem than the other sectors did. This could well be that other sectors consider meeting the requirements as distinct from proving they have done so, whereas for officials the two issues are basically the same thing - if the proof is insufficient, then the requirements have not been met. Other problems that they identified were similar to those identified by others in the industry.

Officials were also the group most represented in identifying areas for improvement of the Clause B2 and its Approved Documents. Well over a third considered that the performance and functional requirements, and the limits on application should be improved. They particularly identified the problem of the time requirements starting from the date of the compliance certificate, which can sometimes be a long time after the installation date of a material. Also, similar to other sectors, some suggested that the life requirements of components should be revisited and the rationale behind them justified. Several also said that problems were not so much related to the Clause itself, but rather to the practical application necessary to make it work.

For the Approved Documents officials, along with other sectors, identified maintenance as a problem. It appears that there are too many arguments around what is "*normal*". Some were also concerned that manufacturers were using this to opt out of their obligations. They also found In-Service History a problem, indicating that the level of proof required to establish this was difficult to administer, along with considering that the table of examples should be revised in order to cover some components better and to improve consistency.

7.4 What Tools and Information Sources are Used?

As discussed in Section 5.3: Sources of Information, the most common sources of information about durability were trade literature, industry information and advice, and respondents' own experience.

Only about half of the sample noted the Building Code and Standards as being a usual source, whereas over 80% used trade literature. All architects regularly used trade literature, which is not surprising when the proliferation of new products and materials is considered. However, it is more surprising that almost 90% of TAs and certifiers also found it an important source of information.

The other most important sources were industry information and advice, and past experience. Very few of those surveyed listed ISO Standards as a tool or source of information, with manufacturers being the only sector showing any significant level of use.

7.5 What Barriers are Encountered?

As discussed in Section 5.4: Barriers to Design for Durability, lack of reliable information (including experience of materials) was considered by most to be the biggest barrier to achieving design for durability, followed by the lack of appreciation of its importance. Few considered that the lack of knowledge of the Clause was a problem.

The most important barrier related to the lack of information, whether in the form of actual experience of materials' performance or reliable objective information for choosing materials or considering substitutions. This is not surprising when related to the sources of information shown in Figure 8: Sources of information, as trade literature, industry information and past experience were those sources most identified by industry sectors. Interviews revealed that there is less trust in test results than in actual local use over a long period of time. There is also limited reliance on the objectivity of information supplied by those who are trying to sell a product.

While accreditations, appraisals and third party reports should be objective and reliable, they were not listed as the most important sources of information, apparently due to the limited number of these that are available in comparison to the large numbers of materials and products on the market. In particular, access to third party reports appeared to be a problem as these are usually confidential with the information not made available to the industry.

The other important barrier identified was the lack of appreciation by others of the importance of durability. This particularly applies to TAs and certifiers, with more than 80% seeing this as a problem. This would appear to indicate that officials perceive a high degree of apathy throughout the industry.

7.5.1 Ways to Overcome Barriers

Two approaches appear to have merit in reducing barriers to the better use of design for durability in New Zealand. The first is raising the awareness of the NZBC requirements throughout all industry sectors involved in specifying materials and ensuring that specifiers have provided appropriate durability information before building plans are approved. The second is to make available more information on materials performance in New Zealand to help specifiers choose materials that meet regulatory and/or client durability requirements.

7.6 Problems with and Improvements to B2

7.6.1 Clause B2

There were comments made that the functional requirement as outlined in B2.2 needs to be clarified. This seems difficult to explain but should be looked at in regard to clarifying the fact that the life of a building is not just 50 years or a specified intended lesser life, as some believed that it could be open to misinterpretation if considered in isolation from the performance requirements.

7.6.1.1 Life requirements

There was no particularly strong common theme expressed regarding the 5, 15 and 50-year figures, although some thought they were too low. However, a general view was that these periods should be reviewed to verify their appropriateness. Another view was that the gap between the 15 and 50-year periods was too large. This was raised in regard to components for which a 50-year requirement is unrealistic, but where 15 years was felt to be too low.

Waterproofing membranes on roof decks under tiles was an example quoted. It was suggested that an intermediate step of 25 years could be added.

There is still a view that visible, maintainable and easily replaced structural items should not be obliged to meet the 50-year requirement.

7.6.1.2 Limits on application

There were a number of views that the limits on application should be reviewed in regard to restricting the type of building that the 50-year requirement should apply to. Some considered that different classes of building should indicate varying levels of compliance, with some types such as farm sheds and lightweight garages being the lowest level of compliance. However, others considered that a specified intended function or life should be viewed sceptically, as the use of buildings can change markedly over time.

There were concerns expressed by TAs and certifiers in regard to the date when the life requirements start. This relates to the period that can elapse between a consent being granted, building work starting, and the final issue of a compliance certificate. In some cases this can amount to years – effectively extending the life requirements by that interval. This point was also raised in the 1995 review.

7.6.2 B2 Approved Documents

In general, there seemed to be an expectation that the Approved Documents should provide more answers to specific materials durability issues.

7.6.2.1 In-service history

The process involved in proving the performance history of a product or material in place in a certain environment was raised as a concern. At present the process is too bureaucratic, expensive and time-consuming, and it is often simpler to spend more on the higher requirements than to waste time trying to establish the history as the cost of expert opinion can often outweigh the potential benefit. While this may be an implementation issue, a more complete set of Approved Documents might reduce this concern.

7.6.2.2 Assessing required durability

Some found the descriptions of the concepts confusing, and recommended that wording should be clarified and revised to better relate to the three categories of life requirements as set out in B2.3.1 of the Clause.

7.6.2.3 B2 AS1 Table 1

This should be expanded to cover some missing components, and to better link back to the requirements of B2.3. There was also concern as to the consistency of requirements for materials or components with very different properties that fall within the same category.

7.6.2.4 Standards

The new durability requirements contained in NZS 3604 (Standards New Zealand, 1999) are still causing concern, particular those for corrosion. However, there was also a view that these had improved matters by clarifying requirements. There is also considerable debate about the issue of untreated timber and moisture problems in buildings, one result of which is a view by some that part of the solution is a revision of NZS 3602.

7.6.2.5 Normal maintenance

This area still causes concern to the industry. The wording needs clarification, particularly in regard to what maintenance activity can be considered "normal". The issue of manufacturers or suppliers using excessive maintenance requirements to avoid liability for durability requirements was raised as a problem.

On the other hand, there was also a view that maintenance should be more clearly defined as an owner's responsibility (which may be an implementation issue), with a manufacturer's responsibility limited to stating what must be done with their product and how often.

7.6.3 Implementation Issues

The major issue raised by the industry was inconsistency of interpretation by Territorial Authorities. This was particularly apparent within and around the main centres, as an applicant may deal with a number of neighbouring Authorities so making any inconsistencies apparent. There were also concerns about inconsistencies within larger Authorities.

A related piece of feedback is that it seems that insurers are settling many disputes out of court with the details therefore not open to the public. The problem is that this practice is limiting the gathering of precedents and legal guidance on areas of contention. At the same time the growing concern with potential legal liability is increasing TA requirements for documentation, which then leads to some of the complaints of the industry on the time and cost of dealing with compliance issues.

8. REFERENCES

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9. APPENDICES

9.1 NZBC Clause B2 DURABILITY

The following is a copy of the Clause together with the text content of its associated Approved Documents (including the latest amendments of 2000).

This is included for reference purposes in this report only.

NZBC Clause B2 DURABILITY

This Clause is extracted from the New Zealand Building Code contained in the First Schedule of the Building Regulations 1992 and amended by the Building Regulations 1997.

Provisions	Limits on application
OBJECTIVE	
B2.1 The objective of this provision is to ensure that a *building* will throughout its life continue to satisfy the other objectives of this code.	
FUNCTIONAL REQUIREMENT	
B2.2 *Building* materials, components and *construction* methods shall be sufficiently durable to ensure that the *building* without reconstruction or major renovation, satisfies the other functional requirements of this code throughout the life of the *building*.	
PERFORMANCE	
B2.3.1 *Building elements* must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the *specified intended life* of the building, if stated, or:	Performance B2.3.1 applies from the time of issue of the applicable code compliance certificate. *Building elements* are not required to satisfy a durability performance which exceeds the *specified intended life* of the *building*.
a) The life of the building, being not less than 50 years if:	
i) Those *building elements* (including floors, walls and fixings) provide structural stability to the building, or	
ii) Those *building elements* are difficult to access or replace, or	
iii) Failure of those *building elements* to comply with the *building code* would go undetected during both normal use and maintenance of the *building*.	
b) 15 years if:	
i) Those *building elements* (including the *building* envelope, exposed plumbing in the subfloor space, and in-built chimneys and flues) are moderately difficult to access or replace, or	

Provisions

ii) Failure of those *building elements* to comply with the *building code* would go undetected during normal use of the *building*, but would be easily detected during normal maintenance.

c) 5 years if:

i) The *building elements* (including services, linings, renewable protective coatings, and *fixtures*) are easy to access and replace, and

ii) Failure of those *building elements* to comply with the *building code* would be easily detected during normal use of the *building*.

B2.3.2 Individual *building elements* which are components of a *building* system and are difficult to access or replace must either:

a) All have the same durability, or

b) Be installed in a manner that permits the replacement of *building elements* of lesser durability without removing *building elements* that have greater durability and are not specifically designed for removal and replacement.

Limits on application

DEFINITIONS

This Clause is extracted from the New Zealand Building Code contained in the First Schedule of the Building Regulations 1992 and amended by the Building Regulations 1997.

Adequate *Adequate* to achieve the objectives of the *building code*.

Building has the meaning ascribed to it by the Building Act 1991.

Building element Any structural or non-structural component or assembly incorporated into or associated with a *building*. Included are *fixtures*, services, *drains*, permanent mechanical installations for access, *glazing*, partitions, ceiling and temporary supports.

Fixture An article intended to remain permanently attached to and form part of a *building*.

Hazardous Creating an unreasonable risk to people of bodily injury or deterioration of health.

Intended use of a *building* includes:

a) Any reasonably foreseeable occasional other use that is not compatible with the intended use; and

b) Normal maintenance; and

c) Activities taken in response to *fire* or any other reasonably foreseeable emergency – but does not include any other maintenance and repairs or rebuilding.

Specified intended life has the meaning ascribed to it by section 39 of the Act as follows: "*specified intended life*" in relation to a proposed *building*, or any existing *building*, or any *building* proposed to be altered, and which is intended to have a use of not more than 50 years, means the period of time, as stated in an application for a *building consent* or in the consent itself, for which the *building* is proposed to be used for its *intended use*.

VERIFICATION METHOD B2/VM1

1.0 DURABILITY EVALUATION

1.0.1 Verification that the durability of a *building element* complies with the NZBC B2.3.1 and B2.3.2 will be by proof of performance and shall take into account the expected in-service exposure conditions by one or more of the following:

a) In-service history,

b) Laboratory testing,

c) Comparable performance of similar *building elements*.

1.1 In-Service History

1.1.1 Verification of durability based on in-service history of a *building element*, including materials, components and systems shall take into account but not be limited to:

a) Length of service,

b) Environment of use,

c) Intensity of use,

d) Any reaction with adjacent materials,

e) Limitations in performance,

f) Degree of degradation, and

g) Changes in formulation.

1.2 Laboratory Testing

1.2.1 Verification of durability based on successful performance in a laboratory test shall be accompanied by an assessment of the tests performed, their relevance to field and service conditions, and in particular:

a) Types of degradation mechanisms likely to be induced by testing,

b) The degradation mechanisms likely in-service,

c) Details of methods of assessment,

d) Variability of results, and

e) The relevance of the test to the *building element* under study.

1.2.2 Figure 1 provides a means of assessing the durability requirements for *building elements*.

1.3 Similar materials

1.3.1 For the purposes of evaluation, a *building element* may be considered as similar to another *building element* with proven performance, if both are subject to the same controls for composition and overall performance. Examples of such controls are Approved Documents or Standards. Where such a direct comparison is not possible, the *building element* shall be independently assessed to determine the degree of similarity.

1.3.2 Assessment shall take into account but not be limited to:

a) Product composition,

b) Method and quality assurance of manufacture,

c) Degradation mechanisms,

d) Local environment,

e) Conditions of use,

f) Required maintenance, and

g) Performance in use.

Comment:

Environment

1) To be acceptable, any opinion in support of the assessed durability for a building element shall clearly identify the conditions of use and the environment under which that durability will be achieved. If the building element can be reasonably expected to be used in circumstances which will reduce the durability, any limitations in use shall be clearly identified and evaluated.

