Date: June 2000

BRANZ
THE RESOURCE CENTRE FOR BUILDING EXCELLENCE

STUDY REPORT
No. 91 (2000)

NEW ZEALAND HOUSE

CONDITION SURVEY

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The survey was funded by the Building Research Levy.

ISSN: 0113-3675

PREFACE

This report summarises the results of on-site inspections of the physical condition of four hundred and sixty-five houses during 1998 and 1999. The houses were chosen at random from the three main centres, and BRANZ staff carried out inspections. The report also includes the results of a telephone survey of more than five hundred homeowners, including owners of those houses inspected. The telephone survey recorded demographic, economic and maintenance information about the homeowners.

ACKNOWLEDGEMENTS

This work was funded by the Building Research Levy. The Centre for Research Evaluation and Social Assessment undertook the social survey of homeowners on BRANZ's behalf. The house inspections were carried out by BRANZ Technical Advisors, Bill Ash, Bill Irvine and Mike O'Malley, whose invaluable efforts are gratefully acknowledged.

BRANZ is also very grateful to the many homeowners who allowed access to inspect their houses. Without their cooperation this survey would not have been possible.

READERSHIP

This report is intended for researchers, manufacturers, economists and maintenance persons.

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1 SUMMARY

In 1994 a survey was carried out on the physical condition of New Zealand houses (1), and this has now been repeated for a new collection of houses based on a representative sample. 465 houses in the Auckland, Wellington and Christchurch regions have been inspected, and the owners interviewed in relation to their maintenance practices (2).

The overall average condition of houses in the survey is similar to that found in the 1994 survey, although there are improvements in the condition of the oldest houses. Beyond an age of about 60 years, the average condition appears to stabilise as a consequence of renovation. However, this improvement in older houses is limited to the Auckland and Wellington regions, and is also concentrated on the interior areas of houses.

The main defects discovered in the houses inspected were similar to those found in the 1994 survey; that is, in the subfloor vents, roof space, claddings, foundations, hot water cylinder, spouting, and windows. As in 1994, the condition of components showed a general deterioration with age, although there were also signs of upgrading being carried out on the older (pre-1940's) housing, in line with increasing values for this age group. However, although the average level of deterioration appears to have stabilised, the range in conditions of these older houses appears to be increasing with age. This polarising effect is a result of selective renovation, and is particularly evident in Auckland and Wellington.

Although the overall average condition has actually improved slightly, this is counteracted by the condition of some components that are more expensive to repair. The cost required to repair the more serious defects is estimated at an average of a total of $4,000[1] per house. Current maintenance expenditure by owners of the surveyed houses is estimated at $1,500 per house per year[2]; this means that at present insufficient maintenance is being undertaken to maintain the housing stock in a satisfactory condition.

Data compiled includes:

- ***Physical Survey***
  Inspection of the physical condition of 465 houses from Auckland, Wellington and Christchurch in 1998/1999 - ***Table 1: Sample****.*
- ***Telephone Survey***
  A telephone survey of 510 homeowners (including owners of those houses inspected) collecting socio-demographic details, and information on home maintenance activity and expenditure - refer ***Appendix.7****.*
- ***Data From Inspections***
  The physical condition, material type and frequency of defect for 25 components that had been similarly collected in the 1994 survey plus a further 4 components - ***Table 12: Additional Components****. Additional information was collected on source(s) of maintenance information, house shell dimensions, house air tightness, surrounding area, security measures, fire protection measures and heating equipment.*

The analyses carried out include:

- ***Condition***
  Comparison of assessed general condition by BRANZ to those by Quotable Value NZ and by the homeowners themselves: ***Figure 6: Assessed Overall Condition****,* and ***Figure 7: Regional Assessments****. Ranking of components by average condition:* ***Table 5: Exterior Defects*** *and comparison of condition with that found in 1994, between regions, and between interior and exterior:* ***Figure 10: Regional Component Conditions****. Identification of extent of serious or poor conditions for components:* ***Figure 11*** *and* ***Figure 12****. to* ***Figure 16****. Component condition by age cohort:* ***Figure 20: Component Condition for Age****. Identification and condition of most common exterior materials:* ***Table 9: Average Condition of Materials****, and identification of type and extent of defects.*

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[1] *The 1994 survey result was $3,800. This figure was updated from $3,200 in 1994 dollars, based on movements in the construction costs for houses (4).*

[2] *Based on the responses during telephone interviews. However, it must be noted that these are somewhat subjective as the labour component of the cost will vary between contracted and owner's time. If this is taken into account, the derived expenditure is likely to be higher than that quoted by the owner.*

- ***Costs***
  Calculation of costs of repair and delay, by component, region and age cohort: ***Figure 23: Outstanding Maintenance Costs per House*** *to* ***Figure 29: Comparison of Interior Component Costs****.*

- ***Other Areas***
  Analyses of insulation, hot water systems, and heating systems, Other Attributes: analyses of security measures, maintenance information, dampness and fire protection.

2 INTRODUCTION

The New Zealand housing stock consists of approximately 1.4 million (1994:1.3M) dwellings valued at more than $147 billion. The first survey to collect information on the physical condition of this national asset was carried out in 1994 when more than 400 houses were given a detailed inspection, and the condition of a wide variety of components assessed**3**. This second survey has followed a similar pattern (with the addition of some new components) in order that trends could be considered.

The results of the first survey indicated house condition, common maintenance problems and outstanding maintenance but were unable to look objectively into reasons behind the results. This current survey attempts to do this by gathering information not only on the house but also on the owner, by means of a telephone survey.

This social survey (2), designed to uncover the key social and economic variables associated with homeowners' maintenance practices, was undertaken on BRANZ's behalf by the Centre for Research Evaluation and Social Assessment (CRESA).

The survey consisted of a short telephone interview using a structured closed-end questionnaire, and covered household characteristics, perceptions of past and present house condition, expenditure on maintenance, deferral of maintenance, types of maintenance carried out and by whom, and maintenance intentions. A copy of the questionnaire, the data results and summarised findings are contained in the Appendix 7**4**. From this data, the study hopes to contribute to our understanding of the condition of New Zealand's housing stock.

3 SURVEY DESIGN

The design of the physical survey was based on that of the 1994 survey, expanded to include additional elements and information – to accommodate experience gained from the last survey, and trends noticed over recent years**5**. The houses in the 1999 survey are not the same as those surveyed in 1994; but rather a new sample derived in a similar fashion to that used in the last study.

3.1 Sample Size

As in 1994, a sample of 500 houses was aimed for. 510 homeowners initially agreed to the survey, and were interviewed by telephone. However, of this initial sample, about 10% dropped out during the course of the surveys and only 465 houses were actually inspected. The main reason for this decrease was due to homeowners moving or changing their minds about the inspection between the time of the telephone interview (October 1998) and the completion of the surveys (August 1999).

3.2 Regional Sample

As in 1994, the survey was limited to the three main centres in which BRANZ has staff based in order to facilitate management of the survey. The regions included a mix of city, suburban and rural areas and CRESA were asked to construct a stratified random sample. *Table 1* shows the target sample together with the actual samples for the telephone interview and the subsequent inspections[6].

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[3] *It should be noted that faults identified are limited to those that could be physically inspected; therefore non-visual faults are, by the nature of the inspection, excluded from the findings.*

[4] *Refer Appendix 7.*

[5] *For example, the last survey noted increasing numbers of houses with second bathrooms - so this survey was expanded to include these. Also, trends such as the increasing use of smoke detectors.*

[6] *Due to limitations of staff resources, it is accepted that the survey tends to be weighted away from Auckland (given its much larger population), and therefore is biased towards Wellington and Christchurch findings. This should be taken into account when considering the results shown in this report. However there was a similar bias in the 1994 study, so comparability between the two surveys is maintained.*

Region	*Target Sample*		*Interview Sample*		*Inspected Sample*		*(1994)*
• *Locality*	*no.*	*%*	*no.*	*%*	*no.*	*%*	*(no.)*
AUCKLAND	**180**	***36***	**171**	***34***	**156**	***34***	*(121)*
• Auckland City	75	*15*	74	*15*	66	*14*	*(67)*
• Manukau City	75	*15*	68	*13*	63	*14*	*(38)*
• Papakura	30	*6*	29	*6*	27	*6*	*(16)*
WELLINGTON	**170**	***34***	**184**	***36***	**169**	***36***	*(154)*
• Wellington City	110	*22*	116	*23*	108	*23*	*(89)*
• Upper Hutt City	30	*6*	35	*7*	32	*7*	*(50)*
• Kapiti Coast District	30	*6*	33	*6*	29	*6*	*(15)*
CHRISTCHURCH	**150**	***30***	**155**	***30***	**140**	***30***	*(127)*
• Christchurch City	120	*24*	122	*24*	113	*24*	*(77)*
• Waimakariri District	30	*6*	33	*6*	27	*6*	*(50)*
TOTALS	**500**	*100*	**510**	*100*	**465**	*100*	*(402)*

Table 1: Sample

3.3 Sample Selection

A random selection of **3,273** owners' names and addresses was obtained from Quotable Value NZ (QV). CRESA matched telephone numbers to **2,385** owner-occupied houses and contracted the Business Research Centre (BRC) to undertake telephone interviewing. Only people who fulfilled the following criteria were eligible for participation:

- *The respondent had to own or part-own and live in the target house*[7].
- *The respondent had to agree to a BRANZ inspection of their house in addition to the twelve minute interview.*

A pre-contact letter[8] was sent to each of the almost **2,000** randomly selected eligible homeowners. This gave information on BRANZ, explained the project, and said that BRC might contact them. Incentives for participation were also offered. BRC made a total of **1,859** calls in order to provide **1,282** eligible homeowners. Of these, 772 refused the call and interviews were completed with **510** homeowners (giving a response rate of 40%). Of the interviewed homeowners, physical inspections were subsequently completed on **465** houses (a rate of 90%).

[7] *The past study was also restricted to owner-occupied houses and this survey kept that requirement in order to maintain comparability of the results. While it would be interesting to compare the condition of owner-occupied versus rented houses, including the latter was beyond the scope and scale of this present study.*

[8] *Refer Appendix A1.*

3.4 Sample Profile and Bias

The response rate to the original telephone calls was considered reasonable, in that participants had to agree to both the interview and the later inspection.

Household Size (members)	*Survey Sample*	*NZ*
1	8%	19%
2	34%	35%
3	21%	16%
4	24%	17%
5	11%	8%
6	2%	3%
7	1%	1%
Mortgage Status		
With	53	53%
Without	47	47%
Length of ownership		
Less than 5 years	26%	
5 to 7 years	14%	
More than 7 years	60%	
Homeowner's age		
Under 50	56%	
50 to 64	28%	
65 and over	17%	
Family Income		
Under $20,000	11%	
$20,000's	12%	
$30,000's	14%	
$40,000's	8%	
Over $50,000	55%	
	QVNZ sample	
Average house size (m^2)	156	140

Table 2: Sample Characteristics

However it did raise questions about whether the sample was representative. CRESA considered this by carrying out some limited analysis of the sample bias using Census 1996 data in relation to tenure, household type and mortgage status. ***Table 2*** shows some of the key characteristics of the sample, comparing them where appropriate to the census data.

The analysis showed that the sample is largely representative with:

- ***slight under representation*** *of one-person households*
- ***under representation*** *of couple only households*
- ***the tenure status*** *the same as for the census population.*

As can be seen, 55% of the sample had a family income of more than $50,000. (To put this in context, the 1996 census showed that only 33% of households had a combined income of more than $50,000.)

This indicates that the sample is likely to be biased towards those with higher incomes than the national average. This is reinforced by house size, with the average house area of the surveyed sample being about 10% over that derived from the total QV random sample. It is also reinforced by comparing the average property valuations of the initial (large) QV sample and the average of the inspected. sample, which (except for the newest age groups) is higher.

Figure 1 shows some of these household characteristics:

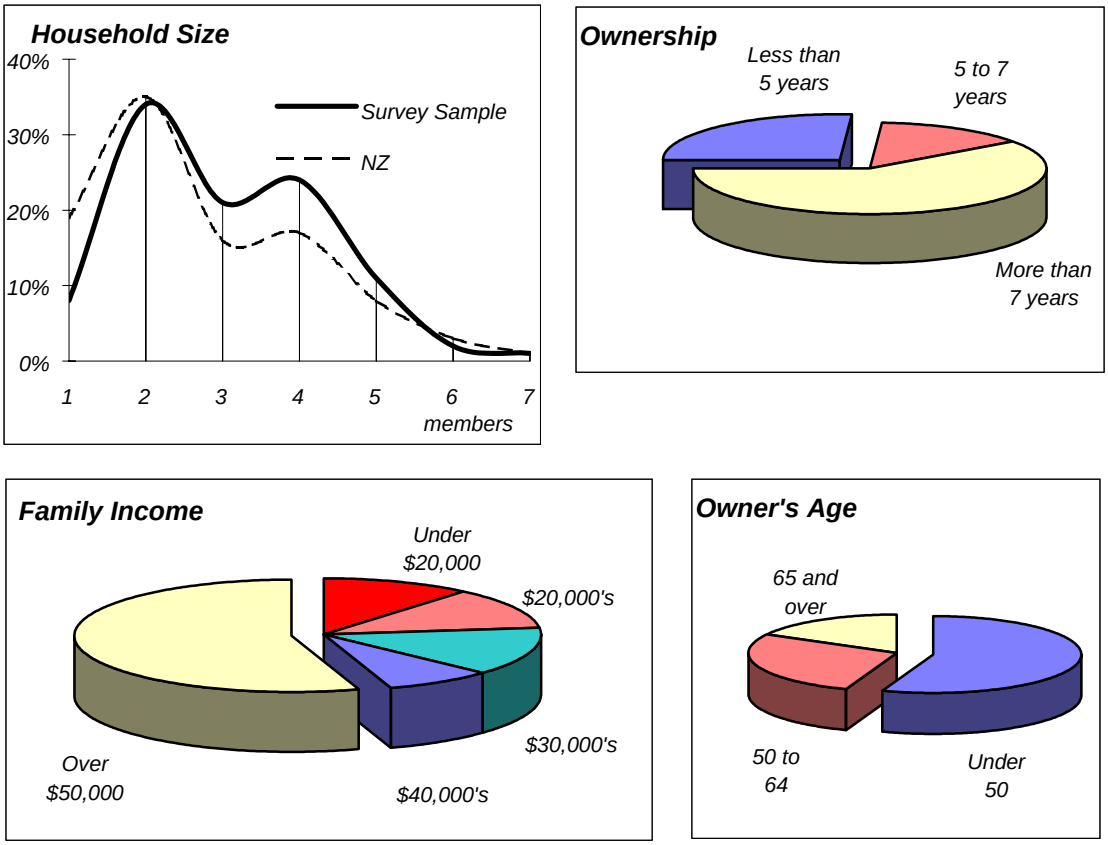

Figure 1: Sample Characteristics

Figure 2 shows floor areas related to the ages of houses:

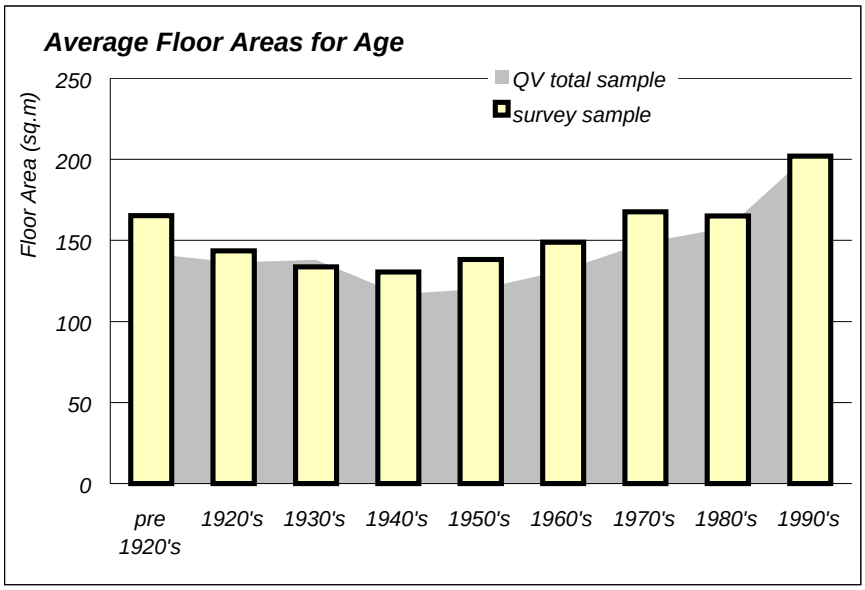

Figure 2: Average Floor Areas for Age

Figure 3 shows areas and valuations[9] related to the ages of houses:

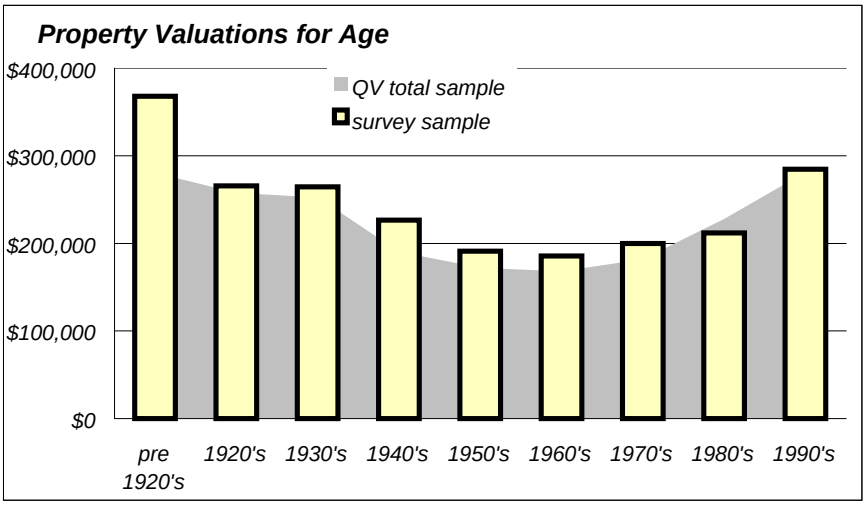

Figure 3: Average Property Valuations for Age

These charts indicate that some self-selection bias had taken place between the original random sample and the surveyed sample. It is possible that owners with houses in poor condition were less likely to offer their houses for inspection, whereas those with better houses (and higher valuations and incomes) were more likely to allow inspection. This suggests the 1999 survey may under-estimate the extent of deterioration in the housing stock. However, the differences indicated in the charts are not major, so it is unlikely that the results will differ markedly from those expected for the original sample.

The main features of the surveyed sample are:

- ***Age of homeowners****: the majority of owners are under 50 years old. This age group makes up around 55% of the surveyed sample.*
- ***Household size****: most homeowners are living at least with partners, and a significant proportion also has children living at home.*
- ***Employment status****: a significant proportion has partners also in paid employment (which relates to the income levels of the sample).*
- ***Length of ownership****: the relatively long length of occupation with 60% owning the house for more than seven years (in contrast to the supposed house turnover of seven years).*
- ***Household income****: the relatively high combined household income.*
- ***Ages of houses****: the 1920's cohort is over-represented, while 1970's and newer cohorts are under-represented in comparison to the original QV sample.*
- ***Property valuations****: the relatively high property valuations of the houses in the sample.*

[9] *It should be noted that whenever the term "Property Valuation" is used in this report, it refers to the value of the land together with improvements; whereas "Building Valuation" refers only to the value of improvements. Due to the large differences in land values between the regions, most analyses use building valuations rather than property valuations when regional comparisons are made.*

3.5 House Inspections

3.5.1 Inspector Training

The same inspectors were used on this survey as were used on the 1994 survey[10], so additional training was limited to a training session involving familiarisation with the new survey forms, and discussions on consistency and any other areas of concern. The main aim was to achieve standardisation of condition assessment[11].

3.5.2 Survey Forms

Overall information about the property, neighbourhood, building and other features was collected by each inspector, together with an assessment of the condition of specific components making up the house**12**. An identification photograph was taken of each house, and any particular defect of unusual severity was also photographed if possible**13**.

3.5.3 Rating Scales

The inspectors identified the materials for a total of 33 components and assessed the overall condition of the component on a scale ranging from serious to excellent. Defects in the component were also identified and recorded. The extent of the particular defects in exterior components was recorded as to frequency, so that the cost implications could be more accurately assessed. The scales used are as shown in Table 3:

CONDITION	***Description***			***Rating***
SERIOUS	Health & safety implications, needs immediate attention.			***1***
POOR	Needs attentions shortly - within the next three months			***2***
MODERATE	Will need attention within the next two years			***3***
GOOD	Very few defects - near new condition			***4***
EXCELLENT	No defects - as new condition			***5***
Frequency of defect	***0-10%***	***10-25%***	***25-50%***	***50-100%***

Table 3: Rating Scale

As well as those components assessed on the five point scale, many other components or factors were recorded, for example: plumbing materials, ground clearance, evidence of subfloor moisture**14**, roof type and slope, material types, wiring type, security devices, fire safety devices etc. These provide valuable background information that can be used for further detailed analysis on the houses.

4 AVERAGE CONDITION RATINGS

4.1 Regional Distribution

The aim for the final inspected sample was to approximately represent total housing stock in terms of condition and age distribution. *Table 1* showed the target figures for each region together with the actual sample for the telephone interview, and those achieved for the physical inspections. As may be seen, the final sample was fairly

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[10] *More extensive training preceded the previous survey, including a trial run of two houses and a survey manual with photographic examples of various defects and their condition ratings.*

[11] *This was helped by the survey forms being checked and processed centrally as they were completed, with any apparent inconsistencies between the regions being resolved at the time.*

[12] *A sample of the survey form used by BRANZ staff during their inspections is contained in the Appendix 2.*

[13] *A selection of these, showing common problem areas, is included in the Appendix 8.*

[14] *Including two moisture readings of floor joists and flooring.*

representative of the initial target distribution, although Auckland numbers were slightly below the target, while Wellington was slightly above.

4.2 Age Group Distribution

Figure 4 shows the final survey distribution of houses over age ranges.

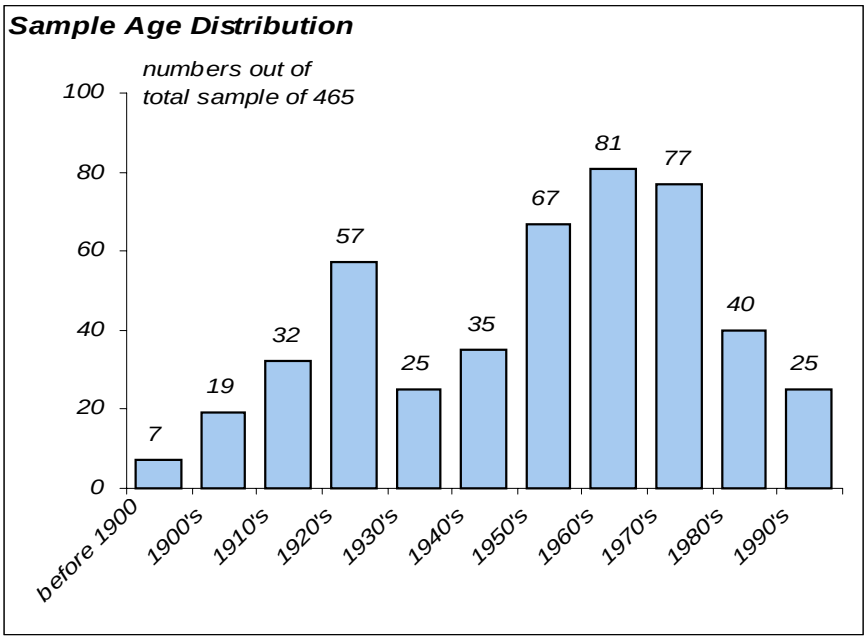

Figure 4: Sample Age Distribution

Table 4 shows the age distribution of the surveyed sample in comparison to that of the original sample and the total NZ housing stock in 1999.

Age	*QV Original Sample*		*Survey Final Sample*		*NZ total*
	Number	*%*	*Number*	*%*	*%*
Pre-1900	38	*1%*	**7**	*2%*	*1%*
1900's	105	*3%*	**19**	*4%*	*2%*
1910's	165	*5%*	**32**	*7%*	*4%*
1920's	295	*9%*	**57**	*12%*	*6%*
1930's	150	*5%*	**25**	*5%*	*4%*
1940's	240	*8%*	**35**	*8%*	*6%*
1950's	532	*17%*	**67**	*14%*	*13%*
1960's	646	*21%*	**81**	*17%*	*18%*
1970's	486	*16%*	**77**	*17%*	*19%*
1980's	273	*9%*	**40**	*9%*	*14%*
1990's	185	*6%*	**25**	*5%*	*13%*
	3115	*100%*	**465**	*100%*	*100%*

Table 4: Sample Age Distribution

This indicates that the sample is also fairly representative of the NZ-wide distribution, with some variations, as shown in ***Figure 5***:

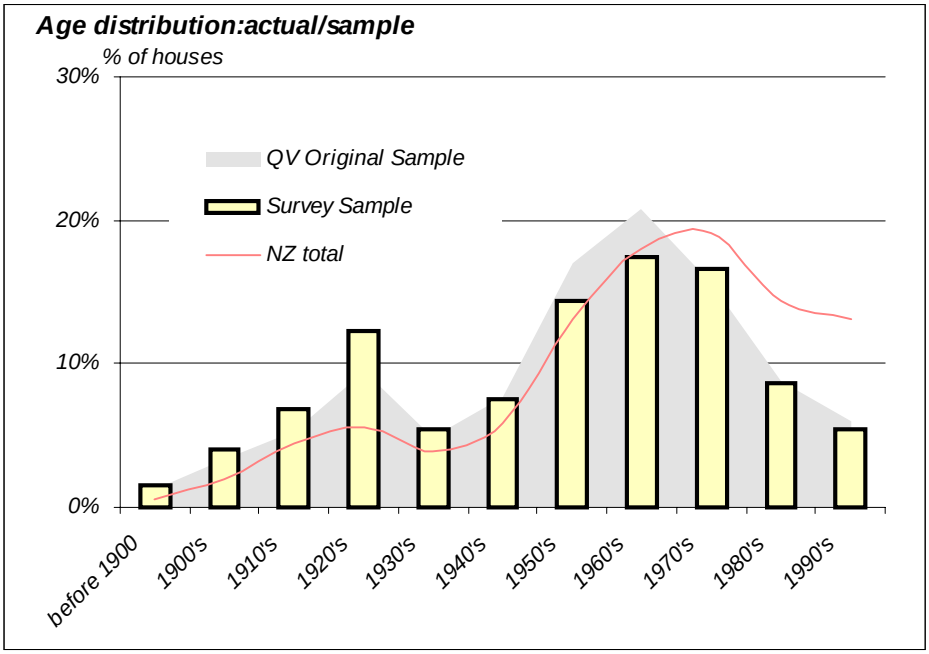

Figure 5: Surveyed to Original Sample

As shown, the earlier decades are over-represented[15], while the newer cohorts are under-represented (which is similar to the variations found in the 1994 survey). The middle age ranges have fairly good matches. The original QV sample was a random selection of all owner-occupied houses within each authority (without controls as to the age of the house), with the aim of being representative of the total housing stock in those regions[16].

4.3 Overall Assessment

As well as assessing the individual components, each inspector also made an overall judgement on how well the house was being maintained. This is a more subjective assessment as to whether the house was:

- ***well maintained***
- ***reasonably maintained***
- ***poorly maintained***

In many cases, the overall assessment does not correspond with the average component condition. Several components ranked as being in *"poor"* condition may be enough to establish a judgement that a house is poorly maintained, but not enough to pull the average component condition below a good or average level[17]. The judgement is nevertheless valuable as it indicates the opinion of experienced inspectors who will weight their assessments according to the importance of the particular areas that may be in poor condition.

It should be noted that, in establishing average component condition, equal weighting is given to each component, whereas components do not contribute equally to the overall physical condition of the house. An example of this is the condition of those components that, if *"poor"*, could lead to further serious implications in other components eg. a leaking roof or rotting weatherboards. Also, while being identified, some elements were not rated as to condition eg. plumbing and wiring.

These more subjective assessments (based on experience) are used to compare with other subjective assessments - those of QV (who maintain records of their last assessment of the condition of the exterior of the house), and those of the homeowners themselves. During the telephone survey, owners were asked to put the condition of

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[15] *In particular, the number of surveyed houses in the 1920's cohort.*

[16] *However the sample did not include rural and provincial housing stock, which may explain some of the differences when the sample house age cohorts are compared to the total NZ age distribution.*

[17] *Unfortunately, there is insufficient detail in this overall subjective judgement to allow further analysis such as weighted averages.*

their house into one of five categories, varying from *"excellent"* to *"very poor"*. These have been simplified into three groups in order to allow comparison. It is notable that very few houses are categorised by the owners or QV as being *"poor"* or *"very poor"*[18]. ***Figure** 6* shows the differences between the inspectors' assessments and the other two judgements, which have been translated into three broad categories in common with those used by the inspectors. The owners' and QV's judgements are very similar, but notable differences are shown between these and the BRANZ assessment - particularly at the lower level of *"poorly maintained"*.

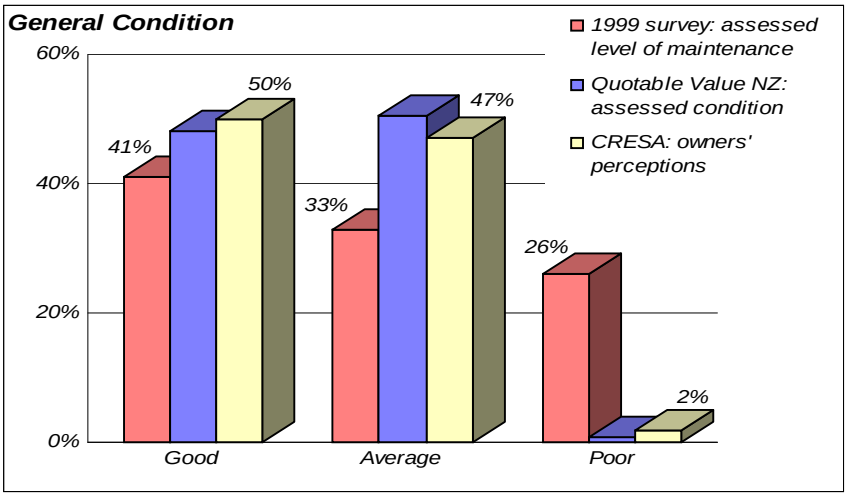
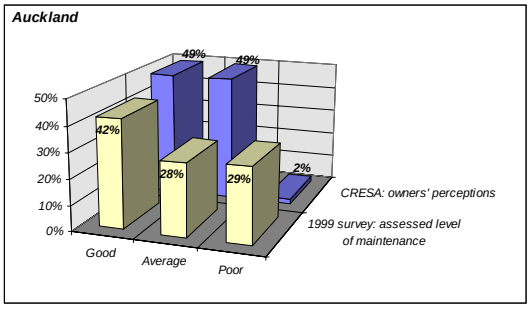


Figure 6: Assessed Overall Condition

In order to further explore this marked difference, *Figure 7* shows the regional differences between BRANZ and owners assessments:



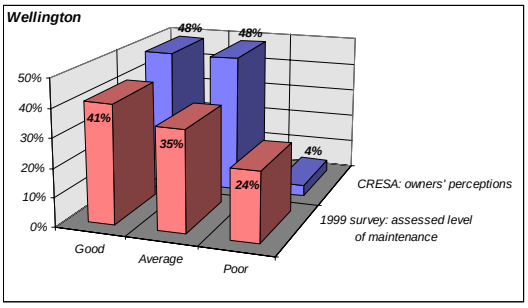
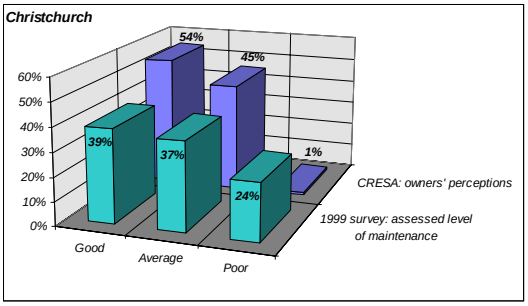


Figure 7: Regional Assessments

These show that, in the surveyed sample, there are differences between the regions - with the gap between the two judgements widening from south to north. Whether this is related to regional differences between owners or to differences between the inspectors cannot be established, but it is interesting to note that the change in perceptions are in the same direction as the change in house valuations.