2) *Circumstances which need to be considered include, but are not limited to:*

a) *Maintenance required to achieve the required durability (e.g. painting, cleaning, replacing high wear items such as washers),*

b) *Installation details of the total system (e.g. fixings, flashings, jointing materials),*

c) *Compatibility with other materials (e.g. galvanic corrosion, plasticiser migration),*

d) *Locality or macroclimatic effects (e.g. coastal or thermal areas, wet or damp ground conditions),*

e) *Microclimatic effects (e.g. sheltered areas on buildings such as eaves),*

f) *External environment influences (e.g. local industrial operations such as fertiliser works), and*

g) *Internal environment (e.g. swimming pools, chemical processing areas, sauna rooms).*

ACCEPTABLE SOLUTION B2/AS1

1.0 DURABILITY APPLICATIONS

1.0.1 This acceptable solution applies to materials and components required to satisfy the performances specified in other NZBC Clauses.

Comment:

All building work shall comply with the NZBC. This means that building elements, both individually and as part of a system, shall meet all the performances required by the applicable NZBC Clauses and shall continue to do so for the required durability period. In some cases, building elements (e.g. decorative coatings and trim) are not required to satisfy an NZBC performance criterion. Such building elements will then have no B2 durability requirement. However, where a building element serves two purposes, only one of which must satisfy the NZBC, it shall have the durability appropriate to its location and use. For example, a decorative finish applied to a building element required by the NZBC to have an impervious easily cleaned surface will need to satisfy the 5 year durability performance.

1.1 Approved Documents

1.1.1 *Building elements*, including materials, components and systems, complying with a publication referenced in the Approved Documents, satisfy B2 requirements only when the conditions of use stated in the publication and Approved Documents prevail.

Comment:

It is not practicable within the Approved Documents to cover all possible combinations, uses and conditions which may be applied to a building element. In special circumstances and where elements are called up but are used outside the scope of the Approved Document application, durability shall be verified by B2/VM1.

1.2 Assessing required durability

1.2.1 Evaluation of *building elements* shall be based on the following concepts:

a) **Difficult to access or replace** - applies to *building elements* where access or replacement involves significant removal or alteration of other *building elements*. Examples are works involving the removal of masonry or concrete *construction*, or structural elements or repair of buried tanking membranes. A 50 year durability is required.

b) **Moderately difficult to access or replace** - applies to *building elements* where access or replacement involves the removal or alteration of other *building elements*. Examples are the replacement of services reticulation in wall cavities and skillion roofs, or of plant and hot water cylinders built into roof spaces without adequately sized access openings. A 15 year durability is required.

c) **Easy to access and replace** - applies to *building elements* where access or replacement involves little alteration or removal of other *building elements*. Examples are linings, trim, light fittings, hot water cylinder *elements* and door hardware, or where specific provision for removal has been made. A 5 year durability is required.

d) **Failure to comply with the NZBC would go undetected during both normal use and maintenance of the *building*** - applies where the *building elements* are hidden from view with no provision for inspection access, and failure would not be apparent until significant damage had occurred to other *building elements*. Examples are building paper behind a masonry veneer cladding, and insulation in a skillion roof. A 50 year durability is required.

e) **Failure to comply with the NZBC would go undetected during normal use of the *building* but would be easily detected during normal maintenance** - applies where normal maintenance will identify faults unlikely to be observed by *building* occupants until significant damage has occurred. Examples are degradation of exterior claddings on roofs and walls, sealant filled joints, flashings, services with specific provision for inspection access, chimneys and flues. A 15 year durability is required.

f) **Failure to comply with the NZBC would be easily detected during normal use of the *building*** - applies where the failure is obvious to the *building* occupants. Examples are exposed *building elements* which are damaged or inoperative such as protective finishes, essential signs, sticking doors, slip resistant surfaces, stair treads and surface-run *building* services equipment. A 5 year durability is required.

1.2.2 Figure 1 provides a means of assessing the durability requirements for *building elements*.

1.3 Examples of durability requirements

1.3.1 Table 1 is an acceptable solution establishing durability requirements of nominated *building elements*.

2.0 MAINTENANCE

2.1 Normal maintenance

2.1.1 Normal maintenance is that work generally recognised as necessary to achieve the expected durability for a given *building element*. The extent and nature of that maintenance will depend on the material, or system, its geographical location and position within the *building*, and can involve the replacement of components subject to accelerated wear.

2.1.2 It is the responsibility of the person specifying the *building element* to determine normal maintenance requirements. These may be based on the manufacturer's recommendations and may also include periodic inspections of *elements* not readily observable without a specific effort (e.g. access to roof or subfloor spaces).

2.1.3 Basic normal maintenance tasks shall include but not be limited to:

a) Where applicable, following manufacturers' maintenance recommendations,

b) Washing down surfaces, particularly exterior *building elements* subject to wind driven salt spray,

c) Re-coating interior and exterior protective finishes,

d) Replacing sealant, seals and gaskets in joints,

e) Replacing valves, washers and similar high wear components in easily accessed service equipment and other *building elements*,

f) Cleaning and replacing filters in *building* services systems,

g) The regular servicing of boilers, cooling towers, lifts, escalators, emergency lighting and fire protection equipment, and

h) The maintenance of signs for access, *escape routes*, emergency equipment and *hazardous* areas.

Comment:

Maintenance does not include such things as upgrading building elements to meet the demands of new technology or the increased environmental expectations of users.

2.2 Scheduled maintenance

2.2.1 Scheduled maintenance comprises the inspection, maintenance and reporting procedures for *building elements* required to have a *compliance schedule* in terms of section 44 of the Building Act. By those procedures the *building elements* concerned are effectively deemed to have a durability of the life of the *building* because they are required to perform as designed at all times. The relevant maintenance procedures may include total replacement.

3.0 GENERIC MATERIALS

3.1 Concrete

3.1.1 NZS 3101:Part I Section 5 is an acceptable solution subject to the following modifications:

a) Where this Standard has provisions that are non specific or in unquantified terms (such as shall be evaluated, modified, specified or the like), these do not form part of the acceptable solution and must be treated as an alternative solution.

b) The word "should" is to be read as "shall" in Notes 1 and 2 of Table 5.1.

3.2 Timber

3.2.1 NZS 3602:Part 1 is an acceptable solution for meeting the durability requirements of timber *building elements*.

3.2.2 NZS 3604 is an acceptable solution for meeting the durability requirements of *buildings* within its scope.

3.3 Solid plastering

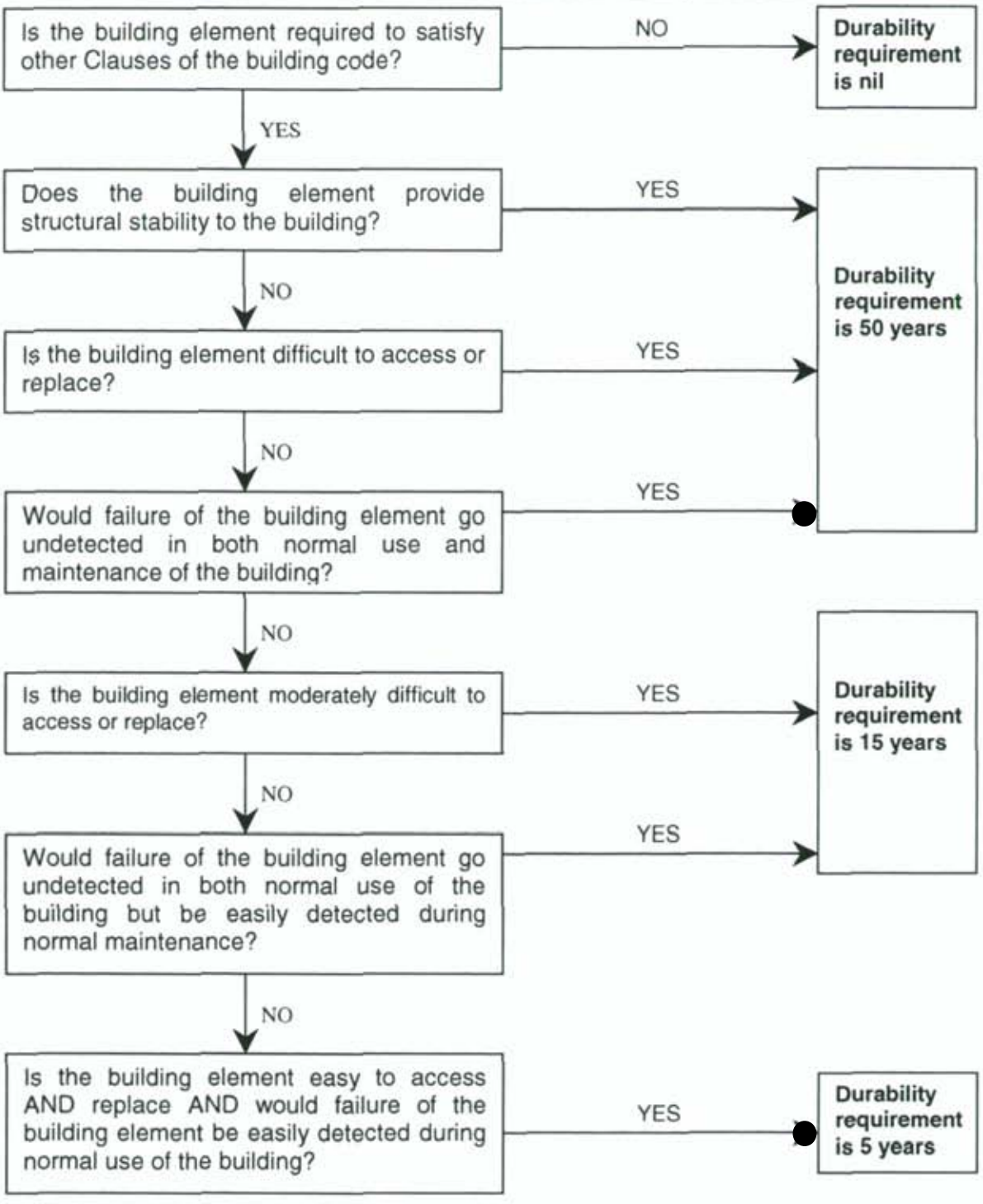
3.3.1 NZS 4251:Part 1 is an acceptable solution for meeting the durability requirements of cement plasters for walls, ceilings and soffits within its scope.

3.4 Earth buildings

3.4.1 NZS 4297 and NZS 4299 are acceptable solutions for meeting the durability requirements of earth *buildings* within their scope.

Figure 1: **Assessment of durability requirement**

Paragraph 1.2.2



Note: *Building elements* shall not be required to satisfy a durability performance which exceeds the *specified intended life* of the building.

Table 1: Nominated building elements required to have 5, 15 and 50 year durabilities

Paragraph 1.3.1

Element	Examples of durability required under NZBC B2.3.1		
	5 years	15 years	50 years
Acoustic elements	Easy to access and replace	Behind non-structural claddings or linings	Integral with structural elements
Building paper and roofing underlay		Exposed to view and easy to access and replace	Access would require removal of masonry or concrete walls, clay or concrete roof tiles, or structural elements
Cladding		Non-structural cladding	Structural cladding (including bracing elements)
Damp-proof membranes (DPM) and vapour barriers		DPMs in easy to access subfloor spaces, vapour barriers behind non-structural linings	Inaccessible tanking, DPMs under concrete floor slabs, vapour barriers behind structural linings
Doors	Internal doors and frames, all hardware	External doors and frames	
Electrical work	Exposed fittings, and surface run wiring, wiring in easy to access ducts	Wiring behind lightweight linings, complex conduit runs in concrete or blockwork walls and floors	Wiring buried in or under concrete slabs, wiring behind structural linings without ducts
Fixings	Non-structural lining fixings	Visible fixings for non-structural cladding	Structural fixings (including subfloor fixings), hidden fixings for claddings or curtain walling
Flooring	Flooring laid independent of bottom plates		Flooring laid under loadbearing bottom plates, flooring as a bracing diaphragm
Floor coverings	Protective coverings or acoustic covering		
Flues	Easy to access e.g. exposed solid fuel burner flues	Built-in flues	
Framing	Easy to access non-structural partitions e.g. non-load-bearing partitions		Structural framing (including bracing elements)
Guttering and downpipes	External spouting and downpipes		Structural framing (including bracing elements)
Hot water cylinders	Easy to access	Moderately difficult to access or replace	
Insulation	Exposed to view e.g. under a raised pole house floor	Behind non-structural claddings and linings, and in roof spaces	Hidden behind masonry or concrete walls, or structural elements, or in skillion roofs
Interior wall linings	Easy to access linings		Structural linings

Table 1: **Nominated building elements required to have 5, 15 and 50 year durabilities** (cont'd)
Paragraph 1.3.1

Element	Examples of durability required under NZBC B2.3.1		
	5 years	**15 years**	**50 years**
Plumbing	Exposed piping, fittings and valves	Piping, fittings and valves behind wall linings or in skillion roofs having no provision for maintenance access	Piping, fittings and valves buried in or under concrete slabs or in masonry cavity walls and not ducted or provided with maintenance access
Protective coatings	Easy to access and replace	Roofing membrane	Inaccessible or difficult to access or replace
Roofing		Non-structural roofing	Structural roofing
Septic tanks		Pre-assembled units easy to access by excavation (covered by driveways)	Built into or under the structure of a building
Stairs	Removable treads	Stairs and balustrades	Stringers or treads built into the structure
Ventilation	Easy to access plant and exposed ducting	Built-in plant or ducting	
Windows	Internal glazing and frames, all hardware	External glazing and frames, skylights	

9.2 Interview List

The following is the list of those interviewed. Due to the assurance of confidentially, names are not given – instead, a brief description of the type of firm is outlined.