[18] *A point that should be taken into account when considering the assessments shown in **Figure 6** and **Figure 7** is that owners tend to concentrate on the condition of the interior because that is what they most readily understand. On the other hand, QV's assessments are generally based only on the exterior, as few houses are inspected inside (unless the valuation is appealed).*

The following charts show the building valuations (excluding land) over age groups, followed by the valuations split into the three regions:

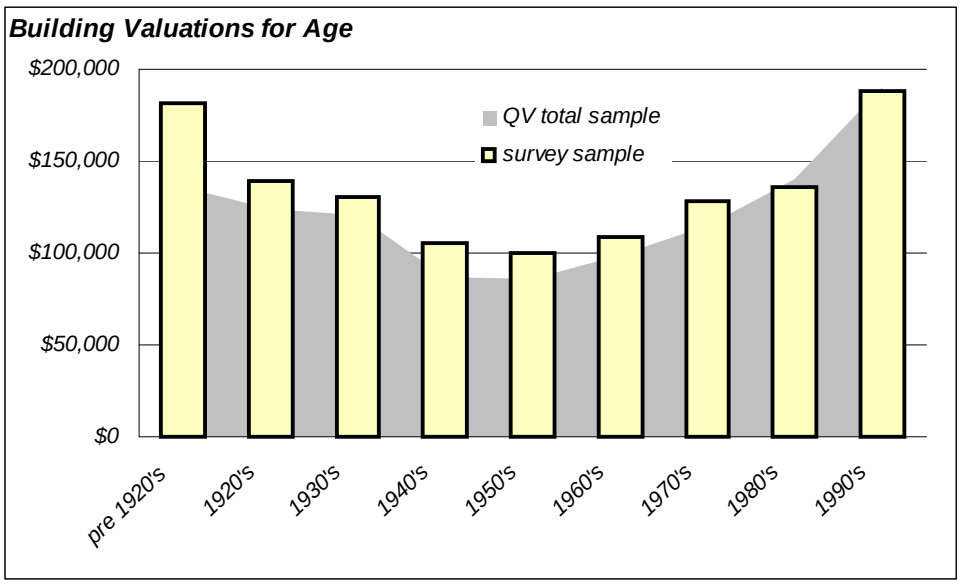


Figure 8: Building Valuations by Age Groups

Figure 8 shows that valuations "bottom out" in the 1950's, rising with increasing age after that point. The picture changes, however, when the regions are considered separately.

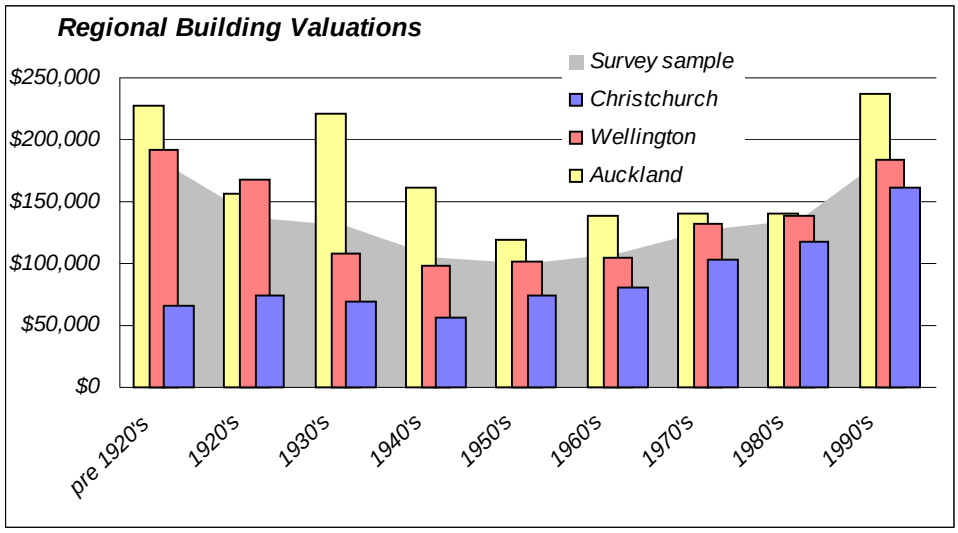


Figure 9: Regional Building Valuations

As shown, the Auckland sample has the highest valuations (except for the 1920's cohort), while Christchurch has the lowest (with Wellington being close to the sample average). Auckland also has the largest gaps between BRANZ and owners' perceptions at the lower levels of *"average"* and *"poor"*, while Christchurch has the smallest.

It could be that an owner's perception is related to the valuation of their house: the higher the valuation, the higher the perception. In Auckland, for example, houses in older suburbs generally have higher valuations. However, these reflect market demand rather than the actual physical condition. These high valuations may nevertheless encourage owners of older houses to perceive them to be in better condition than some of the newer (but less desirable) houses. However, there is insufficient evidence to draw any firm conclusions.

4.4 Component Condition

The scales used to assess component condition were shown in *Table 3*. These ratings are used to derive an average condition for each assessed component over the surveyed sample. These are shown in detail in Appendix 4, and are compared with those findings of the 1994 survey. *Figure 10* breaks these down into regions and also into exterior and interior average conditions.

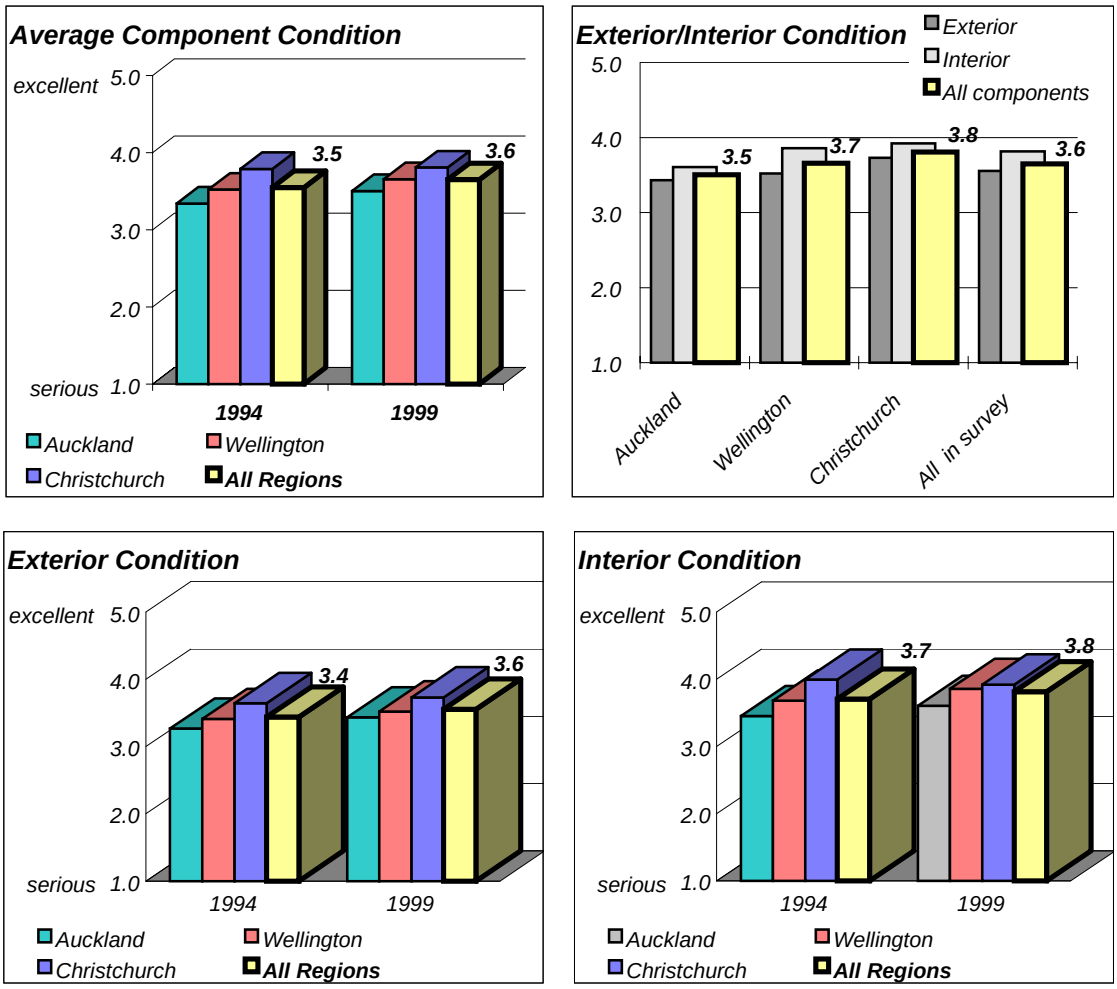


Figure 10: Regional Component Conditions

The main features of these breakdowns are:

- ***In both 1994 and 1999:***
  - ***Christchurch*** *houses had the highest average component condition (both interior and exterior)*
  - ***Auckland*** *houses had the lowest average component condition (both interior and exterior)*
- *The interior component condition was higher than the exterior over all three regions*
- *The above differences (although notable) were not large.*

As explained above, all components are given equal weighting in calculating these averages, and this should be taken into account when assessing composite results.

4.5 Defect Ranking

The following tables (*Table 5* and *Table 6*) rank problem areas in order of descending severity, comparing these with the ranking found in the 1994 survey. For further information, the defects are also classified into three categories (lack of compliance with code requirement, poor management of maintenance tasks, poor building practice or design). The percentage of the sample having components assessed as being in serious or poor conditions is also given.

1999 Survey (Descending order of severity)	*Class* [19]	*Cond. Rating 1999*	*% serious or poor* [20]	*1994 Survey (Descending order of severity)*	*Cond. Rating 1994*
Inadequate subfloor ventilation Insufficient and/or blocked vents	*C P M*	**2.3**	***75%***	**Inadequate subfloor ventilation** Insufficient and/or blocked vents	*2.5*
Roof Space Header tanks, roof underlay, venting from bathrooms and kitchens	*C P M*	**2.8**	***59%***	**Roof Space** Header tanks, roof underlay, venting from bathrooms and kitchens	*2.9*
Ground Clearance Inadequate clearance to cladding	*C P*	**3.4**	***44%***	**Roof Cladding** Rust, loss of chip coating, cracked tiles, missing mortar, poor fixing, paint deterioration.	*3.1*
Windows Decay, paint deterioration, poor or missing flashings, broken glass	*C P M*	**3.5**	***14%***	**Wall Cladding** Decay, holes, checking, poor fixing. cracks, paint deterioration	*3.2*
Insulation Inadequate ceiling insulation	*C P M*	**3.6**	***26%***	**Foundations** Unsafe excavations, ground subsidence, poor bracing, cracks, missing baseboards, missing/poor piles, decay, damp ground	*3.2*
Fasteners Corrosion, no or inadequate fixing	*C P M*	**3.6**	***21%***	**Spouting** Rust, holes, inadequate falls, damage	*3.2*
Spouting Rust, holes, inadequate falls, damage	*M*	**3.6**	***14%***	**Windows** Decay, paint deterioration, poor or missing flashings, broken glass	*3.3*
Wall Cladding Decay, holes, checking, poor fixing, cracks, paint deterioration	*P M*	**3.7**	***13%***	**Exterior Doors** Paint deterioration, cracks, poor hardware	*3.4*
Roof Cladding Rust, loss of chip coating, cracked tiles, missing mortar, poor fixing, paint deterioration.	*C M*	**3.7**	***11%***	**Chimneys** Cracks, fire hazard, earthquake hazard	*3.4*
Exterior Doors Paint deterioration, cracks, poor hardware	*M*	**3.7**	***8%***	**Fasteners** Corrosion, no or inadequate fixing	*3.5*
Chimneys Cracks, fire risk, earthquake hazard	*C P M*	**3.8**	***9%***	**Insulation** Inadequate ceiling insulation	*3.5*
Foundations Unsafe excavations, ground subsidence, poor bracing, cracks, missing baseboards, missing/poor piles, decay, damp ground	*C P M*	**3.9**	***11%***	**Roof Framing** Borer, inadequate framing	*3.7*
Roof Framing Borer, inadequate framing	*C P M*	**3.9**	***5%***	**Floor Framing** Borer, mould and fungus, decay	*3.8*
Floor Framing Borer, mould and fungus, decay	*C M*	**4.0**	***4%***	**Ground Clearance** Inadequate clearance to cladding	*3.8*

Table 5: Exterior Defects

[19] ***C = Building Code requirement M = poor management of maintenance tasks P = poor building practice***

[20] *Note that the % of serious or poor condition (components with ratings of 1 or 2) is not necessarily in line with the ranking of average conditions. The latter therefore takes into account all ratings on each component for each house, and so includes the effect of average to "excellent" conditions (ratings 3 to 5).*

1999 Survey (Descending order of severity)	*Class* [21]	*Cond. Rating 1999*	*% serious or poor*	*1994 Survey (Descending order of severity)*	*Cond. Rating 1994*
Hot Water Cylinder Unrestrained, corrosion, leaks	*M*	**2.9**	***64%***	**Hot Water Cylinder** Unrestrained, corrosion, leaks	*3.2*
Laundry Linings Decay, mould, wear	*M*	**3.7**	***15%***	**Bathroom Linings** Decay, mould, paint peeling	*3.5*
Other Linings Wear, peeling paper, damaged linings	*M*	**3.7**	***9%***	**Bathroom Fittings** Wear, poor seals, decay, staining, poor tapware	*3.5*
Bathroom Linings Decay, mould, paint peeling	*C M*	**3.8**	***11%***	**Laundry Linings** Decay, mould, wear	*3.5*
Kitchen Fittings Wear, paint deterioration, poor seals, poor tapware	*M*	**3.9**	***9%***	**Laundry Fittings** Wear, paint deterioration, poor seals, poor tapware	*3.6*
Laundry Fittings Wear, paint deterioration, poor seals, poor tapware	*M*	**3.9**	***8%***	**Other Linings** Wear, peeling paper, damaged linings	*3.6*
Kitchen Linings Decay, mould, staining	*M*	**3.9**	***7%***	**Kitchen Linings** Decay, mould, staining	*3.7*
Interior Doors Holes, dents, poor hardware	*M*	**3.9**	***9%***	**Kitchen Fittings** Wear, paint deterioration, poor seals, poor tapware	*3.7*
Bathroom Fittings Wear, poor seals, decay, staining, poor tapware	*M*	**4.0**	***9%***	**Interior Doors** Holes, dents, poor hardware	*3.8*

Table 6:Interior Defects

4.6 Serious and Poor Condition

EXTERIOR	***1999***	***1994***
Foundations	11%	40%
Clearance to cladding	44%	30%
Fasteners	21%	23%
Floor framing	7%	13%
Floor	4%	9%
Vents	75%	60%
Cladding	13%	28%
Exterior doors	8%	22%
Windows	14%	27%
Roofing	11%	28%
Guttering	14%	14%
Insulation	26%	30%
Roof framing	5%	17%
Roof space	59%	56%
Chimney	9%	11%

Table 7: Incidence of Serious or Poor Condition

The percentage of components categorised as *"serious"* or *"poor"* are generally in line with the ranking of components by average conditions. Those components with the worst average condition across the sample also tend to be those with the highest incidence of serious or *"poor"* condition.

INTERIOR	***1999***	***1994***
Bathroom linings	11%	28%
Bathroom fittings	9%	28%
Kitchen linings	7%	24%
Kitchen fittings	9%	22%
Oven	4%	8%
Laundry linings	15%	22%
Laundry fittings	8%	24%
Hot water cylinder	64%	50%
Other linings	9%	17%
Interior doors	5%	7%

[21] ***C = Building Code requirement*** ***M = poor management of maintenance tasks*** ***P = poor building practice***

Figure 11 and *Figure 12* compare the 1999 results with those of 1994 for those components with an average condition of *"serious"* or *"poor"* in either survey.