Table 3: Interview List

Category	*City*	*Company Type*	*Position*
ARCHITECTS	*Auckland*	Medium size firm – mainly commercial/industrial work	Principal
		Medium size firm – mainly commercial/industrial work	Senior Arch
		Long established large firm – mainly commercial/institutional work	Snr Specification Arch
		Large property management group – project management/ maintenance	Architect
	Christchurch	Sole practitioner working from home	Principal
		Long established large firm – mainly commercial/institutional work	Principal
	Wellington	Long established large firm – mainly commercial/institutional work	Principal
ENGINEERS	*Auckland*	Sole practitioner working from home	Structural engineer
		Sole practitioner working from home	Structural engineer
	Wellington	Long established large firm – mainly commercial/institutional work	Structural engineer
		Medium size firm – mainly commercial/industrial work	Structural engineer
		Medium size firm – mainly commercial/industrial work	Structural engineer
		Long established multi-disciplinary firm – commercial/institutional work	Structural engineer
		Long established large firm – mainly commercial/institutional work	Structural engineer
CONSULTANTS & ADVISERS	*Auckland*	Sole practitioner – specialist engineering advice re faults	Consultant
		Medium size firm providing wide range of consultancy/ advice	Advisor
		Large property management group – project management/ maintenance	Maintenance specialist
	Wellington	Sole practitioner – general building advisory work – audits, faults, disputes	Consultant
		Large property management group – project management/ maintenance	Advisor
MANUFACTURERS	*Auckland*	Long established large concrete manufacturer	Engineer
		Long established large manufacturer – mainly wood based products	Marketing manager
		Timber supplier and importer	Managing Director
		Local branch of UK manufacturer of plumbing systems	Managing Director
		Local branch of Australian manufacturer of steel fixings	Marketing manager
		Long established large manufacturer – roof tiles	NZ Sales Manager
		Importers of plumbing and heating systems	Managing Director
	Christchurch	Long established large manufacturer – timber trusses	Branch manager
		Long established large company – does design/build work also	National Tech. Manager
	Wellington	Paint manufacturer and supplier	Technical manager
		Window Association of NZ	Sector representative
CONSTRUCTION TRADES	*Auckland*	Master builder – small – residential work	Builder
		Long established large construction firm – medium to large work	Regional Engineer
		Long established large developer of standardized housing	J't Managing Director
	Christchurch	Long established - develops and builds prefabricated outbuildings.	R & D Manager
	Wellington	Long established roofing company	Manager - roofer
		Medium size builders of design and build housing	Manager
BUILDING OFFICIALS		Large City Council	Building
		Large City Council	Plumbing & Drainage
		Large City Council	Building
	Christchurch	Medium size City Council	Team leader-Building
		Medium size City Council	Plumbing & Drainage
		Medium size District Council	Building Control Mgr
	Auckland	Medium size certification firm – mainly residential work	Manager
	Wellington	Large certification firm – branches around country	Certifier
OWNERS	*Auckland*	Provider and manager of public housing	
		Large property management group – project management/ maintenance	Maintenance specialist
	Christchurch	Large property management group	
	Wellington	University – campus works and services	Maintenance Manager
		University – campus works and services	Manager-campus dev.

9.3 Summary of Comments from Interviews

The following notes summarise comments made during interviews:

9.3.1 How Important is Durability on your Decisions in Regard to Material Selection?

Architects and designers

- Can be medium or high depending on type of client - some only interested in bottom-line minimums, while others more in long-term costs. Matter of balance between durability and costs.
- Problems will come back to them – they are responsible for sorting them out so needs to treat durability as important
- Very important but is often forced to balance against cost (depending on the client), e.g. airport treats as critical whereas other clients treat *costs* as of prime importance
- Not associated with minimum NZBC requirements - is treated the same way as was always from pre-code days
- Always been important. Code does not make any difference to importance. Can't afford too many problems when you practise in the same area for a long time.
- Considered as extremely important, and proposals are always well over minimum necessary for compliance. Firm does not aim to push boundaries for materials. Problems will always come back to the firm anyway and be sorted out. Such problems are learned from, and future choices amended accordingly. Institutional clients (e.g. hospitals, education buildings etc.) are most concerned and involved with long-term durability and maintenance issues. It comes down to a balance of durability against budgets (both capital and maintenance costs).
- Influenced, but not governed, by minimum NZBC requirements - is treated the same way as was always from pre-code days. Is matter of appropriate choice to suit circumstances - site, purpose, lifetime, environment etc. Often a balance against costs with some compromises made - but rarely down to minimum levels.

Engineers

- Medium importance re advice - most clients have short-term goals only and are not interested in more than a few years.
- Depends on client type and intentions re length of ownership (if planning to sell within 10 years, then will not be worried beyond that). Background of client is critical - big difference between building backgrounds and financial backgrounds (where short-term bottom line rules). Matter of choosing the appropriate level for the circumstances.
- Must comply with 50 yr requirement for structure - but use a limited range of structural materials with known durability - so durability tends to be "built-in" to design rather than tackled from first principles. Importance can vary with circumstances - costs can dictate, but not to extent of getting too low on quality. Connections are the area of biggest concern and where durability has highest influence. Corrosion zones increase importance. Importance has been increasing in recent years due to growing understanding of durability issues in modern materials and systems (including interactions with environment and with other materials)
- Exposed structural steel durability is more critical than structures which are closed in - where waterproofing is handled by the architects and concerns are therefore less.

Manufacturers and suppliers

- Critical - failures will rebound as grapevine is very efficient in industry and word spreads quickly - only time burnt was when gave into pressure to put together low cost system for developer and one minor component failed causing major costs to remedy. (developer only concerned with short term costs) - have learned lesson.

- More driven by code requirements - in past, was generally up to manufacturer in terms of long-term reputation. Now sometimes higher than in the paste.g. for shower linings.
- Particularly high in view of potential liabilities when supplying builders
- Medium importance for residential work as are using known product with known durability. Increasing importance in commercial work with increasing liability, and one-off non-standard design.
- Not a major issue due to the type of products dealt with - involve limited number of conventional materials which have known characteristics and performance over time.
- Always very concerned with durability as product is structural element where it is critical to safety of structure.
- Increasingly so - more onus is put onto the supplier/contractor now with performance-based specifications. Need to look for right balance of durability and cost.
- Base materials are well-known with long history of use - seals and sealants are less so - more limited life, so more critical to the durability of the complete system. Coatings are mainly visual, rather than affecting durability of the window system.
- Extremely important - paint finish is "end of line" product in a building - so takes all of the wear from use and climate, while at the same time being highly visible.

Builders and other construction trades

- Offer 50 yr warranty on tiles and 10 yrs on installation, so concern with durability has to be extremely high in order to have confidence in system.
- Varies according to type of client, intended length of ownership and budget. However - is important to him as a roofer in Wellington's climate. Leaks will always come back to him.
- Has been in business 25 yrs - problems will come back to him - liability is becoming heavier
- Variable - can be medium or high depending on type of client - some only interested in bottom-line minimums, while others more in long-term costs. Usually handled by consultants who will set out minimum performance-based specifications
- Becoming increasingly important as liability increases - 5 yr guarantee issued. Major problem areas are external leaks and internal moisture prone areas like showers.
- Was low importance, but is increasing due to recent problems with durability requirements.
- Mainly in terms of trying to get best value for money for the client - sometimes balanced against costs involved.

Owners and Property Managers

- Particularly high in view of type of housing – long-term landlords. Durability is the most important factor - probably governs all other criteria.
- Varies according to client and type of project. Some projects (e.g. shops) are not concerned with durability, as they are short-lived by nature. Other types (e.g. polytechs) insist on durability as a prime requirement - together with low maintenance costs etc - as these institutional clients have an on-going long-term ownership interest.
- Critical importance - is responsible for the maintenance of buildings and services, including all security systems.
- Critical importance - as University owns and has to maintain its building in the long term. Campus is also in an exposed site and is subject to particular wear from weather.

Consultants and advisers

- As most work involves complex areas of failure where durability is an issue, advice on remedial work must treat durability as very important. It is also a personal philosophy in regard to long-term sustainability.
- Critical to this type of work which stems from problems - therefore critical to ensure future durability
- If repairing work that has resulted in failure, must be done properly. Tend to avoid clients who are only interested in short term fixes in order to move property on.

- Overall is high, but it can vary with circumstances (client type, building type, budget etc). Most clients are long-term owners (institutional) so durability is very important to them in order to minimise long-term costs
- Critical - as is involved in reporting on failures, so is very aware of the repercussions of wrong choices.

Territorial Authorities and certifiers

- Importance has been increasing over the past 5 years with the increase in numbers of products/imports available. Importance is particularly high re exterior claddings, flashing etc - the waterproofing elements of the building.
- Increasing since code - new 3604 has increased focus, but durability was still very important prior to that
- Becoming increasingly important as insurers require compliance certificates - leading to increased liability for TAs, and increased demand from TAs for assurance via back-up, detail etc.
- Importance has increased in recent years - about 7 years ago, had some bad corrosion problems in region. 3604 has focused attention on this and has clarified the corrosion requirements within the NZBC.
- Depends on type of site in region - some have exposure problems re wind, rain etc. and affect choices in regard to roofing materials etc., while in others the soil types are more important and affect choices in regard to foundations.
- Generally very important - but concentrate on the riskier periods of 15 and 50 years, as 5 years is easy to achieve.

9.3.2 How is Durability Considered during Day-to-Day Activities?

Architects and designers

- Individual materials have their own specific qualities re durability - these must be translated through to the whole system, complete with all accompanying details.
- Smaller jobs: approach tends to evolve over time with preferred details and materials reused. These gradually evolve with time, new product availability, problems arising, etc. Large jobs are more one-off due to larger budgets and therefore more time availability. May start with full life-cycle costings. Design budget is critical to amount of research and background work which is able to be practically done. The type of client is also critical in terms of their continuing ownership. Institutional clients (e.g. hospitals, education buildings etc.) are most concerned and involved with long-term durability and maintenance issues. It comes down to a balance of durability against budgets (both capital and maintenance costs).
- Integral part of design process - carefully monitored throughout the process with a team approach.

Engineers

- Consideration from the earliest stages of the job in order to establish basis materials and rough orders of costs - revisited as necessary throughout the process.
- Durability concerns may influence decisions right from initial design - or may be handled at a later stage depending on the circumstances.

Manufacturers and suppliers

- Has to be considered right from the start
- As far as material choice is concerned, durability consideration is at the very beginning - with detailing durability considerations being later in the process.

- Durability is considered both within the design process of a particular paint, and within the specification of a painting system - which includes substrate identification/preparation, all necessary undercoats, and the final finishing coats.

Builders and other construction trades

- From pricing through to final completion of the works and release of retentions.
- Handled by consultants who will set out minimum performance-based specifications
- Have formal system of feedback from owners that affects future choices - which means that product evolves over time. Longer-term feedback is more dependent on info. from material manufacturers.
- Considered right from the beginning, as job is quoted on initial design - decisions made at that stage to set costs.

Owners and Property Managers

- Is considered an *integral* part of the process of any projects - and is checked at every approval stage as well.
- Some considered at early design stage - ones that are part of external image, where durability of finishes is considered. Others left to the detail stage or specification - in particular internal finishes (laminates, vinyls etc). Others considered at in-between stages - but owner less concerned with these - leaves them to consultants.
- Important part of process - from initial briefing of requirements through to approval of documentation and construction (with release of final retentions).

Consultants and advisers

- Durability issues are an integral part of the job, rather than just a part.
- Ongoing process of maintenance management and of avoiding future problems
- Integral part of repairing in order to solve problem in long term and to avoid future problems.

9.3.3 Meaning of the Term "Durability"

Architects and designers

- Warranties may be important to the client when making choices on materials.
- Appearance OK - Prefers to turn the issue around - ideal is to choose materials that improve with age
- Other –
  - Overall "permanence" of material in place in particular buildings - relates to the basic meaning of durability - an appropriate design life or longevity of buildings.
  - A process, rather than a particular term - decide on appropriate longevity or permanence in regard to the project, and then the link is the durability of the materials.

Engineers

- Warranties
  - Come into contention - but of dubious credibility as may not mean more than statement of belief
  - Want to have - but is not associated with the design life of an element, e.g. windows might have 10-year warranty but 30-year design life.
  - Viewed as sign of manufacturer's confidence in the products durability - concerned re metal cladding
- Maintenance is one of the key elements of durability - if good, life can be extended indefinitely. Decisions in regard to durability can be driven by client concerns on maintenance - main concern pre-code - is an integral part of durability.

- Appearance - First call comes from owner - particularly re coatings. But may or may not be associated with a durability problem.
- Legal requirement - Conscious of increase in liability since Act - from that of past professional negligence.

Manufacturers and suppliers

- Code term rarely relevant - only applies when lowest-cost systems approach minimum levels
- Appearance
  - Important to owners - so problems will come back if appearance suffers
  - Important to owners, e.g. coatings - but will not affect durability. However, industry will still focus on appearance as it is linked to other factors such as public image of product, confidence etc.
  - Important for paint finishes - even if coating is only decorative, or if appearance does not affect durability, e.g. fading. Appearance is important as it is linked to other factors such as public image of product, confidence etc.
- Warranties
  - Products manufactured to NZ standards - warranty is implied. Important from clients' viewpoint as an indication of confidence in durability of product.
  - Have problems with plumbers and suppliers who confuse design life of 50 years with warranty of 2 years. Have problems with concepts of warranties vs guarantees as far as customers are concerned
  - Tightly bound by manufacturers' warranties - these cover materials, but he must cover installation. He is point of contact with owners on warranties.
  - Are important indication of company's confidence in product, and as an indication of expected durability. Can have problem re what is guaranteed, i.e. what condition is expected at the end of the period.
- Time functioning - Important meaning as the coating will usually be protecting the substrate from damage - particularly for industrial finishes, exterior structural steel, timber cladding cedar etc.

Builders and other construction trades

- Appearance
  - Owners can assume that this is a durability issue (colour of pre-coated steel) - when performance is not affected. However, other signs such as rust will be a durability problem.
  - Problems will come back if appearance suffers. May or may not be a durability issue, but it is the first sign to an owner that something might be wrong.
- Warranties - Important to owner and to builder (in the short term). Builder is also often the first point of contact with warranties by other trades.
- Other - Customer satisfaction as shown by lack of call-backs - have been in business over 60 years, so cannot run away from complaints.

Owners and Property Managers

- Warranties - Important as owner - require 5 year warranty on materials and workmanship
- Maintenance –
  - Influences initial choices of materials - and is important in terms of future costs in use of the buildings
  - As long-term owner, upkeep costs are ongoing problem addressed by maximising durability of materials and building systems.
  - Ties into future maintenance costs and the quality of the built environment (image of the campus)
- Other - A process, rather than a particular term - we need to get what we have paid for. Construction must be as specified and approved - that is part of the resulting durability.

Consultants and advisers

- Time functioning –
  - Work is oriented towards base requirements of function and to code requirements
  - Only real meaning - all others are secondary, and have some connection but indirectly. Also, jobs often involve pre-code buildings where NZBC is irrelevant to the work done at the time.
  - faults occur when function fails
- Legal requirement – Important in his role - all legal implications of NZBC and other consumer Acts (including warranties) have bearing on investigations.
- Appearance - Can be involved - appearance may be sign of durability problem, e.g. a coating breaking down
- Other - Long term "permanence" or sustainability - resources not wasted on short term uses.

Territorial Authorities and certifiers

- Time functioning – Prime meaning - others secondary, stem from/ are linked to that primary requirement.
- Code term - Implications of the NZBC are prime concern - meaning is therefore as defined in code.
- Legal requirement –
  - Mainly legal requirement, but other options interrelate and can influence.
  - Owners are becoming more litigious - while TAs are settling too easily.
  - Yes - but not spelt out, so less directly influential
- Time functioning – Prime meaning - others are secondary, and have some connection but indirectly. Maintenance is part of the functional requirement
- Maintenance - In terms of building products this has a bearing
- Warranties –
  - Use warranties as proof of competence - insist on copies to TA before compliance certificate issued
  - Builders are often not concerned beyond their warranty liabilities

9.3.4 Sources of Information about Durability

Architects and designers

- NZ Standards –
  - Do not often use standards for durability - Most work involves secondary consultants who are more likely to use their own particular standards.
  - Architects use standard for concrete appearance - engineers use other concrete standards.
  - Still do some residential work - so timber standards are used. Secondary consultants use their own standards for the larger work.
- Third Party Reports –
  - Re failures will influence present decisions on choices of materials.
  - Hard to get – may pick up second hand via other sources
- Industry Information and Advice –
  - Grapevine is extremely efficient - constantly vigilant for word of problems.
  - Mostly informal network system - very efficient network, and word of product problems gets around the local industry very fast.
- Past experience - Have been in practice now for many years, so experience is one of the most important sources of information.
- Other - Aims to find out generic descriptions from suppliers - can often be difficult. Need to know what the material really is before being able to assess it and to decide how it needs to be handled.

Engineers

- NZ Standards
  - Has copies of all structural standards since 1960 - but no particular one used for durability
  - 3604 is important in terms of corrosion requirements for coatings
  - All structural materials standards (steel, concrete, timber). Also standard for coatings. Does not use 3604 for durability information.
- NZBC B2 - Seldom used - commercial work is not designed down to code minimums
- Trade literature - Only place limited reliance on - aim for independent verification
- Appraisals - Only in a minor way - These are the most reliable sources of information - but are limited in range and tend to be geared towards mainly domestic products.
- Third Party Reports – Does reports on failures, but does not use reports by others often - rarely has access to them
- Industry Information and Advice –
  - History of product performance under environmental conditions - actual performance cf theoretical
  - Professional grapevine still exists but does not have enough time to fully use it
- Past experience –
  - Very important - past failures or problems affect present choices.
  - Has had over 30 years experience in the region, so has built up extensive background of experience.
  - In business in the area for a long time - built up great deal of experience of the performance of materials.

Manufacturers and suppliers

- NZ Standards –
  - Wood panel product std (1959) including updates - no real conflict with newer standards
  - Use overseas standards and tests on products imported - then translate to NZ terms to provide reliable info.
  - Uses a variety - use Aust. Standards for electrostatic powder coatings, but these are decorative rather than affecting durability
- ISO Standards –
  - About 5 manufacturing site use ISO processes (based on ISO 9000 standards)
  - Safety related products like tempering valves - have policy of sourcing only from ISO manufacturers (use few that are not ISO accredited for other products)
- Trade literature –
  - Very limited use - produce own trade literature etc for others to use. Product is specialised, so other information is unlikely to be relevant.
  - Have own Australian information. Does not use other organisations' information.
  - Major source is the firm's own UK trade literature, test results and appraisals.
- Appraisals/ Accreditations –
  - Useful in marketing products and systems as is important to engineers and designers
  - Believe that industry is at present putting undue reliance on these, as they are losing their credibility as sound, unbiased opinions on products.
- Industry Information and Advice –
  - Australian particle board flooring guides - spell out performance
  - Limited - paint manufacturers assoc. shares some common information. Most overseas info. Is not applicable to NZ climate and substrates.
  - Important source of information - association concentrates on common industry information
  - Network system works well - balances common industry good of sharing information against confidentiality
  - Some industry sharing - but less than in past. Company is fairly self-sufficient and relies mainly on own experience.
  - Keep eye on competitors' products

- Past experience –
  - Main source - company does own research, design and testing of products. Has feedback systems operating to pick up problems experienced by painters - when clusters of similar problems show up, problem is focused on and research into solutions is done.
  - Only source of any consequence - known products with known history of use.

Builders and other construction trades

- NZ Standards –
  - 3604 is the core standard for the type of work done
  - Very rarely need - only in disputes where standards form part of specification. Consultants use standards, not company.
  - All of those relevant to housing. 3604 most important - also use aluminium windows and roof standards
- Trade literature - Critical re liability and warranties - as need to ensure that installation is exactly to specifications
- Journals - Rely on to be informed of problems, advice etc, e.g. master builders, BUILD etc.
- Appraisals/ Accreditations – Uses BRANZ appraisals for checking out new products
- Industry Information and Advice –
  - Important - network of local contacts. Also uses BRANZ for advice on problems, products etc.
  - Industry grapevine is very efficient - word of problems gets around fast. Own experience also very important.
  - Have pet suppliers/sub trades so build up trust and pick up info on failures/problems etc.
  - As small builder it is impossible to keep up on his own, so needs industry body, i.e. master builders, to act on his behalf by keeping up with the industry
  - Via Roofing Association and other informal networks - uses charts for galvanic action and corrosion zones etc
- Past experience –
  - Firm is large and has been in business for long time - has built up good experience and contacts.
  - This is the most important - company been in same business for over 60 years. Formal system of feedback ensures that experience is used.
  - Probably most important - company been roofing in area for over 40 years - know how roofs perform in this region and what potential problems there will be.

Owners and Property Managers

- NZBC and Standards - Code and standards are consultants' responsibility.
- Trade literature –
  - Maintains large in-house technical library, and subscribes to a variety of trade and professional journals - finds it an important way of keeping up-to-date.
  - keeps expanding library resources on material information
- Industry Information and Advice –
  - Has on-line international grapevine operating among facility managers with similar services. Also has contact with hospital facility managers and engineering network.
  - Shares experiences from formalised on-line international grapevine operating among facility managers - able to pick up on problems/ solutions/ discussions. Also has own engineering network, and many years of experience in building services, and in maintaining campus buildings.
  - Also has own architectural network, and many years of experience practising as an architect in the region.

Consultants and advisers

- NZCZ B2 –
  - Base reference as necessary when dealing with TAs or certifiers.

- Only if applicable to particular fault investigation - then may have bearing on advised repair
- Keeps copies of relevant sections but only refers to if necessary if a problem arises

- NZ Standards –
  - Which ones will depend on particular fault - all those relevant will be researched
  - May be the standards in force at the time of the work. Current standards provide guidance only, and a base reference as necessary when dealing with TAs or certifiers.
- Trade literature, journals, appraisals –
  - Guidance only - used as part of information resources. Must assess using own personal judgement.
  - Use appraisals but treat with limited reliance.
  - Journals - Not used much - may highlight something for further research.
  - Trade literature - Have built up good reference library for all common materials.
- Industry Information and Advice –
  - Has good network of industry contacts both in NZ and overseas.
  - Use network of expert advice both in NZ and overseas (especially Canada and US West Coast where conditions are similar)
  - Yearly BRANZ seminars for advisers give good opportunity to share information - also provides basis of getting to know other advisers and building up a network or grapevine. Past work contacts are also important sources of shared experience.
- Past experience –
  - Primary source - based on years of experience and specialist qualifications in the industry.
  - Probably main source of information - have built up years of experience, as have other within the firm - collective experience is invaluable.
  - Main source of information - as experiences or sees results of wrong choices, becomes more conservative re potential durability of materials. Common sense knowledge of the generic qualities of materials plays a big part in decisions - also the background of appropriate detailing to form a successful system.

Territorial Authorities and certifiers

- Trade literature - Important source - have built up good reference library for all common materials.
- Third party reports –
  - These are often part of the producer statements required for some products
  - Only rarely - in unusual cases, e.g. on-site effluent disposal systems, mud houses etc.
- Industry Information and Advice –
  - Some industry sharing (BOINZ) gives formal networking. Also informal grapevine amongst certifiers to hear of problems etc.
  - Important source. He believes that there is too little networking done with other TAs - concentrating on trying to improve this by building up regional network with other TAs. Also starting to network with some major local manufacturers and with BRANZ local field staff. Thinks there should be a lot more liaison and information-sharing in order to make the most of past experience of as many people as possible.
  - Regional networking with other TAs - also with some local manufacturers and with BRANZ local field staff.
  - Good network system set up with other TAs in region - meet bi-monthly. Lot of contact with those in Porirua, also Masterton, Palmerston North, New Plymouth and Hamilton.
  - Some networking is starting with other regional TAs, but these are mainly smaller so are relying on larger offices to give advice. Are often called by West Coast TAs where officials have to cover plumbing even though that is not their background expertise.
  - Holds regular well-attended trades evenings (bi-monthly), plus puts out newsletter - all encourages good sharing of information
  - Do use grapevine between TAs - but still treat with caution as it depends on the source. There can be inconsistencies within the TA, let alone among others.