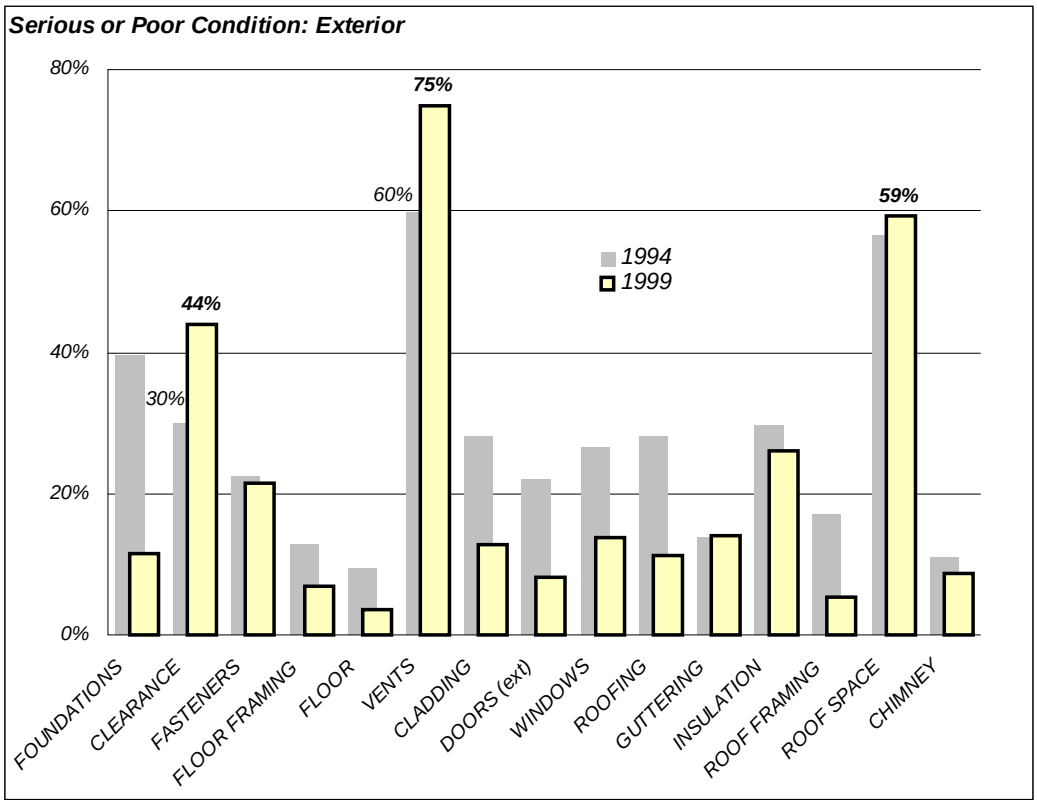


Figure 11: Exterior Components

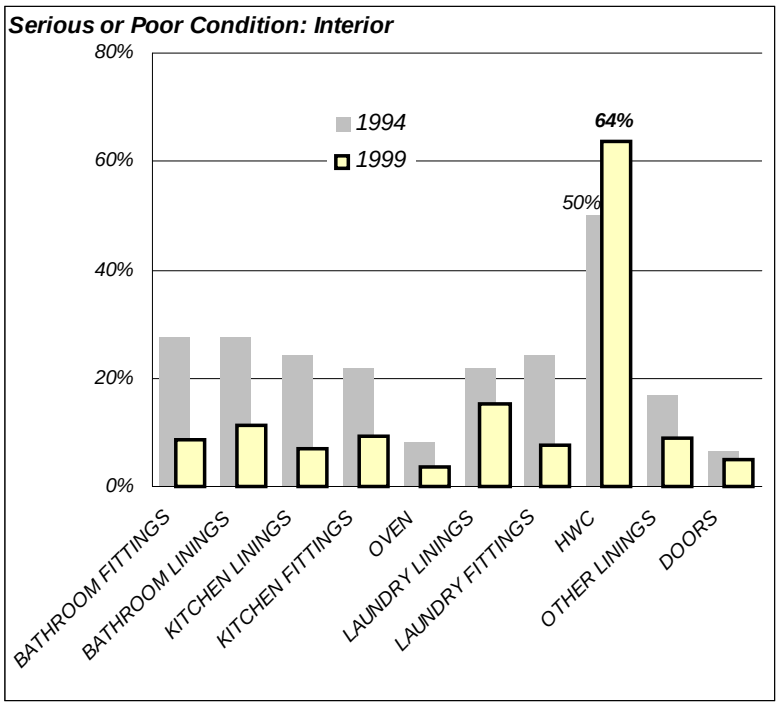


Figure 12: Interior Components

The overall pattern is similar between the two surveys, but the following differences are worth noting:

There is a notable (more than 10%) **increase** in the percentages of the sample with ***"poor"*** or ***"serious"*** ratings from 1994 to 1999 for the following components:

- *Ground clearance to cladding*
- *Subfloor ventilation*
- *Hot water cylinders*

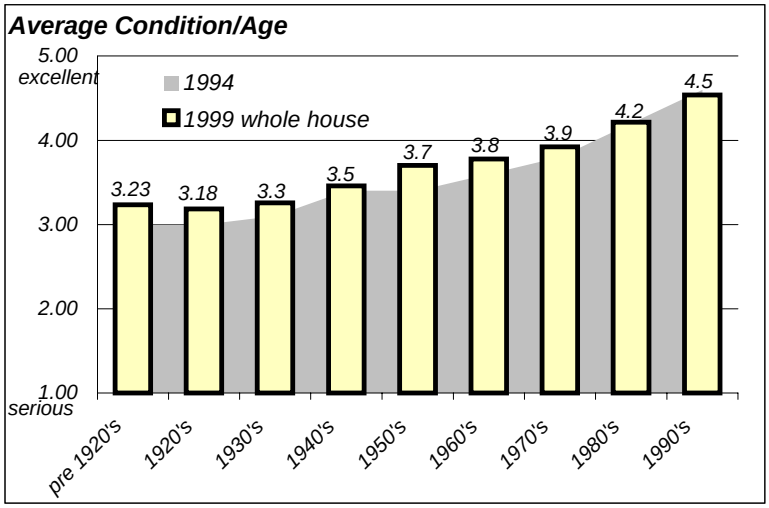
It should be noted that the ratings for some components relate to their **design**[22] rather than their **condition**. This applies particularly to ground clearance from cladding, and subfloor ventilation. These components may be rated very low, but may not have lead to deterioration in actual condition (although the risk of future deterioration is increased). These components are considered later in Sections 6.1, 8.1, and 10.1.

There is a notable (more than 10%) **decrease** in the percentages of the sample with ***"poor"*** or ***"serious"*** condition from 1994 to 1999 for the following components:

- *Foundations*[23]
- *Cladding*
- *Exterior doors*
- *Windows*
- *Roof cladding*
- *Roof framing*
- *Bathroom linings and fittings*
- *Kitchen linings and fittings*
- *Laundry fittings*

4.7 Average Component Condition versus Age Group

As noted earlier, some additional components have been included in this survey. These are considered separately in Section 9 and are excluded from all comparisons with component ratings from the 1994 survey. ***Figure 13*** shows the relation of average component condition to the age of the house.



The 1999 values are the average condition of all components, and then the average of that over all the sample houses in that age group.

Figure 13 also relates this condition to the findings of the 1994 survey, and shows a similar trend with the condition steadily worsening with age.

However, it should be noted that some of the older cohorts are showing improvements in condition in comparison with 1994.

Figure 13: Average Condition for Age

4.7.1 Condition for Age over Regions

When this is considered on a regional basis, it is apparent that this improvement in the average condition of older houses is happening in the Auckland and Wellington regions, but not in Christchurch. ***Figure 14*** shows the average rating for each age group split into the three regions, in order illustrate the different patterns applying for each.

This again may relate to the different patterns of building values for age groups between the regions (shown earlier in *Figure 9*) in which there is a notable difference for Christchurch, where values steadily decrease with age, while those in the other two regions "bottom out" at the 1950's cohort and then steadily increase with age. It can be argued that maintenance or improvement expenditure has some relationship to the value of the building

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[22] *Therefore, in Table 5: Exterior Defects, these would be classified as P (poor building practice or design).*

[23] *The major shift in the incidence of serious or poor condition for foundations from 40% in 1994 to 11% in 1999 could be partly due to a bias towards 1920's houses that have recently undergone re-piling.*

and that, the higher the value of the building, the less likely is the danger of "over-capitalisation" with improvement expenditure. The relevance is whether owners believe in this real-estate truism and act on it, and it appears that they may do[24].

It is likely that variability between the inspectors will explain some of the regional differences, although this influence is considered to be minor. It is obviously important to achieve consistency between inspectors. As discussed earlier, training procedures were undertaken prior to the 1994 survey, and the inspectors for the 1999 survey were the same. In addition, during the survey, the forms were monitored for apparent inconsistencies as they were received. These were followed up and various decisions were made at a central level as necessary to preserve comparability.

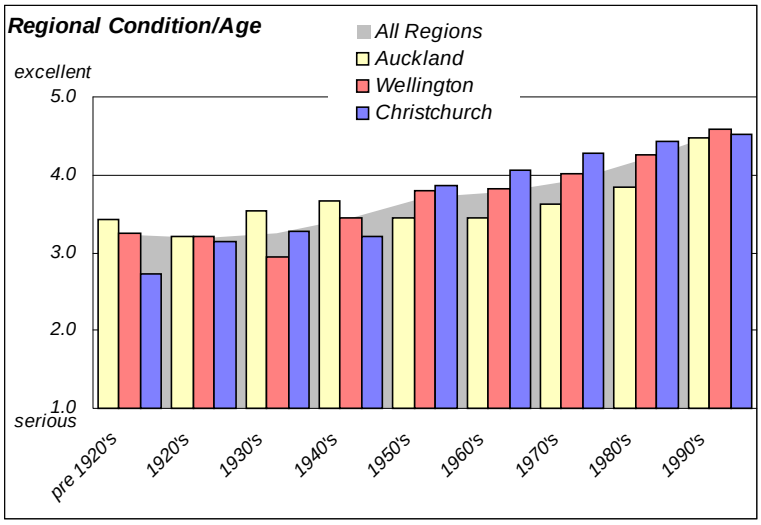

Figure 14: Regional Condition for Age

4.7.2 Exterior/Interior Condition for Age

Another interesting breakdown is to consider the exterior versus the interior condition across the age groups, and the results are shown in *Figure 15*.

What is notable in this analysis is the increasing disparity between the internal and external component condition for those houses of the 1930's and older.

This appears to reflect the recent popularity of "doing up" old houses, but also shows that much of the effort is being used on the interior of these houses rather than the exterior shell. The worry in this is that expenditure on critical elements may be giving way to more "cosmetic" non-essential elements. This may help to explain the large decrease in the percentages of interior components that are rated as *"poor"* or serious (as shown in *Table 7*).

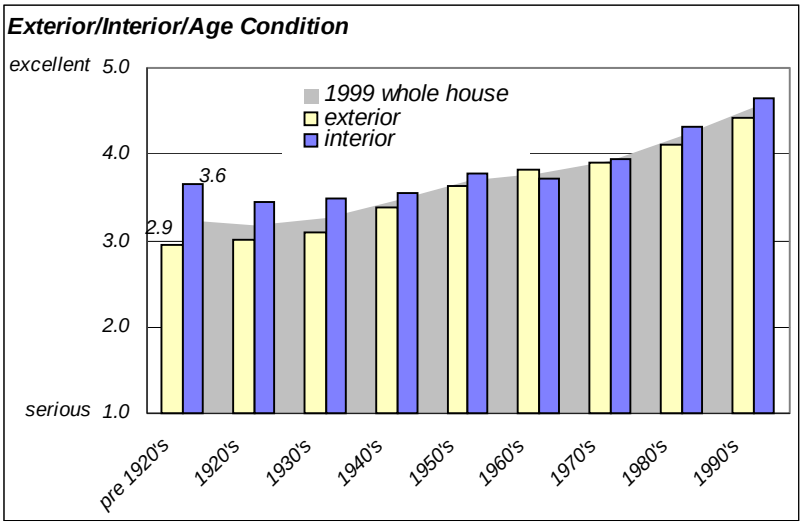

Figure 15: Exterior/Interior for Age

[24] However it is important not to over-emphasise or simplify such a link, as other demographic influences such as household lifestyles (eg. both partners working/ no children), and trends towards living closer to the city (in older areas) will also influence the relationship between house age and house condition.

4.7.3 Range of Conditions Within Age Groups

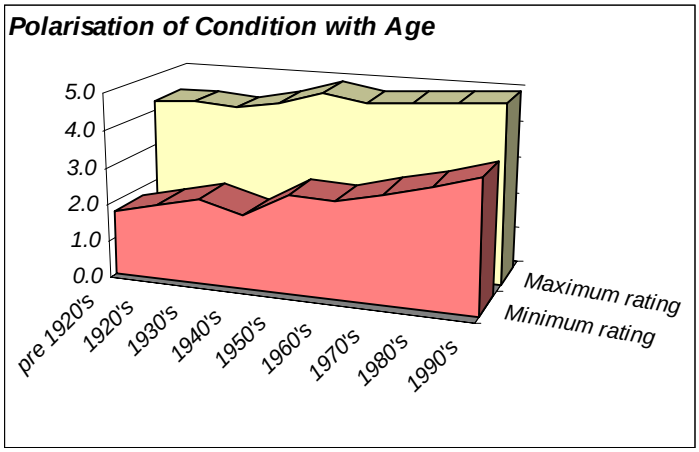

Figure 16: Polarisation of Condition

As shown in the charts above, the condition of houses deteriorates with age up to houses of around 60 years old; at this stage the average condition stabilises as many of the older houses are renovated.

However it also appeared that the range of overall house ratings increased with age, so this is explored in ***Figure 16***. As shown the disparity generally increases, from a difference in condition rating between best and worst of 1.3 for the newest age group to 2.6 for the oldest.

4.7.4 Conclusion

The average condition of houses in the survey, when taken over all age cohorts, is very similar to that found in the 1994 survey. There is a slight improvement, but this is less than 3%, and therefore should not be regarded as significant. More interesting differences appear when the composite or overall average condition is broken down into interior and exterior, age groups, and regions.

Beyond an age of 60 years the condition of the average house appears constant over a large age span. This is not due to a cessation in the deterioration of building components, rather it seems to be the consequence of renovation of the older housing stock.

As older houses have become more popular over the past decades (as illustrated by the increase in building valuations of this group), many have been repaired, modernised, and upgraded; in some cases to the extent that their condition becomes comparable to that of a much newer house (particularly in the interior components). These houses counteract the effect of those that continue to deteriorate, and the net result is that the average condition stabilises and an equilibrium state is established.

However, although the average level of deterioration appears to have stabilised, the **range** of condition of these older houses appears to be increasing with age. This "polarising" effect is a result of selective renovation, and is particularly evident in Auckland and Wellington[25].

[25] *Although it is beyond the scope of the present study, this may be worth exploring further in order to compare property values against such polarisation of condition.*

5 HOUSEHOLDS RELATED TO CONDITIONS

In order to try to establish patterns related to average house condition, the following questions have been explored by relating the information collected from the owners to that gathered during the physical inspections of the houses:

***What type of household** is most represented in the houses with lowest average condition?*

- ***Ages** of those owners?*
- ***Sizes** of households?*
- ***Income levels** of households?*
- ***Mortgage status** of households?*
- ***Length of time** house owned for?*

The same questions have been considered for houses with the higher average conditions, with the aim being to explore the probability that particular households will own the best or the worst houses.

5.1 Households in Worst and Best Condition Houses

Those houses with an average condition of less than 3 (*"average"*) and higher than 4.5 (between *"good"* and *"excellent"*) were identified and correlated to the household characteristics of size, mortgage status, owners' ages, length of ownership, and income levels in order to identify whether any group was over-represented in these categories. 55 houses in the sample had an average condition less than 3, and 47 rated over 4.5. These two groups approximately constitute the upper and lower decile for the sample.

5.1.1 Worst Houses

It should be noted that this category covered all houses with an average component condition below 3 (*average*). *Figure 17* shows the household characteristics for those houses rated as **below** *"average"*:

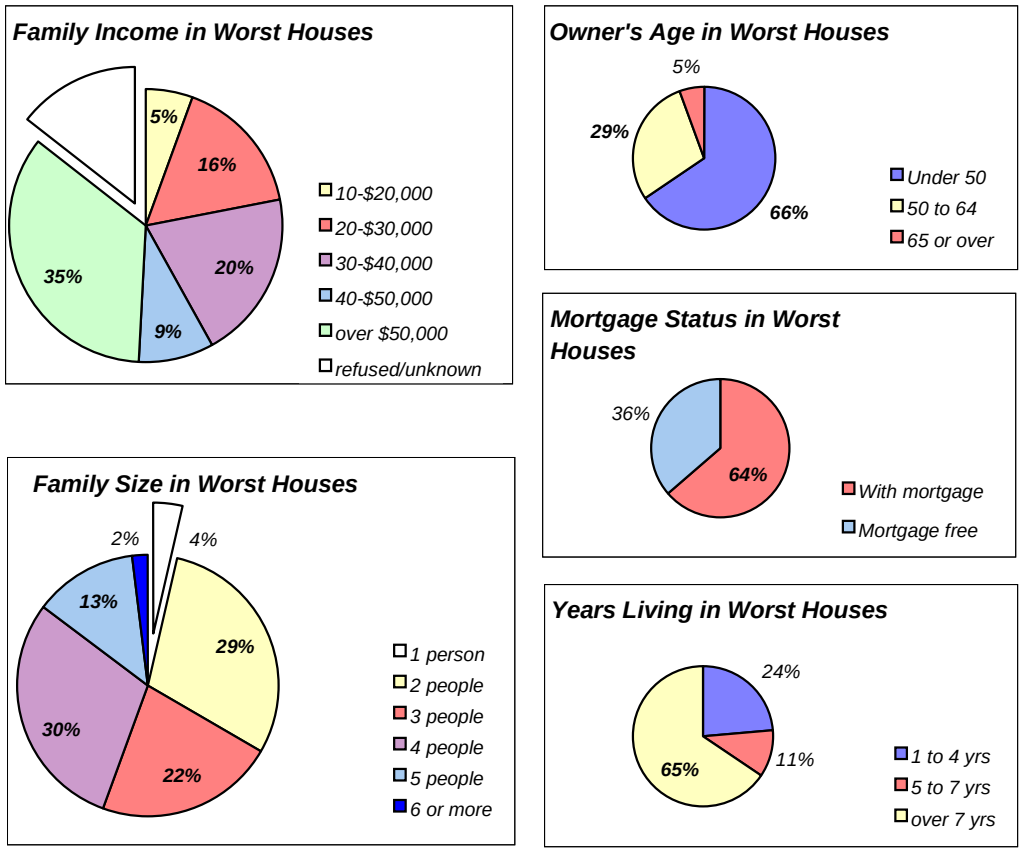

Figure 17: Households in Worst Houses

Very few houses were in the lowest categories. No house averaged below 1.5, only one was below 2 (*"poor"*), and only fourteen houses (3% of the sample) were below 2.5. Therefore to get any idea of common household characteristics, the level was chosen as below 3, which gave a total of fifty-five (more than 10% of the sample) households to consider. Because of the lack of houses rated in the lowest categories, the majority of the lowest

10% of the sample cannot really be described as sub-standard. They obviously have some components that are *"poor"* or even *"serious"*, but these are insufficient to pull the overall average down to a lower level.