- Have good regional network with bi-monthly meetings, plus quarterly BOINZ meetings - fairly efficient grapevine around TAs - but still bound to have some level of inconsistency
- Past experience –
  - Is main source - firm has built up good database and records to highlight past problems etc.
  - Particularly important in regard to alternative solutions.
  - Losing experienced local inspectors is a problem.

9.3.5 Knowledge of B2 Requirements

Architects and designers

- Low –
  - Durability continues to be considered as it was in pre-code time. Aims for performance which is well over code minimums. Durability is considered as extremely important, so projects have never hit problems with TAs as proposal are always well over minimum necessary for compliance. It is very rare for TA to require more information. Firm does not aim to push boundaries for materials. Problems will always come back to the firm anyway and be sorted out. Such problems are learned from, and future choices amended accordingly.
  - Do not get involved in detailed issues of the code requirements.
- General –
  - Is usually all that is needed - if a specific problem or material is an issue, then may investigate further.
  - Not particularly influential - so have not needed detailed knowledge. Know where to find detail if needed.
- Detailed - Use detailed knowledge only when costs force choice towards minimum levels.

Engineers

- Low – Has detailed knowledge of durability - but less of the NZBC requirements.
- General –
  - Not particularly influential - so have not needed detailed knowledge. Know where to find detail if needed- but do not usually need to.
  - Only general (structure simple as usually 50 years). Knows where to find details if need to refer more deeply - rare, unless it is a special commission.
- Detailed - Not because he thinks it is valuable but because he has no choice but to know it well and be able to argue it when required.

Manufacturers and suppliers

- Low – rarely have to deal with - a consultant handles accreditation of products.
- General – only refer to as required.
- Detailed -
  - Has become more important since involvement in piping which is more inaccessible
  - Are often driven by code so need to have detailed knowledge
  - Needs a detailed knowledge in order to be able to confidently meet legal requirements.
  - High for designers, lower for fabricators. Depends on the stage - it is high at the initial design stage - then lower at fabrication stage, when are following a predetermined system
  - More than general, but less than detailed. Have had to develop a reasonable knowledge in order to argue the terms necessary for paint coatings, e.g. substrate might have to last for 15 or 50 years, but coating is designed to be easily replaceable so is only 5 years.

Builders and other construction trades

- Low –
  - Code requirements do not affect his work - relies on manufacturer's specifications

- Limited - only use when required. Rely on Master Builders to keep up to date with key requirements - and to let member know of implications.
- Because of type of buildings, consultants handle code requirements as part of the documentation.
- Relies on manufacturers of materials used in standard product. Materials are limited - so deal with each supplier to ensure they have dealt with durability code issues. However recent problems have lead to knowledge increasing.

- General – Only recently needed to consider in regard to new 3604 corrosion requirements (re roofing ties).

Owners and Property Managers

- Low –
  - Only indirect knowledge - 3604 and other NZ standards used as the link back to NZBC in regard to any dispute.
  - Has knowledge of durability - but less of the NZBC requirements. Is concerned about durability of campus buildings, but B2 minimums not relevant to these concerns. Any problems would be raised by consultants.

Consultants and advisers

- General –
  - Works from first principles - refers to only as needed. Knows aims and principles very well and seldom needs to refer to details.
  - How to get info related to particular problem is more important.
  - Will only go back to the requirements occasionally to double-check, if aware of perhaps getting close to minimum or if there is a problem with assessment (e.g. decks).
- Detailed –
  - Needs a detailed knowledge in order to be able to do type of work.
  - Has to - NZBC important when investigating faults and advising clients. Also important in building auditing.

Territorial Authorities and certifiers

- Detailed –
  - Needs a detailed knowledge in order to be able to confidently certify as compliant - need to work towards educating trades in region about requirements.
  - Essential to have detailed knowledge too - has concerns for future liability as number of post-code years grow.

9.3.6 Stage at which B2 is Considered

Architects and designers

- Early in design - As part of initial choice of materials - affects design. Budgets also settled early so main choices must be made then.
- Various stages depending on client –
  - Dependent on client's budget - if cost is prime concern, then will be considering minimum levels more often.
  - Only checks when in doubt - which only happens when costs govern and minimums likely.
  - Choices may be revisited if costs become a problem and changes are needed - otherwise does not need reconsidering after early design.
- If TA needs more information –
  - TA increasingly wants more information which is frustrating and time-consuming, considering that the end product quality remains the same as it has always been. More and

more back up to decisions appears to be necessary in order to cover TA in terms of any potential liability.
    - Never hit problems with TAs as proposal are always well over minimum necessary for compliance. It is very rare for TA to require more information. Firm does not aim to push boundaries for materials.
- Not specifically – Durability issues are covered in normal professional way throughout design and detailing

Engineers

- Early in design - Most important at the concept stage of design - choose materials appropriate to project and to code requirements. Then these are revisited at later stages for various details and specification needs.
- Working drawings/specification -
    - Once basic structure is settled, then detailed requirements are better considered in terms of B2 - tends to affect detail rather than initial concept design.
    - B2 covered during specification stage - because there is no choice but to consider it.
    - Durability considered early as part of initial selection of materials, but B2 not considered until later. Will go back and check B2 if necessary at the more detailed level.
- If TA needs more information –
    - Have never been asked for more detail than have supplied to TA.
    - Only rarely happens - durability considered as it has always been since pre-code days - B2 is really incidental as it gives the bare minimum requirements.
- Not specifically –
    - Durability issues are covered in normal professional way through out design and detailing (not in terms of B2).
    - Durability issues handled in traditional manner - code is necessary as underlying safety net but has little influence on the type of work done.
    - In general terms only - 50yr requirement is kept in mind throughout whole process - affects early choice, e.g. exposed structural steel, then details, e.g. cover to concrete.

Manufacturers and suppliers

- Early in design –
    - Consider very early to decide which components to use. along with assoc. durabilities.
    - Looked at right at beginning as sets all later design details and costings - do not need to revisit at later stages.
- Working drawings/specification - design and specification - that is when B2 would be considered. By the time that manufacturing starts, all decisions will have already been made.
- Manufacturing/installation – Critical as workmanship affects durability, e.g. joints.
- If TA needs more information –
    - Increasing contact with TAs and certifiers - they rely on manufacturers' specifications - provide producer statements which align products to NZ code to allow reliable back-up.
    - Becoming more important as TAs require more documentation on products and systems.
    - Commercial work - TAs have little knowledge of product so need to rely on manufacturers' information.
    - Increasingly directly involved with TAs in order to sort out durability problems. Also provide producer statements to TAs or users.
- Not specifically – Durability is handled in same way as before the code - treated as the most critical quality of paint system. Firm is always testing/researching to improve durability and aims for beyond 5yr level - B2 is largely irrelevant.

Builders and other construction trades

- Early in design –
    - Settle on base materials and systems to style and cost level of house type - need to consider B2 at that early stage to avoid later problems.

- Consider early to identify costs. The more important costs are, the more consideration has to be given to B2.

- Not specifically –
  - Does not usually involve him - if there is a problem will go back to designer to get sorted out.
  - Because of nature of buildings, consultants handle code requirements as part of the documentation.

9.3.7 Influence of B2 on Decisions

Architects and designers

- Little –
  - Mostly rely on past experience (including that of others in firm).
  - Taken into account through all design and documentation stages - but has little influence, as requirements are less than what is aimed for. B2 is incidental to ways decisions are made.
  - Durability continues to be considered as it was in pre-code time. Aims for performance which is well over code minimums. Durability is considered as extremely important, so projects have never hit problems with TAs as proposals are always well over minimum necessary for compliance. Problems will always come back to the firm anyway and be sorted out.
- Some – Up to recently would have been low, as B2 did not really impinge on approach and day-to-day working methods. However, since new 3604, it is becoming increasingly important.
- Variable –
  - Dependent on client and how close to minimums work may be getting.
  - Dependent on client and long-term priorities.

Engineers

- Little –
  - Durability considered as it has always been since pre-code days - B2 is really incidental as it gives the bare minimum requirements. It therefore has little influence.
  - Durability issues handled in traditional manner - code is necessary as underlying safety net but has little influence on the type of work done.
- Some –
  - Influence limited - tend to be conservative in choice of materials with known durability anyway. Durability issues handled in traditional manner - code is necessary as underlying safety net but has little influence on the type of work done. B2 has more influence on connections in the structure, which can be the weak points.
  - Variable depending on what part of structure is being considered and where it is located in terms of corrosion, e.g. hot dipped galvanised beam might be compared to timber for costs with B2 having high influence. - claddings are most influenced, while closed-in structural elements are the least.
  - Influence is pretty limited - tends to be built-in according to good engineering practice. However, can sometimes be a problem to quantify (prove durability).
- High – Only because there is no choice - but disagrees with whole way the code approaches durability.

Manufacturers and suppliers

- Low - Durability is handled in same way as before the code - treated as the most critical quality of paint system. Firm is always testing/researching to improve durability and aims for beyond 5yr level - B2 is largely irrelevant.

- Some –
  - Reputation is of greater influence than the code requirements. Also other consumer-oriented acts may give heavier liability than the Building Act.
  - Variable - most conventional uses are not highly influenced, but some special ones are, e.g. concrete floor to a milk treatment plant where issues are critical because of environment.
- High –
  - Driven by code, particularly in regard to products like shower linings which can struggle to meet 15 yr level
  - Tend to follow conservative practices because of requirement to comply
  - Designs are driven by minimum requirements for competitive reasons, so these are highly influential. However, a conservative safety margin is always allowed.

Builders and other construction trades

- Little –
  - only indirectly via manufacturing information on new corrosion zones as required by new 3604.
  - Because of nature of buildings (large commercial/industrial), consultants handle code requirements as part of the documentation.
- Some – Have always exceeded the 15yr minimum of the code - but ties are now an issue re. 3604 corrosion zones.
- High – Has increased since 3604 - prior to that it would have still had some influence, but not as high.

Owners and Property Managers

- Little –
  - Because of the nature of the houses, requirements are well above the code minimums so B2 is largely irrelevant to the work done.
  - Opinions built up from past experience of building services and in the campus itself - so B2 does not have influence.

Consultants and advisers

- Some –
  - Works from first principles - refers to only as needed. Knows aims and principles very well and seldom needs to refer to details. Approach more intuitive. Depends on the circumstances as to the degree of influence (age etc.). Also, usually working beyond minimum requirements in same way as would have in pre-code days.
  - Experience usually more useful. Depends on circumstances - some faults pre-date code, for others and for building auditing - code is highly influential. Influenced by B2, rather than governed by it. In project mgmt work, would only influence if pushed towards minimums, or if dubious about a particular detail or material.
  - Depends on circumstances - some faults pre-date code, for others and for building auditing - code is highly influential. Tend to be influenced by B2, rather than governed by it.
- High –
  - Client relies on expertise to ensure that compliance requirements as met - because of nature of particular job in fault investigation.
  - Because of type of fault investigation work that is done, critical that remedial work be performed correctly.

Territorial Authorities and certifiers

- Some – Need to consider whole systems rather than the individual materials - junctions are the problem and knowledge of interactions is critical.

- High –
  - B2 affects every other Clause so has high influence. Also increasing risks of liability adds to influence.
  - Believes that B2 had little influence prior to the new 3604 - the requirements make clearer what is needed. There is also increasing risk of litigation - where approvals are measured against compliance with the code.
  - Influence is increasing with increasing risk of litigation that will measure approvals against compliance with the code.
  - However, he is not so sure about the consistency of application amongst staff - continually trying to improve level of consistency but it is difficult with such a large organisation.
- Variable –
  - Depends on material being considered and where located in terms of corrosion - claddings and other external materials most influenced. Concentrate on those materials that are unfamiliar, as 90% of materials in houses are conventional with known performance. Watch carefully when products are substituted.
  - Can be variable depending on the project - the more standard it is, the less attention is needed. New products and building systems are much more focused on in order to concentrate on the risk areas.

9.3.8 Reliance on Others

Architects and designers

- Little or none – Fairly limited - trust own judgement more than that of others
- Some - Most reliance is put on manufacturers' literature - depends on reliability of source and amount of back-up that is provided.
- Total - Usually complete reliance - but depends on who. Tend to use the same builders; manufacturers etc so build up a relationship of trust.

Engineers

- Some –
  - Reliance tempered according to knowledge and experience of source - and also by knowledge of generic qualities of materials being used. History of use is also important.
  - Depends on who - other consultants must be relied on to do their part of the work according to the code, also that manufacturers will supply according to their specifications. However, as most work is fully documented and specified - main responsibility is firm's not someone else's.
  - TAs may often be the only ones who get to see all of the information - so it is hard to get the complete picture - and only have limited reliance that they will ensure that construction is as per consent documents.
  - Most work is fully documented and specified - main responsibility is firm's not someone else's. Limited when it comes to the construction - need independent verification that building is built as documented.
  - Depending on who dealing with (history, reputation). Also depends on whether are primary or secondary consultant. Less reliance placed on other consultants if firm is primary consultant, as will be responsible for whole package rather than just their own part.
- Total - In terms of B2 - other sectors must bear responsibility. Gives advice - client must make decisions.

Manufacturers and suppliers

- Little or none –
  - Reliance limited due to own specialised knowledge of timber - means that profile supplied by designers will be queried if considered unsuitable.

- Limited reliance as are very careful to take responsible approach. If likely to be ultimately responsible - then need to be careful to check, question and recommend changes if not happy with proposal.
- Limited reliance on others. Do not have control over the condition of the substrate or how product is applied. The substrate can change without the firm knowing - hard to keep on top of. Also substrate manufacturers can differ on recommendations as to surface preparation, including that needed for recoating. No control over the use of the product on-site.

- Some - Depends on what the product is - usually little reliance on other concrete producers, but total reliance on others like brick manufacturers.
- Total – Need to have total reliance on other manufacturers for the other components of the system, e.g. glass and hardware in particular.

Builders and other construction trades

- Some - Some elements are considered as manufacturers' responsibility, e.g. roofing and windows.
- Total –
  - Always use same suppliers - can trust reliability.
  - Must be completely reliant on manufacturers.
  - Must assume that designers have complied. Also that products are as claimed in trade info. - then if built as per documents, own responsibility is met.
  - Because of nature of buildings, consultants handle code requirements as part of the documentation. Must rely on those responsible for the documentation.
  - Uses other people's materials so rely completely on their statements of durability.
  - Manufacturers must be reliable - stick to known firms. Uses regular subcontractors and suppliers wherever possible - otherwise would be requiring more back-up information for assurance.

Owners and Property Managers

- Total -
  - Compliance is responsibility of the developer and the relevant TA.
  - In regard to Code matters - have to rely on consultants to ensure that all requirements are met, as it is their responsibility.

Consultants and advisers

- Little or none – Job involves sorting out past problems - so needs to question all aspects relating to the problem.
- Some –
  - Depends on the circumstances - individual or company involved, history, reputation etc.
  - While he may place reliance on individual materials or manufacturers, a building must combine these by joining them together - it is the interactions that must work, and which often cause the biggest problems. At those points reliance must be limited, as whose responsibility is it?

Territorial Authorities and certifiers

- Little or none – Fairly limited - manufacturers cover only their material, whereas building systems are made up of many materials acting together - these joints are critical.
- Some -
  - Will concentrate on the risk areas - those materials that are unfamiliar, as 90% of materials in houses are conventional with known performance, and is not possible to cover everything in great detail. Also gets to know "problem" clients who are only interested in short-term durability - firm avoids them.
  - Varies according to history and experience of applicant - same applies to locally manufactured products.

- Can vary from no reliance to great reliance depending on the particular applicant and their experience, size, local reputation and history of problems.
- Small town/ rural area, so possible to get to know most people involved in industry. Good liaison with local trades, so get to know them fairly well - reliance depends on the experience and reputation of the person dealing with.
- Tend to have more reliance on certain manufacturers rather than certain designers - but it does vary according to who you are dealing with.
- He looks for reasons to say yes, rather than reasons to say no - but amount of reliance is variable according to the particular product and its history. New products tend to attract more attention.

9.3.9 Problems in Achieving Durability

Architects and designers

- Information/experience of material –
  - Accelerating number of new products and imports - often with dubious information. Many imports with insufficient back-up information to allow assessment - or insufficient reliability.
  - How long has it been used locally and how has it performed? Becoming more conservative with experience.
  - Man-made products are a particular problem as generic knowledge is limited.
  - Try to use trusted suppliers, but have continuing pressure from new suppliers offering cheaper alternatives.
  - Do not want to be guinea pig for new products and systems - re new products - which may not yet have been used in local conditions. Although they may well have performed in other climates, they may not work here.
  - Can sometimes be a problem in finding sufficient unbiased information. Many imports with insufficient back-up information to allow assessment - or insufficient reliability. Rely on BRANZ info. but there is not enough to cover all products.
- Lack of appreciation of importance –
  - Appreciation by others in office - who make choices with limited knowledge and experience of performance.
  - Lack of appreciation in the general sense of durability - firm is not interested in designing to minimum levels, but persuading others that the minimum levels are not adequate may be a problem.
  - On-site trades appear to be becoming more ignorant of latest requirements - and not treating them as being any part of their responsibility. They only appear to be interested in keeping clear of any liability by passing the buck to the next in line.
  - Nature of client is critical - are they willing to pay for durability, but rarely strike a lack of appreciation.

Engineers

- Information/experience of material –
  - Lack of reliable info - When investigating new systems or products, e.g. wall claddings.
  - Accelerating number of new products and imports - often with dubious information. Many imports with insufficient back-up information to allow assessment - or insufficient reliability.
  - Becoming more conservative with experience. Are interested in how long material has been used locally and how it has performed - accelerated aging tests still are not the same as actual use.
- Lack of appreciation of importance –
  - Lack of understanding of necessary maintenance to ensure component continues to function.

- Clients usually have only short term goals re durability.
- Some clients have no concept of the potential corrosion hazards of metals in marine environments and therefore of the need to spend more on fixings which will survive.
- Some clients have no concept of the way that a material alters with time, or of the repercussions of possible durability problems.
- Some architects have limited understanding of corrosion hazards, so do not appreciate importance of keeping water away from structure, e.g. reinforcing in retaining walls - have reported on failures like this. Often designers have responsibility for weatherproofing structure but may not appreciate the importance.
- Not usually problem - clients know importance but problem is more in implementing - re the costs involved (costs/benefits balance) - a particular problem with conc slab waterproofing.

- Other –
  - Not a matter of specific problems - disagree with code's approach. Materials are not the problem, systems are.
  - Even with conventional structural materials - have concern that ingredients/nature of these are changing over timee.g. cements, timbers, admixtures, environment of use etc.

Manufacturers and suppliers

- Information/experience of material –
  - In regard to new products - which may not yet have been used in NZ conditions.
  - Installer may want to substitute cheaper components into designed systems.
  - Base material is not the problem - the system may be, e.g. bare concrete block relying on sealers for durability against water penetration - with lack of experience of new imports and products.
  - New suppliers and products - sealants are the main area where lots of new unknown products are becoming available - these may have little reliable information and back-up test results. Tend to be conservative re. potential risks of using.
  - Only in regard to other components like sealants - insist on certificates re durability.
  - Continuing and increasing problem as the numbers of new substrates increase - limited experience in local conditions and unknown properties. Overseas information about new substrates is often not application to NZ climatic conditions.
- Lack of appreciation of importance –
  - Describing durability to plumbers who tend to see it as synonymous with a guarantee and who don't understand the concept of design life is often a problem.
  - Feels that product users do appreciate the importance of durability, but make a conscious decision to cut corners when applying (e.g. Preparation), as doing the job properly is too onerous, or the owner intends to sell within a short time so is only concerned that the finish looks good for a short time.
- Other –
  - Users often expect and try to find a simplistic answer to a complex problem - do not understand interactions that make up the whole system - problems rarely have single cause.
  - Appropriate durability appreciation can be a problem - both under and over specification. Lack of distinction between different types of steel leads to inappropriate requirement for coating.
  - Do not have control over the condition of the substrate or how product is applied. The substrate can change without the firm knowing - hard to keep on top of. Also substrate manufacturers can differ on recommendations as to surface preparation, including that needed for recoating. No control over the use of the product on-site.

Builders and other construction trades

- Information/experience of material –

- From TAs and certifiers - inconsistent information and advice - lack of understanding and accountability.
- In regard to new products - which may not yet have been used in local conditions. Have had experience in being guinea pig (fibreglass membrane) on product not used locally before - led to problems.
- More and more new products that he has no experience with.
- May be offered alternatives during construction phase, but he is cautious of new products, and the owner must approve of. Also, the hassle of seeking approval of the TA usually makes it not worth the effort, unless the owner has budget problems and needs to look for costs savings.
- Can be offered substitutions during constructions by subcontractors or suppliers - only concerned with price and often without back-up.
- Applies to new products - but not big problem as tend to operate conservatively based on proven experience.
- Accelerating number of new products and imports - often with dubious information. Many imports with insufficient back-up information to allow assessment - or insufficient reliability. Rely on BRANZ info. but there is not enough to cover all products.
- In regard to new products - which may not yet have been used in local conditions. Although they may well have performed in other climates, they may not work here.
- Accelerating number of new products and imports - often with dubious information. Many imports with insufficient backup information to allow assessment - or insufficient reliability.

- Lack of appreciation of importance –
  - Not a problem - finds that clients want to make a well-informed decision so want information about the durability properties of roofing. Possibly something to do with roofs in this particularly harsh climate.
  - Owners are not the problem - they expect the best quality. The problem is further down the ranks of site trades - where those installing materials may not understand the importance.
  - Continual education of subcontractors - but tend to stay with the same ones so not too much of problem.

Owners and Property Managers

- Information/experience of material –
  - In regard to new products - need a proven track record as HNZ is not interested in being a guinea pig. Tends to be very conservative when choosing materials and systems.
  - Often offered cheaper substitutes but insist on independent reliable appraisals
  - New materials when consultants are pushing boundaries which may impinge on durability.
  - Tend to stick to systems which have known performance over time. Still need to improve the feedback system of maintenance problems - this is the key to improving long term durability.
  - Do not want to be guinea pig for new products and systems re new products - which may not yet have been used in local conditions. Although they may well have performed in other climates, they may not work here.
  - Will insist on further information if not satisfied, before agreeing to unknown materials - are concerned that we get what we have paid for during construction.
- Lack of appreciation of importance –
  - Commonly from the construction trades - do not understand the need for additional work such as extra dwangs for fixing strength etc. Otherwise normal ways of building are often not adequate for the wear that these tenanted houses are subjected to.
  - May occasionally be a problem with consultant not appreciating the particular durability concerns of the campus - both from the type of use that it gets, and from its exposed site conditions.

Consultants and advisers

- Information/experience of material –
  - Works in complex, specialised areas - is difficult to get sufficient relevant, reliable information. Also accelerating number of new products and imports - often with dubious or insufficient information.
  - Can be a problem when dealing with TAs or certifiers who believe that they understand when their knowledge is actually limited.
  - Re. particular type of jobs he is called in to investigate - complex, difficult and specialised problems. Becomes a balance of cost, practicality, access to repair etc.
  - Can be difficult to get sufficient relevant, reliable information. Also accelerating number of new products and imports - often with dubious or insufficient information. However, have good networks to go through in order to track down information and find solutions.
  - Interested in how long material has been used locally and how it has performed - accelerated aging tests still not the same as actual use. For instance, roofing systems tested in Europe may not withstand local conditions.
  - Accelerating number of new products and imports - often with dubious information. Many imports with insufficient back-up information to allow assessment - or insufficient reliability. Becoming more conservative with experience.
  - Can be offered substitutions during constructions by subcontractors or suppliers - only concerned with price and often without back-up.
- Lack of appreciation of importance –
  - Not usually a major problem - clients want to solve the problem long term. However, can sometimes be pressured to skimp - firm insists on work being done properly.
  - This never applies to his work - as reason for his involvement is a past lack - owner is therefore very concerned to avoid future problems once the fault is repaired.
  - Clients often have a lack of understanding of the possible risks involved in choosing the lowest cost options - but he is very careful to warn them of these, and they then usually take his advice.

Territorial Authorities and certifiers

- Information/experience of material –
  - Accelerating number of new products and imports - often with dubious or insufficient information. Increasingly want producer statements, as information is insufficient to allow adequate assessment. Are interested in how long it has been used locally and how it has performed - accelerated aging tests still are not the same as actual use.
  - Onus is on applicants to provide back-up - to certify that product or system will meet durability requirements.
  - Substitutions between plans and site with lack of back-up documentation.
  - Number and variety of products is continually expanding - makes assessment difficult. Lack of appraisals for new products is a problem.
  - Continuing problem - insist on sufficient back-up info. but can be difficult - TAs often end up trying to find the information themselves.
  - Try to keep good technical library, but can be hard to - manufacturers used to keep TAs up to date with their trade literature with tech. reps visiting regularly and updating manuals - this is now left up to CMS so info can be unreliable.
- Lack of appreciation of importance – Some builders unclear about B2 and 3604 durability requirements - do not appreciate responsibilities.
- Substitutions -
  - Buildings are often not supervised properly. Applicants are supposed to file amendments when substituting, but are sure that many slip through.
  - Should not be a problem if the building is supervised properly - however, this is often not the case. Also the practicality of inspecting when items are visible - and also being able to spot substitutions. Owners trying to do this themselves often do not spot substitutions, or they agree to them without realising that they should not.