As shown it is difficult to derive common household characteristics from *Figure 17*. There appears to be no single type of household more likely to live in the worst houses, and this is probably related to the lack of houses falling into *"poor"* overall conditions (as discussed above). The two major common factors appear to be the length of time that the owners have lived in the house and their mortgage status. Other characteristics are outlined in *Table 8* below, alongside those of the best houses.

However, it must also be noted that some of the worst houses in New Zealand are to be found outside of the three regions covered in this survey. Work done by CRESA (3) has established that substandard housing conditions exist in some parts of the Bay of Plenty and Northland. It is therefore important that this part of the study is not taken as necessarily indicative of some more rural areas in the country.

5.1.2 Households in Best Houses

The problem in setting the cut-off level for deciding what would constitute the best houses was the opposite to that described above. Too many houses (139) had an average component condition above 4 (*"good"*). The cut-off was therefore set at 4.5 (the mid-point between *"good"* and *"excellent"*), which gave a sample of 47 (around 10% of the total sample). ***Figure 18*** shows the same for those in the best houses in the survey:

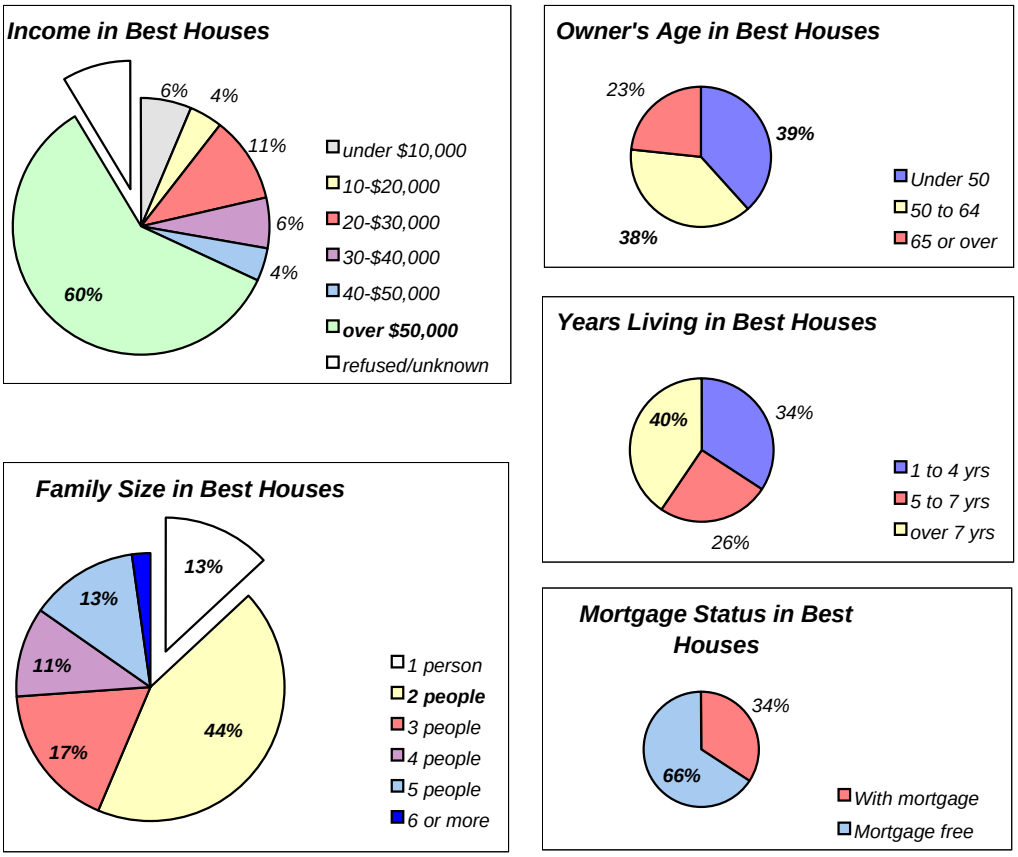

Figure 18: Households in Best Houses

In contrast to the worst houses, more common characteristics show up. Major common characteristics of those in best houses are income, size of household, and mortgage status.

5.2 Comparison of Characteristics

Table 8 below summarises the characteristics of the best and worst houses:

	% in Survey Sample	*% in Best Houses*	*% in Worst Houses*
Family Income	55% over $50,000 23% under $30,000 11% under $20,000	**Over 60% over $50,000** Over 20% under $30,000 Over 10% under $20,000	**About 35% over $50,000** About 20% under $30,000 About 5% under $20,000
Family Numbers	8% one person 34% two people 21% three people (63% three or less) 38% four or more	More than 10% one person **More than 40% two people** 17% three people (74% three or less) **About 25% four or more**	**Under 5% one person** Under 30% two people Over 20% three people (55% three or less) Over 40% four or more
Owner's Age	56% under 50 28% 50 to 64 17% 65 and over	**Almost 40% under 50** **Almost 40% 50 to 64** **Almost 25% 65 and over**	**About 65% under 50** Almost 30% 50 to 64 **About 5% 65 and over**
Mortgage Status	53% with mortgage	**About 35% with mortgage**	**About 65% with mortgage**
Length of time in house	26% for under 5 years 60% for more than 7 years	**About 35% for under 5 yrs** **40% for more than 7 years**	About 25% for under 5 yrs About 65% for more than 7 years

(Note: Bolded areas are most dissimilar from the characteristics of the whole sample)

Table 8: Household Characteristics

Figure 19 reflects the most notable differences as ratios in order to allow comparison between various groups.

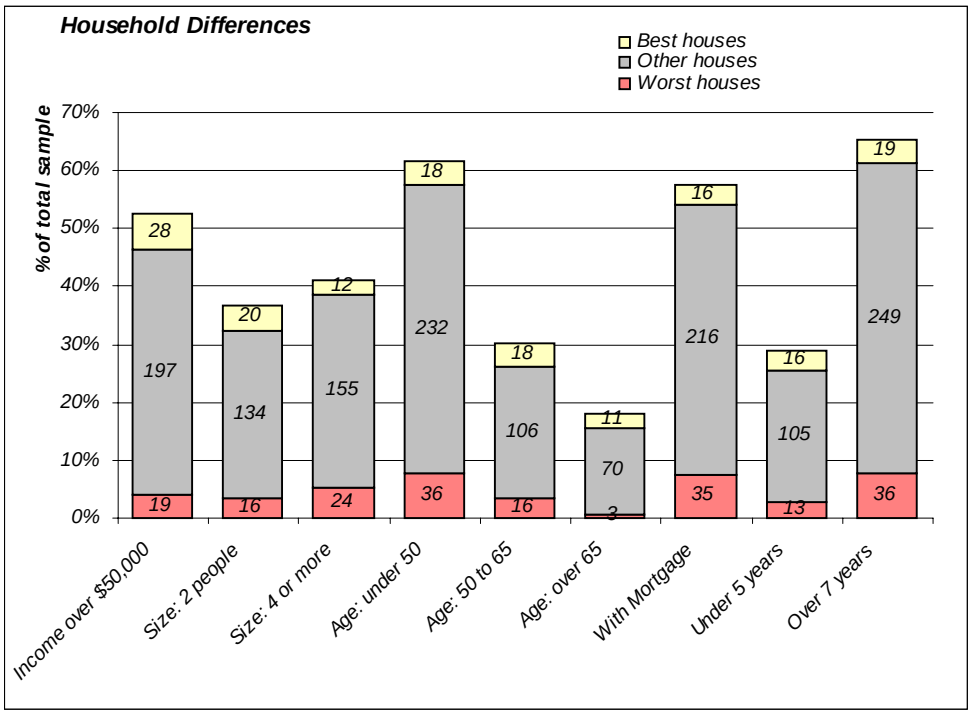

Figure 19: Household Differences

5.3 Conclusion

There appears to be no single group that is over-represented in the worst houses of the survey. The strongest variances from the sample appear to be the:

- *Lower proportions of higher income households*
- *Higher proportions of younger owners*
- *Higher proportions of mortgages (two-thirds had a mortgage).*

However for the best houses, there are more associated characteristics:

- *Higher proportions of high income households*
- *Only about one third of owners hold mortgages*
- *Higher proportions of smaller households than the sample*
- *Higher proportions of older (over 50 years of age) owners than the sample.*

6 BUILDING ELEMENTS

House components have been grouped into the four basic elements of floor, walls, roof and interior linings in order to be able to consider any patterns that may emerge. *Figure 20* shows these component groups over the age cohorts.

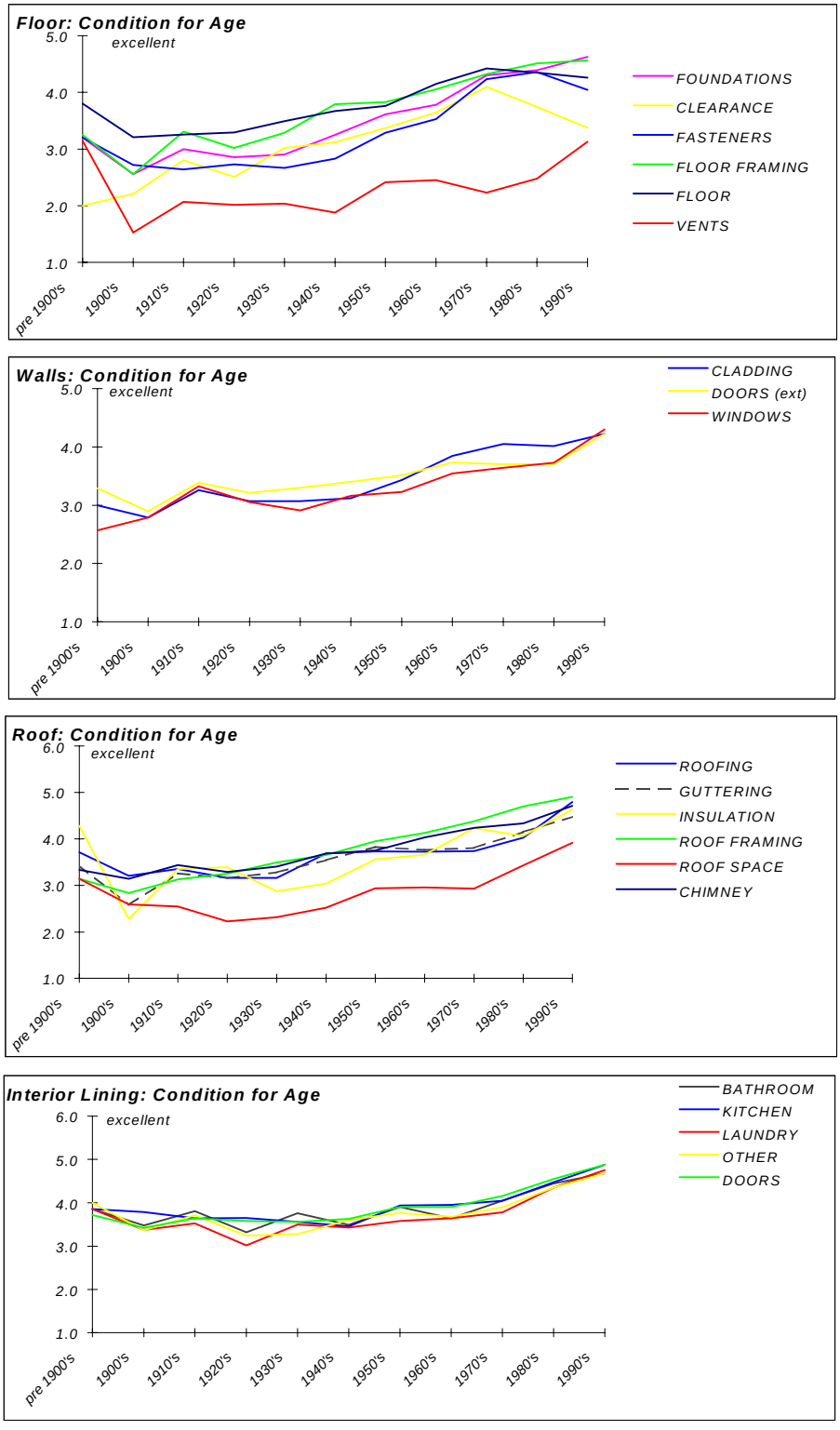

Figure 20: Component Condition for Age

Caution must be exercised when considering apparent trends at the pre-1910's cohort levels, as the numbers surveyed were small. As shown previously in *Figure 4: Sample Age Distribution*, the numbers in the sample were only 7 for the pre-1900 cohort, and 19 for the 1910's cohort, so the results may not be indicative of the total population of this age group of houses. However, while taking that into account, some trends may be identified.

In general, the condition appears to follow that of the average component condition shown in *Figure 13 "Average Condition for Age"* with the condition steadily deteriorating with age until the 1930's cohort - where it appears to level out, and even improve with age. While there were some signs of this in the 1994 results, the trend appears to be more noticeable in 1999 - particularly in the Auckland and Wellington regions as shown in *Figure 14: "Regional Condition for Age"*.

6.1 Floor Element

The collection of components making up the floor is the most variable of the groups. However, if the two related components of ground clearance and subfloor vents are excluded, the remaining components are similar in pattern.

As in 1994, ground clearance[26] and subfloor ventilation are particular problem areas[27] as shown in ***Figure 11: Exterior Components***. Shortcomings in these components are not necessarily associated with older houses. In fact, pre-1920's houses commonly used spaced baseboards at subfloor levels, which normally provided more than sufficient ventilation. Later, solid perimeter walls became more common and vents were limited to "holes" in these walls, which were often too small and too few in number. The graph for vents shows that this inadequacy has remained right up until the 1980's cohort. In addition to the inadequacy of constructed vents, owners themselves have often contributed to the problem by blocking vents.

Ground clearance also shows concerning trends, with the average rating decreasing markedly in younger houses (1970's onwards). This is very similar to the results found in 1994, and it is interesting to speculate on the reasons. One factor may well be changes in the way that New Zealanders use their houses, and the increasing attention given to achieving good "indoor/outdoor flow", where changes in levels may be minimised at the expense of good building practice. In particular, the increasing use of concrete slabs in more recent houses has allowed interior floor levels to carry through to outside areas, sometimes with insufficient means of providing adequate separation of cladding materials from adjacent ground levels. This appears to be an area that could do with some attention in terms of educating the building trades. However, it may well be more important to educate landscapers, gardeners, and the owners themselves. The problem may well be that later effects of inadequate clearance, while possibly severe, are too far in the future to engender immediate concern.

6.2 Walls

The components making up this element are very consistent with each other and with the overall average pattern. As expected, these components deteriorate with age with a flattening up of the trend for those cohorts of 1930's and older. The encouraging note in this is that the condition appears to be stabilised in older houses. Providing that maintenance/renewal work continues, this may be expected to remain at such an average level in the future.

6.3 Roof

If pre-1920's cohorts are combined, the condition of the components making up the roof element is also reasonably consistent. Ratings of ceiling insulation appear to reflect upgrading activity in older houses, and it is interesting to note that the cohorts of 1930's to 1960's appear to require attention in this area. This is considered in more detail later in this report (Section 11.2 Insulation for Age).