- Increasing problem - products can look the same so it can be hard to spot substitutions. Lack of good site supervision is a problem.

9.3.10 Problems Encountered with B2

Architects and designers

- Meeting required durability – Sometimes have problems in designing accessibility to meet the 15yr level.
- Problems with standards – Have heard comments about problems associated with the new 3604 requirements - but have not struck problems themselves. Do mostly higher-cost housing, where the additional expense is not so much of an issue.
- Other –
  - There is a general issue re degree of difficulty to replace elements. Code is somewhat simplistic in assuming ease to be similar for all building types, e.g. replacing windows in a conventional house is reasonably easy so 15 years makes sense, but replacing windows in a multi-storey building is a major exercise - yet both types of buildings are treated the same.
  - have found some signs of inconsistent treatment by TAs.
- No problems -
  - B2 is largely irrelevant as issues are handled as per pre-code days - fundamental issues of permanence are considered in relation to the function of the building and to the client's budget.
  - No problems as designs are well above code level anyway. If TA requires producer statements, these are only for non-engineered projects - otherwise secondary consultants handle the statements as required.
  - Have not had major problems - any have been minor and have been sorted out at the time.

Engineers

- Meeting required durability –
  - Quite a lot of his work is outside the acceptable solutions - so meeting the 50yr requirement and proving that you have done so can sometimes be a problem depending on the circumstances- is usually related to the system rather than to individual materials. It is the components needed to complete the system like joints, junctions, access, coatings, maintenance etc.
- Evaluating durability as designed –
  - Are concerned about the reliability of being able to consistently assess durability - there are too many unknown and potentially influencing changes, with no national monitoring or feedback to the industry being done. So, even with conventional structural materials like concrete or steel, he is not convinced that durability performance is really known or can be proved.
  - In terms of the possibly changing nature of base structural materials and the environment in which they are used. Who really knows how long they will last?
- Problems with standards –
  - Why do requirements for metal coatings (per 3604) need to be increased, when history does not prove the need - if maintained, then life is not a problem. Do not believe that issues have been properly addressed.
  - Have noticed that new corrosion requirements of 3604 are helping his work by making stainless steel fixings much cheaper due to the increased demand - so is lowering the costs of what the firm was using anyway.
- Projects outside standards - Feel that alternative solutions are too difficult to get passed to be worth the time and hassle involved - therefore finds he sticks with conservative systems. This does not encourage innovation, e.g. tried to get straw house through but found it was not worth the effort.

- Administration of Clause –
  - Inconsistency and laxity of enforcement by TAs - gets the feeling that they just want to avoid liability by collecting documents, rather than by good inspection and supervision procedures. For example - are wanting producer statements after construction before issuing compliance certificates - when he has not supervised the building so cannot be sure that it has been built according to the consent documents. The TA is wanting more than they are entitled to under the Act.
  - Administration of Clause by inconsistent TAs, who have little expertise in the field.
  - Inconsistency within and between TAs is still a problem - although less than in pre-code days. However that is at the expense of becoming more rulebook oriented.
- Other –
  - Base component materials are one thing - combining these into systems is the critical factor in how the final product functions, and over how long a period of time.
  - Was durability a problem in the past, or was the problem one of maintenance?

Manufacturers and suppliers

- Assessing required durability - Can be difficult to work out where some particular elements fall re durability requirements, e.g. decking.
- Problems with standards –Some standards seems to conflict - also, new timber products may not qualify as durable despite overseas data, e.g. marine plywood. BRANZ is used to assist on projects outside scope of standards - believe more help is needed at sharp end of industry.
- Administration of Clause –
  - Process can be very time consuming and expensive - e.g. had to employ corrosion expert to assess expected life of hot-dipped heavy gauge steel brackets in order to satisfy TA that these were as durable as epoxy-coated.
  - Agrees with concept of performance-based code - but has problems in practice as there are too many people to deal with. Process can be very time consuming and expensive.
  - Only problems which association has encountered is the lack of enforcement of non-compliant windows by TAs. Believe that B2 was quite well written, and any initial problems were handled in the early days.
- Other –
  - Inconsistent and/or incorrect application of the provisions by TAs.
  - 50 years is so long that there is a suspicion that assurances given may not be reliable. The Code is still too new, and 50 years is too far in the future for people to worry too much about now - there may well be an attitude that we will only be in the same business for the next 20 years so why worry further ahead than that - the 15 year requirement may therefore be taken more seriously.
- No problems –
  - NZ performance-based code is excellent compared with others like Australia's - where dealing with their prescriptive rules is very difficult.
  - Design life of product is in advance of minimum requirements. Research work on durability still done as it was prior to the code - targets well in excess of the minimums (even sealers should last longer than 5 years).
  - The paint industry translated the code requirements for coatings some time ago - so do not have problems which relate to the use of the Clause. Durability is handled in same way as before the code - treated as the most critical quality of paint system. Firm is always testing/researching to improve durability and aims for beyond 5yr level - B2 is largely irrelevant.

Builders and other construction trades

- Problems with standards –
  - In regard to the corrosion requirements in the new 3604 - roofing ties in ventilated roof spaces.

- Although have problems with the assessment of a particular corrosion zone in Wgtn from the map - tend to be conservative and if in doubt, use higher requirements.
- Re corrosion requirements of 3604 - also find them inconsistent.
- In regard to the corrosion requirements in the new 3604 - roofing ties in ventilated roof spaces
- Have problems with the corrosions requirements of the new 3604 - particularly those related to concrete.

- Administration of Clause –
  - Only real problem is TAs in region interpreting rules inconsistently - one will have no problem while another will not accept the same thing - becomes costly and time-consuming when you don't get consistent answers.
  - TAs and certifiers interpreting inconsistently (even within the same region).
- Other – Considers that requirements are too low for roofing - could be 25 yrs. Durability in interior wet areas (eg showers) is a growing problem and harder to achieve.
- No problems - Consultants' responsibility.

Consultants and advisers

- Meeting required durability –Has only really occurred on borderline items like decks. E.g. A top layer for wear over a lower waterproofing layer (say pavers or timber over Butynol) - leads to the issues of ease of access to the substrate for replacement - and so affects durability requirements.
- Other – Clause is over simplistic - treats all elements as being the same in terms of ease of replacement, but some materials are more complex, e.g. weatherboard compared to stucco.
- No problems – job is investigating relevant governing legislation in force at the time of construction - so B2 only involved in post-code building work, in which case evaluation is made against B2.

Territorial Authorities and certifiers

- Assessing required durability - Sometimes the examples don't seem to follow through from the requirements.
- Evaluating durability as designed –
  - Need to know performance of some materials, e.g. some piping will last long enough to satisfy the 15 year requirement but cannot be used under a building as it will not last 50 years. Specific areas can have special hazards and this needs to be known when checking for compliance.
  - In-service history is problem - difficulty is the proof required to establish the history of use of the product.
- Problems with standards –
  - Some inconsistency between old standards and new standards, e.g. old plaster std vs 3604 on fixing of mesh.
  - 3604 is helping by clarifying some of the requirements, and by focusing attention on to this Clause.
- Projects outside standards – These are not usually a problem as they are normally multi-storey buildings with engineering consultants who produce alternative solutions.
- Administration of Clause – Problem of turning the theoretical into a practical application on-site and with the applicant. Requirements can be open to misinterpretation.
- Other –In terms of specific items with limited life - what happens after those specified years have passed? There is no system in place for reassessment, e.g. freestanding fireplaces.
- No problems –
  - No major problems - although table could be extended - some items such as decks can be problem to classify.
  - No major problems - 3604 has made requirements much clearer.
  - No major problem - just overall difficulty of processing, assessing all of the information submitted - and then making a justifiable decision.

9.3.11 Ways of Improving Clause B2: the Clause

Architects and designers

- Functional/performance requirements –
  - Functional requirement can be open to misinterpretation if not read together with performance criteria.
  - Consider that targets are too low from a client's viewpoint. No part of a new building should last as little time as 5 years. Targets do not really encourage design for durability.
- Limits on application – Intended life should be viewed sceptically, e.g. temporary classrooms still used 50 yrs later. Buildings can have an indefinite life if maintained - B2 limits concepts to 50yrs. Maintenance is a big issue.
- No problems - The Code itself is not a problem as traditional methods of designing and detailing have resulted in durability that is well beyond the required minimums.

Engineers

- Limits on application –
  - Need restrictions on the type of building that Clause should relate to, e.g. lightweight garages could be excluded.
  - Have some concerns about structural lining/cladding on lightweight buildings - but feel that this can be sorted out by correct maintenance recommendations, rather than by alterations to the Clause.
  - Believe that code goes beyond adequate levels for health and safety re durability - for some types/uses of buildings. Thinks that should consider different classes of buildings (similar to earthquake classes) to indicate (say) 3 levels of compliance - with types like farm buildings and garages being the lowest level.
- Other - Start concentrating on maintenance issues - then work from there. Look at what is needed to extend life - instructions etc should come from manufacturers.
- No problems - No specific problems - continue to treat durability issues as have always done.

Manufacturers and suppliers

- Functional/performance requirements –
  - Why 5, 15 and 50 years? These should be reconsidered, and the rationale justified.
  - Design life of product is in advance of minimum requirements. Research work on durability is still done as it was prior to the code - targets well in excess of the minimums (even sealers should last longer than 5 years).
- Limits on application – There is a problem with different classes of buildings and appropriate durabilities for each type - code does not distinguish between a shed or garage and a luxury house.
- Other - Need to consider systems rather than just components - combination is critical, including cladding, fixings, detailing, coating etc.
- No problems - The paint industry translated the code requirements for coatings some time ago - so do not have problems which relate to the use of the Clause. Durability is handled in same way as before the code - treated as the most critical quality of paint system. Firm is always testing/researching to improve durability and aims for beyond 5yr level - B2 is largely irrelevant.

Builders and other construction trades

- Limits on application – There is a problem with different classes of buildings and appropriate durabilities for each type - code does not distinguish between a shed or garage and a luxury house - so assumes 50year requirements for both. Perhaps need classes - similar to earthquake codes.

- No problems - Responsibility is limited to ensuring that construction is of best quality and according to contract documentation - only improvement would be to improve consistency of administration by TAs.

Consultants and advisers

- Functional/performance requirements –
  - Feel that the periods are too low and encourage work that is designed down to the minimum. Why the particular choice of periods - why 5, 15 and 50? These should be revisited.
  - Need to revisit and reassess the periods to ensure that they are fully justified. Also need to look at the consistency of the requirements for different materials within the same category (ie claddings), and need to cover items such as decking.

Territorial Authorities and certifiers

- Functional/performance requirements –
  - Last 5 to 10 yrs has seen the quantity of products/systems escalate to point that one person cannot assess durability without adequate and reliable documentation - to be reasonably satisfied as to compliance.
  - Durability periods should start from installation not from the compliance certificate date which can sometimes be years after installation.
  - Why the particular choice of periods - why 5, 15 and 50? These should be revisited - and more detailed levels considered. Too many items tend to fall around 10yrs.
- Limits on application – Some argument that certain types of building should not be required to meet full B2 requirements.
- Other - Problems not so much related to Clause itself but more to the practical application needed to make it work.

9.3.12 Ways of Improving Clause B2: the Approved Documents

Architects and designers

- Assessing required durability – Descriptions confusing - should better relate to the 3 categories as per Clause.
- Durability requirements – Table 1 implies durabilities which are too low - 15yr items won't be replaced so why limit them to 15 years?
- Maintenance –
  - 2.1.1 what does this lead to? Performing is one thing, doing anything with the information is another - needs to be more clear on where the info should end up (left on file won't achieve anything).
  - Maintenance definitions need to be clarified.
- Administration of Clause – documentation requirements are a problem - becoming more onerous and time-consuming. Councils used to rely on individual's experience and history more, but this seems to be decreasing (although that may be due to changing TA staff).
- No problem –
  - Traditional methods of designing and detailing have resulted in durability well beyond the required minimums.
  - Do not have any particular problem with B2. Durability issues do come back to the firm, but not in NZBC terms. Clients who have problems go directly back to the architects in the same way that they always have done as per pre-code days.

Engineers

- In-Service history - Ability to prove the performance history of a product or material in place in a certain environment should be made easier. At present the process is far too bureaucratic, expensive and time-consuming.