The other component of interest in this element is the roof space. The older houses often displayed general shortcomings in lack of bracing, over-spacing of structural timbers etc., although this may not be a major problem as the native timbers used still appear to be performing adequately despite the structural design being below current standards for radiata pine.

However, the major factor contributing to the low rating of this component (below average right up to the 1970's) is more concerning. This is the lack of earthquake restraints for header tanks and poses a potentially serious problem. The message on ceiling insulation appears to be making more of an impact than that of the potential dangers, in the event of an earthquake, of an unrestrained tank of water in the ceiling space of a house.

6.4 Interior Linings

As with the exterior walls, the components making up this element are very consistent with each other and with the overall average pattern. As expected, these components deteriorate with age with a flattening up of the trend

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[26] *The height of the cladding above the adjacent ground level (the rating is based on a comparison to current Standards.*

[27] *These factors are related to design adequacy rather than physical condition as discussed earlier.*

for those cohorts of 1930's and older. The trend for improvement in the interior of older houses is noticeable, particularly in kitchen areas where the condition remains consistently well above average over all age cohorts. In fact the condition of all linings is very similar from the oldest houses right up until the very recent ages - those of the 1980's and 1990's. It appears that there are no general problem areas in the interior of our houses[28].

[28] *However, it should be noted that one particular component (discussed in Section 4.5) is not included in this assessment - and that is the unrestrained hot water cylinder. As with the header tank discussed above, the message on the need for adequate restraint against earthquake movement is not being reflected in the results from surveyed houses.*

7 MATERIALS

7.1 Exterior Materials

The most common materials[29] used for walls, roofs and windows were considered in terms of their frequency of use and the results are given in ***Figure 21***.

It is obvious that, while there may have been many different materials used over the past few decades, few of these have yet to make much impact on the homogeneous nature of New Zealand's existing housing stock.

The most common house still has weatherboard walls, painted corrugated (or similar profile) roofs and timber windows.

This is not surprising as almost 70% of the surveyed houses were built prior to the 1970's (before more recent materials such as aluminium windows, fibre-cement wall cladding and chip-coated metal tile roofing became common).

Future surveys should see gradual changes in the relative importance of these traditional materials as the proportion of older houses decreases.

Almost 70% of houses have some walls of weatherboard, with more than half of this in native timbers. The only other materials of note are brick at 30% (either clay or concrete[30]) and fibre cement sheet at around 20%. Other wall cladding materials are still less than 10%, although these proportions will obviously increase over time as new houses are added to the total housing stock.

Almost 60% of houses have a corrugated (or similar profile) steel roof, with more than 40% in painted galvanised steel. Coil-coated steel is becoming more common at 10%. The only other roof materials of significance are chip-coated metal tiles at 18% and concrete tiles at 23%. What is notable is the frequency of painted or recoated concrete tiles. This has been a fairly recent development, so it will be interesting to note their condition in years to come.

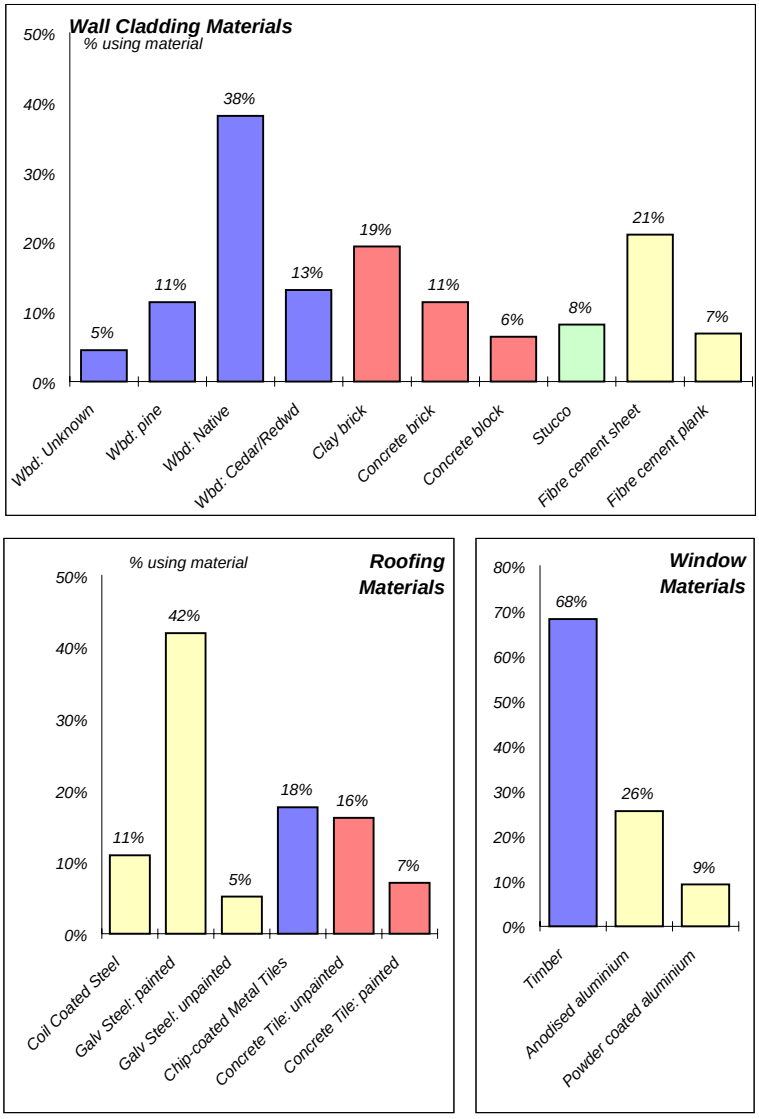

Figure 21: Most Common Materials

Despite the common use of aluminium windows since the 1970's, 65% of houses still have timber windows. More than 20% of aluminium windows are anodised.

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[29] *Other materials, such as EIFS (external insulation and finish systems) and solid timber, have not been shown as too few houses in the sample used them. This will tend to change in future surveys as more new houses are surveyed and older houses are reclad in new materials such as EIFS. Only materials used in 10 or more (over 2%) houses are included in the results shown. It should also be noted that many houses used more than one material (so that the %'s add up to more than 100%).*

[30] *The relatively high use (11%) of concrete brick is due to its high use in the Christchurch region. Only 15 (less than 3%) houses in the other two regions used concrete brick.*

The high proportion of these few materials should be considered in relation to their average conditions. They have been almost exclusively used in older houses (up to the 1960's), and many have been in place for more than 50 years.

Because of this, the deteriorating condition of these older houses is expected to be reflected in the average material condition taken over all age groups. This effect is shown in the following section, which considers the conditions of the more common materials.

7.2 Condition by Material

The average condition of all of the more common materials identified by the inspectors has been calculated. *Table 9* identifies and gives the incidence of common defects in wall and roof claddings, and windows: the average conditions have been further broken down into regions, and also compared to the applicable 1994 results[31].

	Auckland			Wellington			Christchurch			All			
Material	*No.*	**Cond.**	*1994*	*No.*	**Cond.**	*1994*	*No.*	**Cond.**	*1994*	*No.*	**Cond.**	*1994*	*variance*
WALL CLADDING													
Wbd: Unknown	*13*	**3.6**		*1*	4.0		*7*	3.7		*21*	**3.7**		
Wbd: Treated rad. pine	*27*	**3.6**	*2.8*	*25*	**3.5**	*3*	*1*	**4.0**	*2.9*	*53*	**3.6**	*2.9*	***23.0%***
Wbd: Native	*60*	**3.4**	*2.9*	*85*	**3.3**	*2.6*	*32*	**2.7**	*2.4*	*177*	**3.2**	*2.7*	***19.5%***
Wbd: Cedar/Redwood	*19*	**3.7**	*3.1*	*38*	**3.8**	*3.2*	*4*	**4.3**	*4.8*	*61*	**3.8**	*3.4*	***11.9%***
Vertical Boarding:	*8*	3.9		*2*	3.0		*1*	3.0		*11*	**3.6**		
Clay brick	*41*	**3.8**	*3.6*	*17*	**4.4**	*4*	*32*	**4.8**	*4.3*	*90*	**4.3**	*4*	*6.9%*
Concrete brick	*6*	4.0		*9*	4.3	*4.3*	*38*	**4.5**	*4.7*	*53*	**4.4**	*4.7*	*-6.5%*
Concrete block	*15*	**3.4**	*4*	*5*	4.0	*4.3*	*10*	**4.4**	*4.2*	*30*	**3.8**	*4.2*	*-8.7%*
Stucco	*9*	3.7	*3*	*14*	**3.4**	*1*	*15*	**3.1**	*2.6*	*38*	**3.3**	*2.4*	***38.2%***
Fibre cement sheet	*46*	**3.8**	*3*	*38*	**3.6**	*3.4*	*14*	**4.1**	*3*	*98*	**3.8**	*3.2*	***17.7%***
Fibre cement plank	*15*	**3.5**	*2.4*	*11*	**4.3**	*3.7*	*6*	4.2	*3.7*	*32*	**3.9**	*3.3*	***18.4%***
Other (<10 for all)	*22*	**3.8**	*3.3*	*19*	**3.5**	*3*	*12*	**3.3**	*3.8*	*53*	**3.6**	*3.5*	*3.2%*
ROOF CLADDING													
Chip-coated Metal Tiles	*28*	**3.2**	*2.6*	*30*	**3.7**	*3.4*	*24*	**4.0**	*4*	*82*	**3.6**	*3.4*	*7.2%*
Metal Tiles - painted	*6*	3.5		*2*	3.0		*1*	5.0		*9*	3.6		
Galv Steel	*69*	**3.2**	*2.8*	*90*	**3.4**	*2.6*	*60*	**3.4**	*3*	*219*	**3.4**	*2.8*	***19.7%***
Coil Coated Steel	*10*	**3.8**	*3.7*	*20*	**4.0**	*3.9*	*21*	**4.6**	*4.6*	*51*	**4.2**	*4.2*	*-0.1%*
Concrete Tile	*43*	**3.9**	*3*	*29*	**3.7**	*3*	*36*	**4.4**	*3.8*	*108*	**4.0**	*3.3*	***21.5%***
Clay Tiles	*5*	3.8	*3*	*1*	5.0	*3*	*1*	1.0		*7*	3.6	*3*	*19.0%*
Asbestos	*3*	3.3		*2*	3.0	*2*	*0*		*2.5*	*5*	3.2	*2.2*	*45.5%*
Membrane	*0*			*8*	3.9		*0*			*8*	3.9		
Other (<10 for all)	*14*	**3.3**	*3.2*	*6*	3.2	*2.8*	*2*	4.0	*4.5*	*21*	**3.3**	*3*	*9.5%*
WINDOWS													
Timber	*107*	**3.3**	*2.5*	*118*	**3.2**	*2.7*	*92*	**3.2**	*3.3*	*317*	**3.2**	*2.9*	***11.1%***
Anodised aluminium	*42*	**3.7**	*3.4*	*40*	**4.2**	*3.9*	*37*	**4.1**	*4.6*	*119*	**4.0**	*4.1*	*-3.1%*
Powdercoated aluminium	*10*	**4.2**	*4*	*14*	**4.4**	*5*	*19*	**4.5**	*4.9*	*43*	**4.4**	*4.7*	*-6.0%*
Other (<10 for all)	*4*	4.0	*4.3*	*0*		*3*	*1*	4.0	*5*	*5*	4.0	*4*	*0.0%*
Note: Results for samples less than 10 are shaded yellow													

Table 9: Average Condition of Materials

[31] *It should be noted that some material types were found in very few houses, and the results for these small sample numbers should not be taken as indicative of the condition of the material over the whole population. The numbers in the sample are given alongside the averages in order to allow the results to be considered accordingly.*

The following charts in *Figure 22* show the analysis of wall and roof cladding materials, and windows.

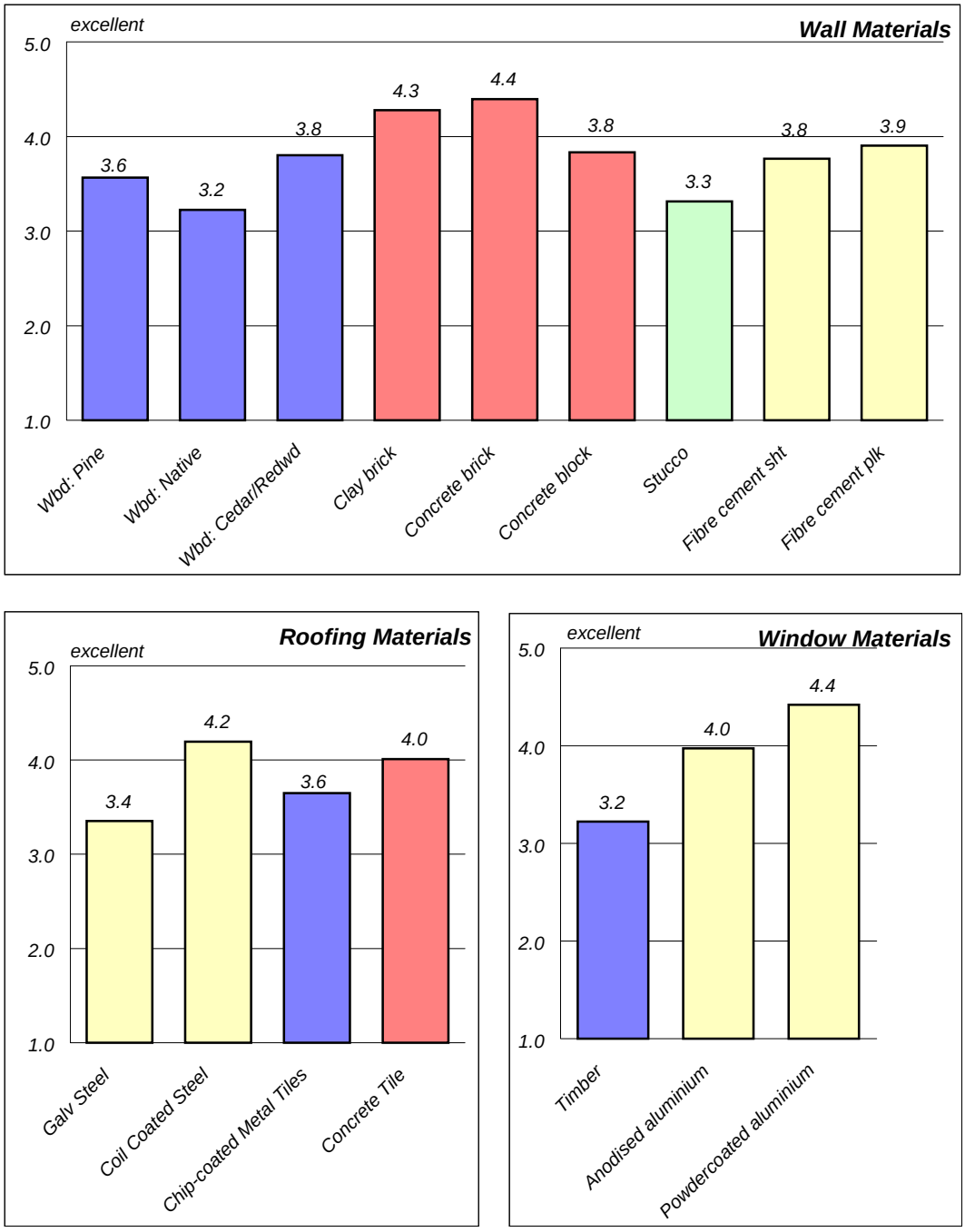

Figure 22: Condition of Common Exterior Materials

As shown, the worst average condition was found in native weatherboards, galvanised roofing and timber windows.