- Assessing required durability –Are concerned about the reliability of being able to consistently assess durability - there are too many unknown and potentially influencing changes, with no national monitoring or feedback to the industry being done. So, even with conventional structural materials like concrete or steel, he is not convinced that durability performance is really known or can be proved.
- Maintenance – This needs far more focus - concentrate on what is needed to extend life. Investigate warrants of fitness, maintenance schedules etc to form core of any serviceability requirements. Make maintenance the responsibility of the owner - with manufacturers to clearly state what must be done and how often.
- Administration of Clause – Have general concerns about the increasing paranoia about potential liability and its effect of scaring off innovation and new systems - increasing tendency to stick to rulebook approach by TAs.
- Other - Believes that code approach to durability is completely wrong and needs to be looked at from first principles (rather than just fiddled with).

Manufacturers and suppliers

- Durability requirements –
  - Table should be expanded to cover some particular elements like decking - presently hard to classify.
  - Some flooring species are not covered - need reference to acceptable overseas standards.
- Maintenance –
  - Only area which should be investigated and possibly expanded (including warrants of fitness to ensure that necessary maintenance is being carried out by owners)
  - Feels that this should be given more focus - should be revisited and redefined in more detail. If a substrate material is maintained ideally, then the life can be extended almost indefinitely. That maintenance includes the recoating of the finish at appropriate intervals - but the question remains as to what "normal" maintenance actually is - the section does not adequately define that.
- Other –
  - Has general concerns about traditional materials like copper having an assumed long life without the need for the type of proper testing that other materials have to go through.
  - Problems related to appropriate durability requirements for different types of building.
  - Education of building industry should be improved when new or increased provisions are introduced.
- No problem - If any changes are made - the main aim should be to keep it as simple and general as possible.

Builders and other construction trades

- In-service history - Need easier methods of establishing history - otherwise it is simpler just to spend money on the higher requirements, rather than waste time trying - the cost of expert opinions can outweigh the possible benefit. It is often just not worth following in-service history through.
- Durability requirements –
  - Corrosion zone requirements and expected maintenance of visible structural elements etc at risk of corrosion if not maintained. Relates to type of building - cheap prefab garages.
  - In regard to old tile roofs with conventional ties in corrosion zones - showing good durability after many years.
  - Table 1: Structural cladding - problem where cladding has to last 50years even if building likely to be replaced within that period, e.g. Garages, outbuildings. Not practical for pre-fab buildings where bracing is visible and can be easily maintained - and can also be easily replaced as necessary without risking structural integrity.
  - Related to the corrosion requirements of 3604 - need better acceptable solutions, e.g. increase concrete cover instead of just as in 3604.
- Administration of Clause –

- only improvement would be to improve consistency of administration by Tas.
- Only problems are in the administration of the requirements - with inconsistent interpretation by TAs.

- No problem - Responsibility is limited to ensuring that construction is of best quality and according to contract documentation.

Consultants and advisers

- Durability requirements –
  - Feel that the periods are too low and encourage work that is designed down to the minimum. Why the particular choice of periods - why 5, 15 and 50? These should be revisited.
  - Need to revisit and reassess the periods to ensure that they are fully justified. Also need to look at the consistency of the requirements for different materials within the same category (ie claddings), and need to cover items such as decking.

Territorial Authorities and certifiers

- In-service history - In-service history is the problem - the difficulty is the proof required to establish the history of use of the product - and the required documentation.
- Durability requirements –
  - Table should be revisited with elements such as decks covered better.
  - Could be expanded to tie in better with new 3604 corrosion zones.
  - Could better relate to 3604 marine requirements.
  - Requirement for SS fixings unnecessary where galvanised would be OK if accessible and maintained properly - require schedule of maintenance for such elements.
  - Table 1: Structural cladding - problem where cladding has to last 50 years even if building likely to be replaced within that period, e.g. garages, outbuildings. Not practical for pre-fabricated buildings where bracing is visible and can be easily maintained - and can also be easily replaced as necessary without risking structural integrity.
  - There is a question of whether Table should form part of the Approved Documents - as the links back to the Clause requirements can be dubious, e.g. why 15 years for roofs?
- Maintenance –
  - What is "normal"? - manufacturers seem to be increasingly using this in order to opt out of their obligations.
  - Lots of arguments around what is "normal" maintenance.
- Administration of Clause – TAs becoming too paranoid about litigation - he believes that they do not back up decisions sufficiently and will settle out of court too quickly if threatened - which just encourages further litigation.
- Other - Only real criticism is the problem of considering materials separately - the interaction of dissimilar metals will affect their durability (zinc, copper, aluminium etc).

9.4 Questionnaire

The following is a copy of the questionnaire sent to the selected sample:

DURABILITY QUESTIONNAIRE
Survey of Clause B2 of the New Zealand Building Code (NZBC)

The durability provisions of the Building Code (Clause B2 and the associated Approved Documents) were last reviewed in 1995. The Building Industry Authority (BIA) is now beginning work on the next review of B2. As part of the review process, BRANZ is assisting by gathering industry feedback on experiences with dealing with durability issues and B2 in day-to-day work. The answers to the following questionnaire will provide us with valuable information.

The information given in the following questionnaire will be used in aggregate form, and the contents of individual forms will remain confidential. Please feel free to make additional comments on the back of pages if wished.

When questionnaire is complete, please post back by ***15 September 2000*** *in the reply-paid envelope to:*

Sue Clark
7 Henderson Street
Karori
WELLINGTON

1 *GENERAL*

a. Occupation?

b. Type of business involved in (eg. builder, supplier, manufacturer etc.)?

2 *What part of the building process are you usually involved in? (in regard to building materials)*

Tick as many boxes as applicable and add comments if required

		√
a.	Choosing materials used in buildings?	
b.	Designing building elements?	
c.	Specifying proprietary building components/systems/products?	
d.	Designing/building proprietary building components/systems/products?	
e.	Advising building owners or managers on materials used in buildings?	
f.	Checking building proposals for compliance with the Building Code?	
g.	Certifying building proposals as compliant with the Building Code?	
h.	Other (please specify)	

3 *Who makes the decisions on choice of materials?*

a. Not applicable to my job

b. Someone else within my organisation

Who? ***occupation of main decision-maker?***

c. Someone outside of my organisation

Who? ***occupation of main decision-maker?***

d. I make the final decisions

e. Don't know

4 *How important is durability on your decisions regarding material selection?*

a. Low importance

b. Medium importance

c. Very important

d. Not applicable to my job

5 *How do you usually consider issues of durability?*

a. Issues considered as throughout all parts of job

b. Durability considered as part of overall process

c. Rely on others to deal with

d. Not applicable to my job

6 *What does the term "Durability" mean to you?*

Tick as many boxes as applicable and add comments if required

		√
a.	The length of time before a building element requires maintenance	☐
b.	Assuming normal maintenance, the length of time that a building element continues to function	☐
c.	The length of time before the appearance deteriorates	☐
d.	A legal requirement	☐
e.	A warranty	☐
f.	A NZ Building Code term	☐
g.	Not sure	☐
h.	Other (please specify)	

7

What source(s) of information do you usually rely on to assess durability?

a.	Not applicable to my job	☐
b.	NZ Building Code Approved Documents ***Which ones?***	☐
c.	NZ Building Standards ***Which ones?***	☐
d.	ISO Standards ***Which ones?***	☐
e.	Manufacturers' trade literature	☐
f.	Trade or professional journals	☐
g.	Accreditations	☐
h.	Appraisals	☐
i.	Third party reports	☐
j.	Industry information/advice	☐
l.	Past experience (own or others)	☐
m.	Other (specify)	

If you ticked a, b or c in question 2, please answer the following. If not, go to question 9

8 BUILDING DESIGNERS/SPECIFIERS

8.1 ***How would you assess your knowledge of the requirements of NZBC B2 (durability Clause)?***

a. Low awareness ☐
b. General overall knowledge ☐
c. Detailed knowledge ☐

8.2 ***At what stage or stages in the process is B2 usually considered?***

a. Early in the design stage ☐
b. At a developed design stage ☐
c. At the working drawing or construction detailing stage ☐
d. At the final specification stage ☐
e. During the construction phase ☐
f. At various stages depending on client requirements ☐
g. If TA requires more information for building consent ☐
h. Not specifically considered ☐
i. Other (please specify)

8.3 ***How do requirements usually influence decisions regarding design or choice of materials?***

a. Little influence ☐
b. Some influence ☐
c. Highly influenced by requirements ☐

If you ticked d in question 2, please answer the following. If not, go to question 10

9 MANUFACTURERS

9.1 ***How would you assess your knowledge of the requirements of NZBC B2 (durability Clause)?***

a. Low awareness ☐
b. General overall knowledge ☐
c. Detailed knowledge ☐

9.2 ***At what stage or stages in the process is B2 usually considered?***

a. Early in the design stage ☐
b. At a developed design stage ☐
c. At the working drawing or manufacturing detail stage ☐
d. At the final specification stage ☐
e. During the manufacturing phase ☐
f. During "Appraisal" stage ☐
g. At various stages depending on client requirements ☐
h. Not specifically considered ☐
i. Other (please specify)

9.3 ***How do requirements usually influence decisions regarding design or choice of materials?***

a. Little influence ☐
b. Some influence ☐
c. Highly influenced by requirements ☐

If you ticked f or g in question 2, please answer the following. If not, go to question 11

10 TERRITORIAL AUTHORITIES/BUILDING CERTIFIERS

10.1 ***How would you assess your knowledge of the requirements of NZBC B2 (durability Clause)?***

a. Low awareness ☐
b. General overall knowledge ☐
c. Detailed knowledge ☐

10.2 ***How do the requirements of B2 usually affect the building consent/certification process?***

a. Little influence ☐
b. Some influence ☐
c. Highly influenced by requirements ☐
d. Not applicable ☐
e. Other (please specify)

10.3 ***How much reliance is usually placed on those designing, specifying or manufacturing building elements or components for ensuring that requirements are met?***

a. Little or no reliance ☐
b. Some reliance ☐
c. Total reliance ☐
d. Not applicable ☐

If you ticked e or h in question 2, please answer the following. If not, go to question 12

11 BUILDERS, SUPPLIERS, BUILDING OWNERS/MANAGERS AND OTHERS

11.1 ***How would you assess your knowledge of the requirements of NZBC B2 (durability Clause)?***

a. Low awareness ☐
b. General overall knowledge ☐
c. Detailed knowledge ☐

11.2 ***How do the requirements usually affect advise given to clients or customers?***

a. Little or no influence ☐
b. Some influence ☐
c. Highly influenced by requirements ☐
d. Not applicable ☐

11.3 ***How do Building Code durability requirements usually influence decisions in regard to your choice/opinion of materials or components?***

a. Little or no influence ☐
b. Some influence ☐
c. Highly influenced by requirements ☐
d. Not applicable ☐

11.4 ***How much reliance is usually placed on those designing, specifying or manufacturing building elements or components for ensuring that requirements are met?***

a. Little or no reliance ☐
b. Some reliance ☐
c. Total reliance ☐
d. Not applicable ☐

Everyone to answer the remaining questions

PROBLEMS

12 ***What problems do you have when generally assessing durability?***

a. Not applicable to my job ☐
b. Lack of knowledge about Clause B2 ☐
c. Lack of experience of materials' performance ☐
d. Lack of reliable information or advice ☐
e. Lack of reliable comparisons when considering substitutions ☐
f. Lack of appreciation (by others) about importance of durability ☐
g. Other (specify)

13 ***What problems do you have when using Clause B2?***

a. Not applicable to my job ☐
b. Clarity of requirements ☐
c. Consistency of requirements ☐
d. Assessing required durability ☐
e. Meeting required durability ☐
f. Evaluation of durability ☐
g. Problems related to Standards quoted as acceptable solutions ☐
h. Lack of guidance for projects outside scope of Standards which are quoted as acceptable solutions ☐
i. Application of verification methods ☐
Which ones cause problems?

j. Other (specify)

Space for additional comments

IMPROVEMENTS

14 ***What parts of Clause B2 could be improved?***

a. Not applicable to my job ☐

b. Specific parts of the Clause (specify): ☐

- Objective ☐
- Functional Requirement ☐
- Performance criteria ☐
- Limits on application ☐

c. Other (please specify)

15 ***What parts of the B2 Approved Documents could be improved?***

a. Not applicable to my job ☐

b. Definitions ☐

c. VERIFICATION METHOD

Durability evaluation:
- In-Service History ☐
- Laboratory Testing ☐
- Similar materials ☐

d. ACCEPTABLE SOLUTION

Assessing required durability ☐

Maintenance
- Normal Maintenance ☐
- Scheduled Maintenance ☐

Generic materials
- Concrete ☐
- Timber ☐

h. Other (please specify)

Space for additional comments

Thank you for completing this survey. Your responses and comments will be added to others received from the industry, and analysis of the results will form the first stage in the review process.

BRANZ

THE RESOURCE CENTRE FOR BUILDING EXCELLENCE

MISSION

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for the development of the
building and construction industry.

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