7.2.1 Wall Cladding

The worst average condition occurred in native weatherboards (3.2), stucco (3.3) and radiata pine weatherboards (3.6). This remains in line with the findings of the 1994 survey. The most frequent defects found in the common wall cladding materials shown in *Figure 22* are as follows:

Weatherboards
- *Checking in timber*
- *Decay in timber*
- *Common borer infestation*
- *Nail rust staining*
- *Paint deterioration*
- *Fungal growth*

Fibre-cement Sheet
- *Nail rust staining*
- *Minor cracks*
- *Paint deterioration*
- *Fungal growth*

Clay Brick
- *Efflorescence*
- *Minor cracks*
- *Full depth holes or cracks*
- *Fungal growth*

Concrete Brick
- *Minor cracks*
- *Joint cracking*
- *Fungal growth*

Stucco
- *Minor cracks*
- *Full depth holes or cracks*
- *Joint cracking*
- *Fungal growth*

7.2.2 Roof Cladding

The worst average condition occurred in asbestos cement[32] (3.2), galvanised profiled steel (3.4), chip coated metal tiles(3.6), and clay tiles(3.6). The most frequent defects found in the common roof cladding materials shown in *Figure 22* are as follows:

Galvanised Profiled Steel
- *Base metal corrosion*
- *Holes and dents*
- *Deterioration of fixings*
- *Missing or loose fixings*
- *Paint deterioration*

Coil-coated Steel
- *Top coat deterioration*
- *Base metal corrosion*

Chip-coated Metal Tiles
- *Partial to complete loss of chip coating*
- *Base metal corrosion*

Concrete Tile: Unpainted
- *Cracked tiles*
- *Fungal /moss growth*
- *Dislodged pointing*

7.2.3 Windows

The worst average condition occurred in timber windows (3.2). The most frequent defects found in the common window materials shown in *Figure 22* are as follows:

Timber
- *Decay in timber*
- *Windows sticking*
- *Broken or cracked panes of glass*
- *Checking in timber*
- *Putty cracks/dislodged or missing putty*
- *Corrosion in flashings and hinges*
- *Nail rust staining*
- *Cracked or stressed joints*
- *Paint deterioration*

Anodised and Powder Coated Aluminium
- *Loose window seals*
- *Coating failures*

[32] *However fibre-cement is not included as a common roof material in Figure 22: Condition of Common Exterior Materials as there were only 5 houses using it.*

7.3 Traditional Materials

As shown, the traditional materials are generally in the worst condition when averaged over all of those houses using them. This is not surprising, as they have been used in houses over a long time. Given the general trend of worsening condition with time, they would be expected to produce lower average conditions.

It is also not surprising that more "permanent" materials such as clay and concrete brick are out-performing timber weatherboards as wall claddings, and concrete tile is out-performing steel as roof claddings. This is in line with the findings of the 1994 survey.

8 COSTS

A convenient measure of the condition of a house is the estimated cost of putting it into good order. The cost of outstanding maintenance has been calculated based on the information collected in the surveys. As shown in the survey form, the inspectors were asked to identify defects in the rated components, and to estimate their frequency. Based on this, they then assessed the overall condition of the component. The costs have been derived using unit repair costs for the different condition ratings and different materials. This allows an assessment of each individual house as a whole (aggregated over all separate components), which can then be averaged over the survey sample to give the results presented in this report.

In order to maintain comparability with the calculated costs resulting from the 1994 survey, the same base unit rates have been updated to 1999 dollars using the movement in the cost of house construction (4). The original unit costs were estimated by BRANZ technical advisers and scientists, and are shown in Appendix 6. This information was applied to each house in the survey, and the relevant floor area, to calculate the cost of outstanding maintenance and repairs. It should be noted that all 1994 survey results have also been updated to 1999 equivalents.

8.1 Outstanding Maintenance & Repair Costs

As pointed out previously, the average component condition rating weights all components equally, whereas defects in some components cost a great deal more to remedy than others. An example of this is the cost of remedying inadequate subfloor ventilation for a house with a continuous concrete perimeter foundation wall (estimated at between $840 and $2,400 for a standard house), compared to the cost of remedying a hot water cylinder (at between $60 and $960). These differences in costs therefore weight the appropriate components according to their cost of repair, and the average cost per house is affected accordingly.

As in 1994, a high proportion of the cost occurs in modifying the subfloor vents to conform to current Building Code standards.

Again, the survey was unable to find a definite relationship between the size of vent areas and the incidence of defects in the floor, fasteners or linings.

However, as discussed in the 1994 report, the potential damage to other parts of the house that can result from lack of subfloor ventilation is severe.

Whether this will actually eventuate will depend on other site circumstances such as shelter, land contours, wind conditions and alternative air leakage paths; all of which can affect the impact.

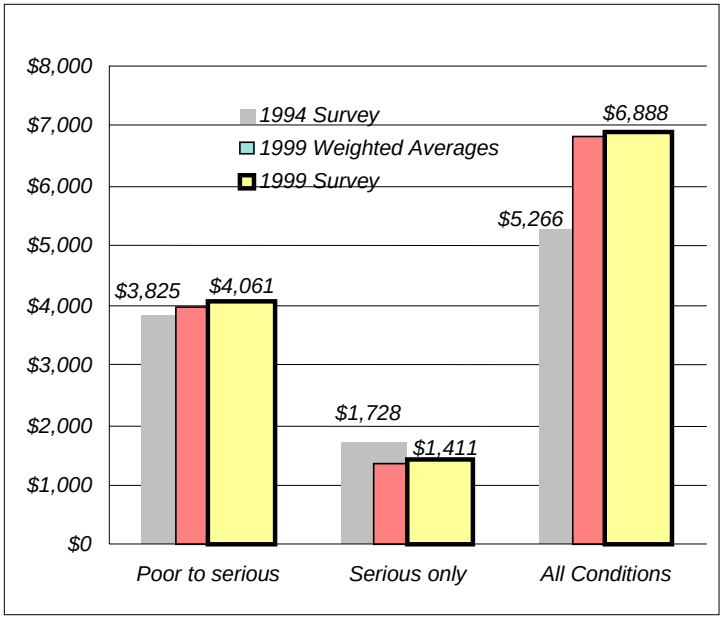

Figure 23: Outstanding Maintenance Costs per House

Figure 23 shows the overall outstanding maintenance costs, and compares these with the updated 1994 figures. It also gives the costs for *"serious"* conditions only, and for *"poor" to ""serious""* range conditions only[33].

8.1.1 All Conditions

As shown, the average house requires approximately $6,900 *(1994: $5,300)* to bring it to "as new" condition. What must be noted is that this average cost includes maintenance to all of those components that are rated as being in an *"average"* condition and, although the unit rates of repair are lowest for this rating, the number of components involved is very high and therefore the overall average cost is also high.

The most notable difference shown by ***Figure 23*** is between average costs of repair of components in all conditions. This initially appears to contradict the results of the average component conditions (which improved slightly since the 1994 survey). However, the increase is logical when particular component costs are further investigated, and it becomes obvious that the 1999 survey included more expensive exterior components that were rated in *"average"* condition (so included in the *all conditions* category). Section 8.3 gives the breakdown into costs by components and *Figure 28: Comparison of Exterior Component Costs* shows the relevant increases since the last survey.

8.1.2 More Urgent Conditions

A more realistic aim for repairing an existing house is to attend to the more urgent repairs of those components that fall into the *"poor"* to *"serious"* range. These are therefore considered separately, which gives an indication of the costs of remedying those more urgent needs. The average cost of attending to both these categories amounts to approximately $4,000 per house on average *(1994: $3,800).* There has been little change in the cost of repair of these conditions since the last survey.

8.1.3 Most Urgent Conditions Only

The minimum repairs necessary to any house are to those defects in serious condition, as this category is defined as needing immediate attention. As in 1994, the number of components rated as *"serious"* is low (even though the costs of repair are higher) - and this is reflected in the average cost of about $1,400 per house *(1994: $1,700)* to remedy only the most urgent items.

8.2 Costs by Regions

Figure 24 gives the breakdown of the costs into the three regions. The results for *"all conditions"* show that Wellington houses have the highest outstanding maintenance costs, with Auckland and Christchurch being much the same. However, all three regions are similar in this category - but that similarity changes when the average and better condition components are removed from the calculation.

It is interesting to note the effect of component weighting by costs. As shown earlier, Christchurch has the best average component condition rating (and this is reflected in the costs of *"all conditions"*), yet indicates that houses in this region also have the highest costs of the more urgent repairs. This appears to be largely due to the high costs of remedying subfloor ventilation inadequacies, when applied to the relatively high number of houses in Christchurch that have continuous concrete perimeter walls with inadequate vents. As expected, and in line with the 1994 results, average costs of outstanding maintenance show a general rise with house age. *Figure 25* shows the average cost of repair by age cohort.

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33 *Weighted average costs have also been provided to allow for the varying numbers within each age group in the sample. These show little variation from the unweighted figures.*

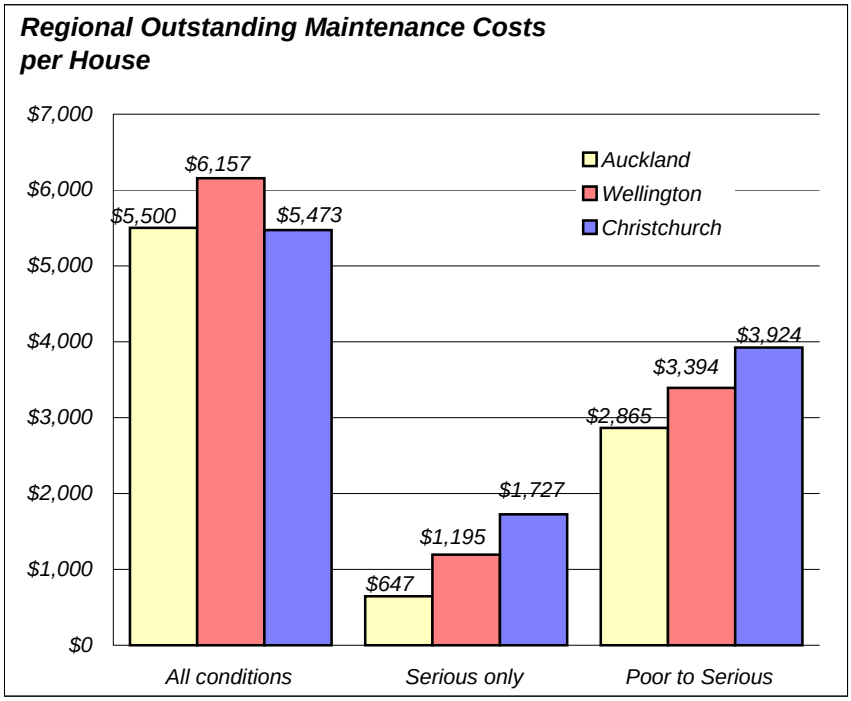

Figure 24: Regional Outstanding Costs per House

The pattern shown generally reflects the pattern of condition for age as shown earlier in Figure 13. As discussed in previously the condition of the average house appears constant beyond an age of around 60 years as a consequence of renovation of the older housing stock.

This conclusion is borne out by the pattern of maintenance costs, which appear to rise fairly steadily with age until the 1930's when there is a general flattening out, with the difference in costs between age groups becoming less.

In 1994, costs appeared to peak at around the 1920's era; whereas in 1999 the peak is around the pre-1920's era. This time the peak reflects the lowest point of average condition for the sample, which would be expected. The costs related to more urgent maintenance are also in line with the pattern for all conditions (except for 1920's houses having slightly higher costs of repairing serious conditions).

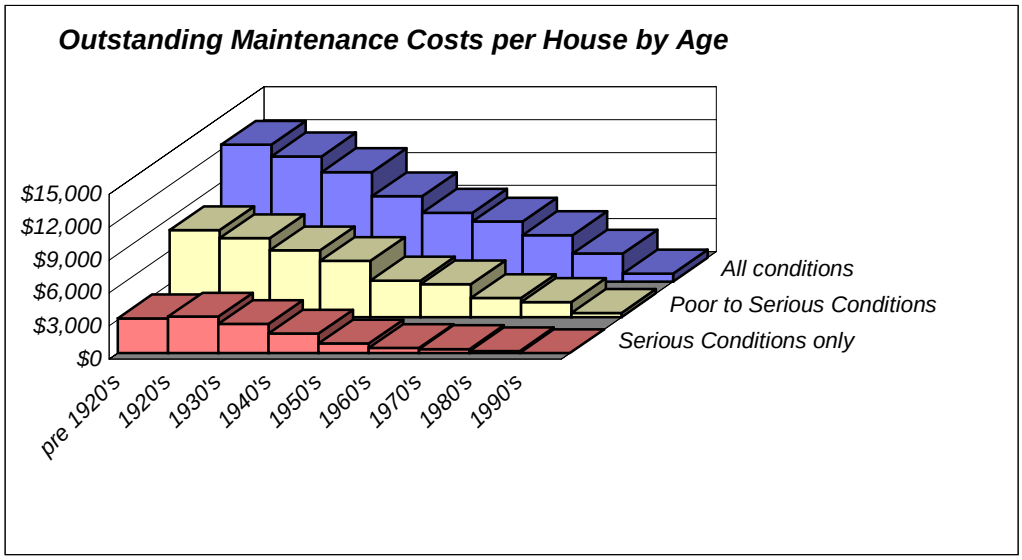

Figure 25: Outstanding Maintenance Costs per House by Age

8.3 Costs by Components

Figure 26 and Figure 27 the breakdown of average costs into the individual components of the house.

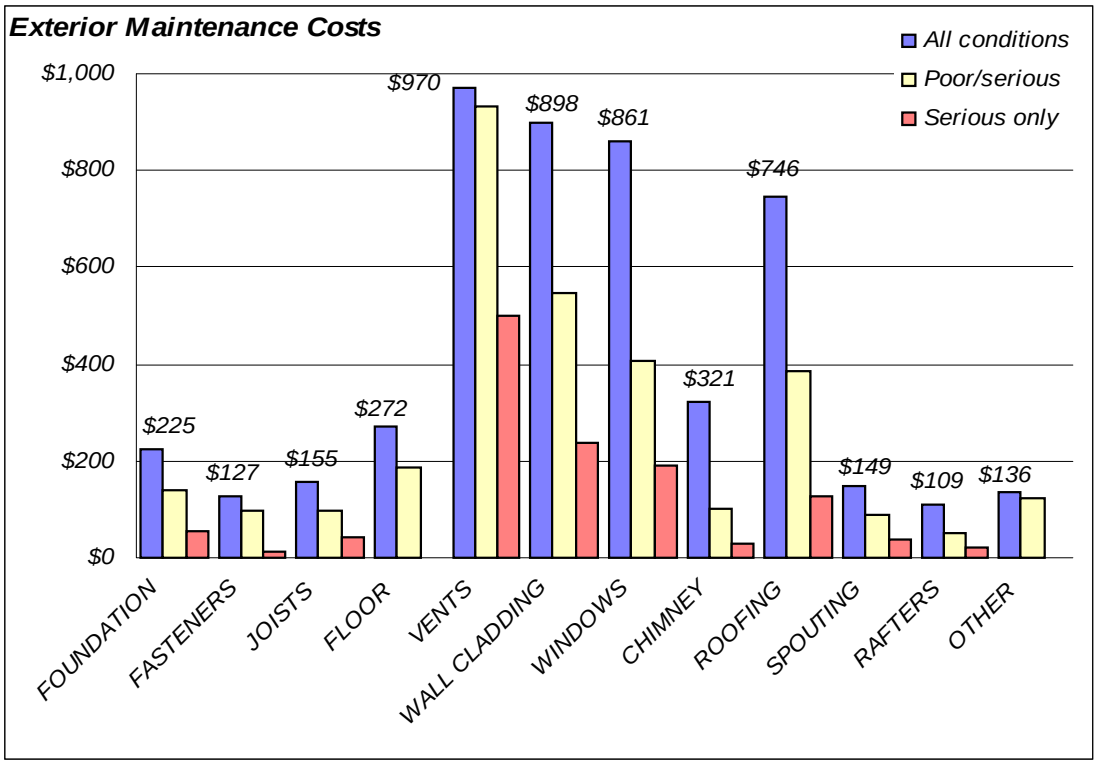

Figure 26: Exterior Maintenance Costs

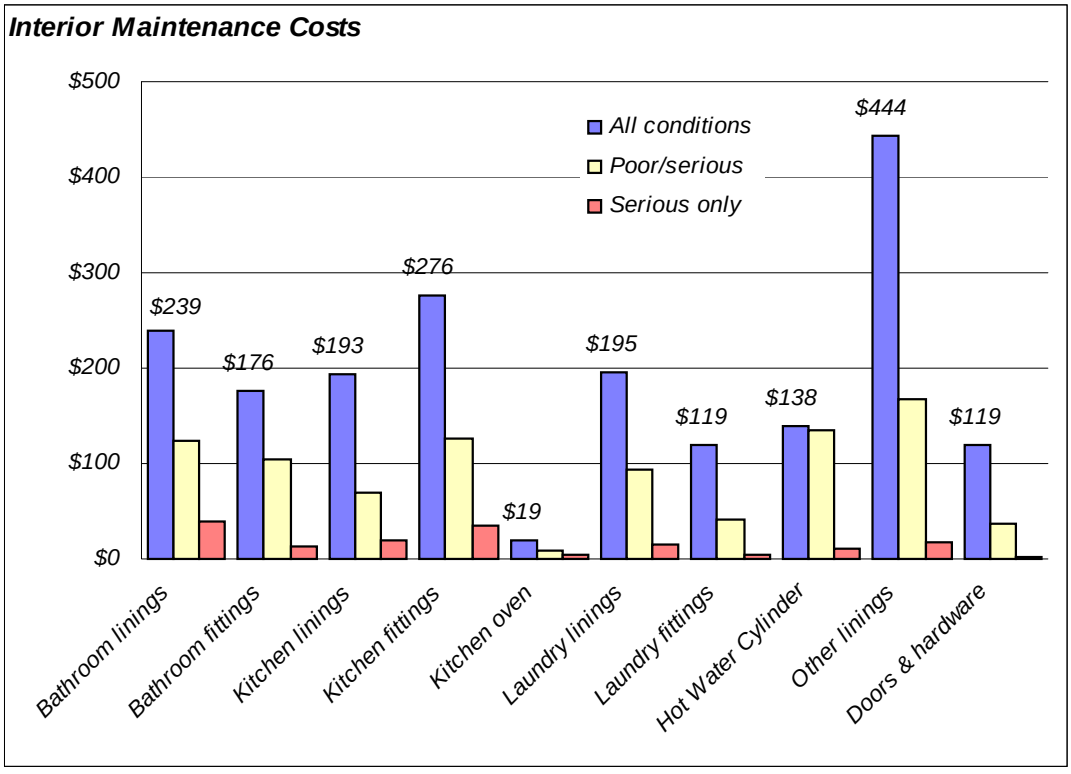

Figure 27: Interior Maintenance Costs

8.3.1 Exterior Components

Figure 28 indicates the change in outstanding repair costs of exterior components since the last survey:

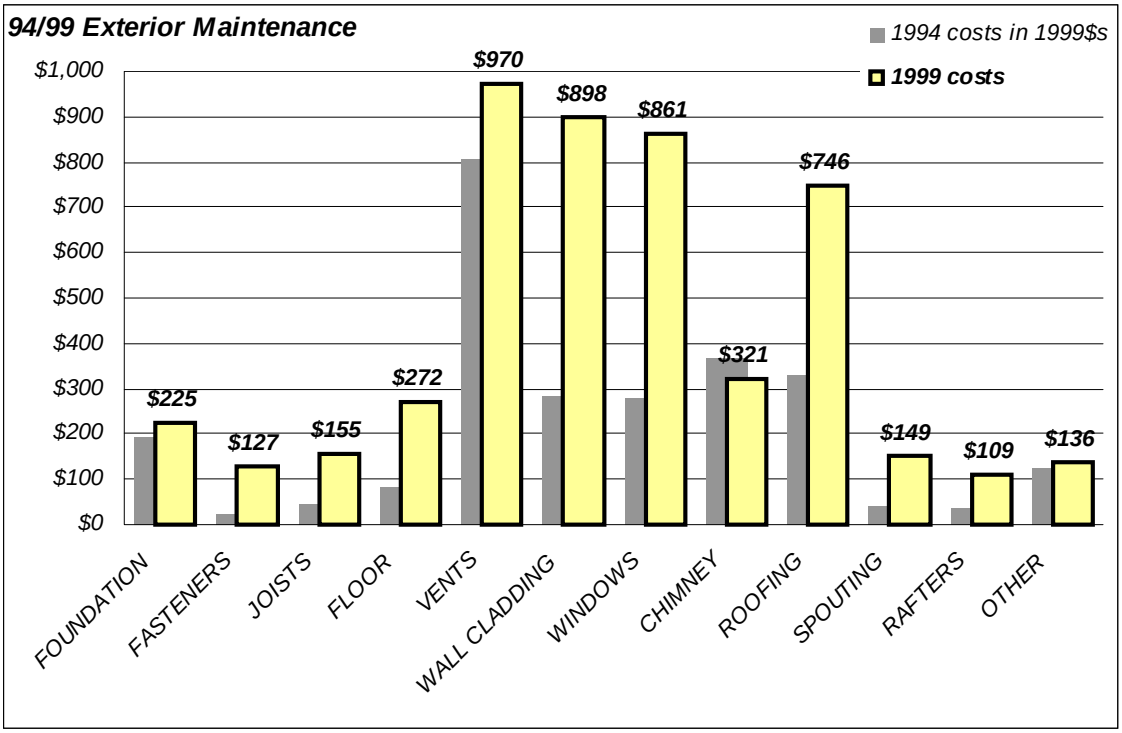

Figure 28: Comparison of Exterior Component Costs

As in 1994, the highest cost item is the subfloor vents. Roofing, wall cladding and window costs are also high cost items as in 1994. The most notable change is the increase in costs for these items. In 1994, roof, wall and window costs were well under $400 for all conditions, whereas in 1999, this appears to have more than doubled, as indicated in *Figure 28*.

In contrast to the cost increases shown, the average conditions of these components have actually improved since 1994 as shown earlier in *Table 9: Average Condition of Materials*, so this cannot explain the cost changes. The percentage having serious or *"poor"* condition has also improved as shown earlier in *Figure 11: Exterior Components*, so some other influence must drive this change. That driver is a combination of two influences. The first, but least influential, is the increases in the proportions of houses with cladding and windows made of materials with more expensive repair rates. There are slightly more houses in this survey with timber windows (2%), timber wall claddings (6%) and galvanised steel roofs (2%). The second, and most influential, is the increase in the numbers of the latter type of materials that are rated as *"moderate"* relative to those rated as *"good"* or *"excellent"* (and therefore with no associated repair costs).

The change in the relative **spread** of conditions between 1994 and 1999 can therefore explain the increase in costs of repair of these particular components. The costs of repair for these components in *"moderate"* condition is high ($1,200 for windows, $1,400 for wall cladding, and $1,200 for roofing), so the repair costs of all conditions can increase while, at the same time, the average component conditions can improve; for instance, in 1994, the higher percentages of *"poor"* or serious ratings of claddings and windows counteracted the higher percentages of good and excellent ratings of these components to produce average ratings which are slightly lower than those in 1999. In 1999, over 50% of the total repair costs of windows is due to *"moderate"* condition windows (in 1994, this was only 30%), for wall cladding the proportion is 40% (25% in 1994), and for roofing it is almost 50% (30% in 1994).

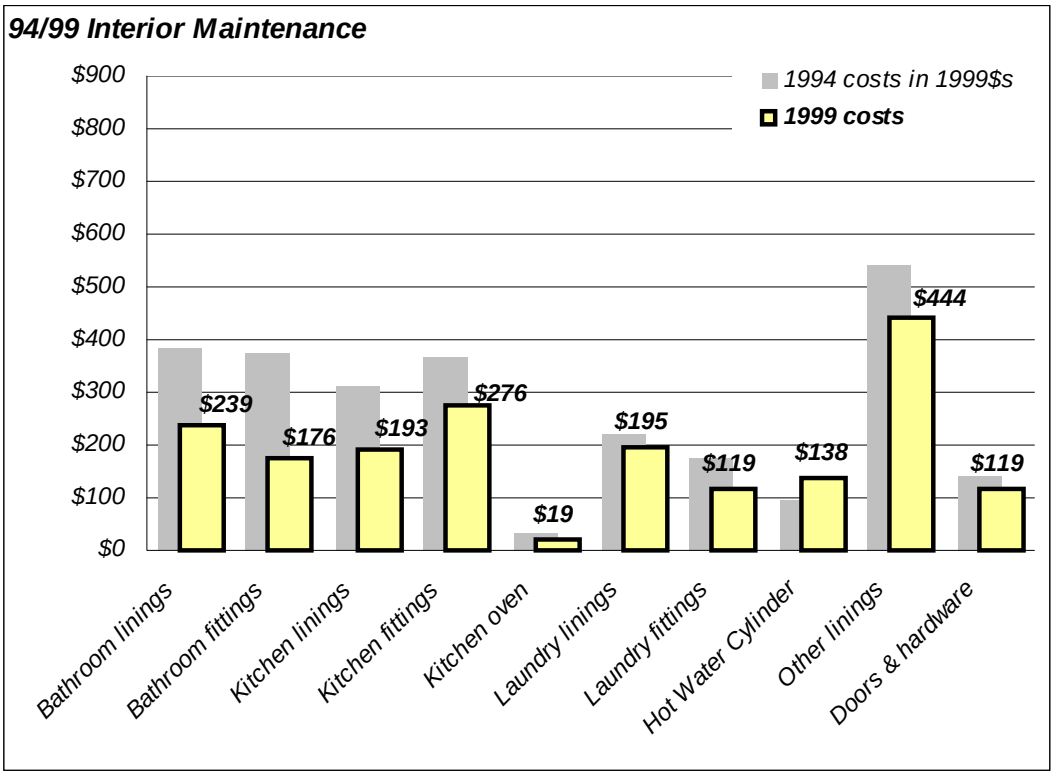

Figure 29: Comparison of Interior Component Costs

8.3.2 Interior Components

Figure 29 indicates the change in outstanding repair costs of interior components since the last survey.

As in 1994, the interior component with the highest average maintenance cost is the interior linings of living areas and bedrooms at around $440 *($540 in 1994).* This time the change is more in line with improved condition (from 3.6 in 1994 to 3.7 in 1999). However, the major difference is the decrease in the percentage having serious or *"poor"* condition (from 17% in 1994 to 9% in 1999), which is sufficient to explain the change.

More marked differences occur in kitchens and bathrooms. In 1994, bathroom and kitchen linings and fittings were components requiring notable expenditure (around $360). These have decreased in 1999 by more than $100. In particular, bathroom fittings have decreased by around $200. These changes are in line with improvements in the conditions and the decrease in the percentage having serious or *"poor"* condition, as shown in *Table 10* below:

	Linings		***Fittings***	
	1999	*1994*	*1999*	*1994*
KITCHENS				
Average Condition	3.9	3.7	3.9	3.7
% Serious or Poor	*7%*	*24%*	*9%*	*22%*
Average repair costs	**$193**	**$312**	**$276**	**$369**
BATHROOMS				
Average Condition	3.8	3.5	4.0	3.5
% Serious or Poor	*11%*	*27%*	*9%*	*28%*
Average repair costs	**$239**	**$385**	**$176**	**$375**

Table 10: Kitchen & Bathroom Costs

8.4 Costs of Delays in Maintenance

In the 1994 study the costs of delaying maintenance was investigated by estimating the cost effects of delays in remedying component defects for each condition rating. Delays of five years and ten years were considered, with the probable worsening of condition that would be involved after those time periods. These costs averaged out at around $2,500 for a five-year delay, and $7,100 for a ten-year delay.

This report does not investigate the effects of delay. It is considered that the results on average conditions and average outstanding costs are insufficiently different from the 1994 survey to warrant the additional analysis. Instead the additional costs are assumed to be of similar scale to those estimated in 1994, and the same percentage increases have been applied to the 1999 costs to provide indicative measures. The results[34] are shown in *Table 11*.

	1994					***1999 costs** (estimated)*		
COMPONENTS	*1994 cost*	*5yr delay*[35]	*%inc.*	*10yr delay*[36]	*%inc.*	*1999 cost*	*5yr delay*	*10yr delay*
Foundations	194	194	*100%*	671	*347%*	225	**225**	**779**
Floor Framing	46	67	*147%*	67	*147%*	155	**228**	**228**
Floor	81	0	*0%*	77	*96%*	273	**0**	**261**
Wall Claddings	282	345	*122%*	877	*311%*	898	**1096**	**2789**
Windows	278	365	*132%*	944	*340%*	862	**1135**	**2929**
Roofing	332	231	*70%*	454	*137%*	746	**519**	**1023**
Spouting	42	37	*89%*	120	*286%*	149	**132**	**426**
Bathroom Fittings	375	284	*76%*	706	*188%*	175	**132**	**331**
Bathroom Linings	385	560	*146%*	560	*146%*	239	**349**	**349**
Kitchen Fittings	369	216	*59%*	1109	*301%*	276	**162**	**831**
Kitchen Linings	313	0	*0%*	150	*48%*	194	**0**	**93**
Laundry Fittings	175	119	*68%*	619	*353%*	119	**81**	**419**
Laundry Linings	219	0	*0%*	175	*80%*	195	**0**	**156**
Doors etc	143	121	*85%*	567	*397%*	119	**101**	**472**
TOTALS		$2,539		$7,095			**$4,160**	**$11,086**

Table 11: Additional Costs of Delay

As shown, the additional costs of repair, when based on the same percentage rise as the 1994 figures, are in the order of $4,000 for a five-year delay and $11,000 for a ten-year delay. The increased levels over the 1994 figures are related to the higher average costs for the more expensive exterior items (in particular wall cladding and windows). The issue of deferred maintenance has not been investigated further in this report. However, it is an area where further work should be considered. This is discussed in *Section 16.6*.

[34] *With 1994 costs updated to 1999 dollars based on house construction price rises (4).*

[35] *Additional cost of repair (over original cost) with a five-year delay in the work.*

[36] *Additional cost of repair (over original cost) with a ten-year delay in the work. (In some cases there is no additional cost over that estimated for a five-year delay).*

9 ADDITIONAL RATED COMPONENTS

As mentioned earlier, some additional components were assessed during this survey. These are described separately, in order to maintain comparability with the results of the 1994 survey. All comparisons with the1994 survey results exclude these additional components. The average component conditions are shown in *Table 12*, together with the adjusted overall house component condition (which includes the additional components).

New Components	*Average Component Condition*
Steps, Ramps & Decks	3.7
Carports	3.5
Second bathrooms	
Fittings	4.2
Linings	4.1
Initial Overall Average Component Condition	*3.59 rounded to 3.6*
Adjusted Overall Average Component Condition	**3.61 rounded to 3.6**

Table 12: Additional Components

9.1 Carports

As shown later in *Figure 38: Defects in Other Components*, the major defects found in carports were inadequate bracing (in around 20% of those surveyed), and inadequate fixings at perimeters and/or to the house (around 10%).

9.2 Decks, Ramps & Decks

As shown later in *Figure 38: Defects in Other Components*, the major defects were uneven risers to steps (almost 20% of those inspected), and unsafe surfaces (more than 10%). The latter was usually a result of unevenness or slipperiness.

9.3 Influence on Overall Average Condition

As shown in *Table 12*, the additional components[37] make little difference to the overall average component condition for the survey, and their average conditions are in line with other similar components.

Because of this, and because limited numbers of houses have the components, these additional ratings should make little difference to the average costs of repairs. The components also have limited relevance in that they cannot be compared to 1994 equivalents. Costs have therefore not been calculated. However, these extra components should be included in future surveys and costed at that time in order to supply comparisons.

[37] *The second bathrooms showed similar types of defects and conditions to those of the main bathrooms.*

10 OTHER PROBLEM AREAS

During the survey, it became apparent that BRANZ inspectors were noting some recurring problems and defects. This section considers those zones of a house which have not been fully explored in earlier sections, and which have relatively high levels of common defects.

10.1 Subfloor Area

Inspectors identified many recurring problems related to subfloor spaces. The majority of these were moisture-related, so these have been considered separately in order to present an overall picture of contributing factors and resulting problems that have been identified.

Another common problem related to the lack of appropriate fasteners between concrete piles and floor framing, so these have also been considered separately.

10.1.1 Subfloor Dampness

As discussed earlier, subfloor ventilation was identified as a particular problem area.

As shown in *Figure 30*, only a quarter of timber-floor houses were assessed as adequate, while many had only a small fraction of the amount of ventilation currently required in new houses.

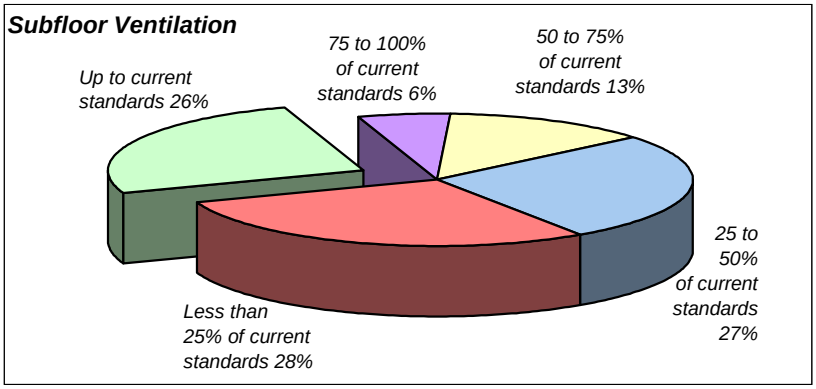

Figure 30: Subfloor Ventilation

As a similar situation had been identified in the 1994 survey, inspectors were asked to record subfloor timber moisture levels and to identify the timber species used, and the results are shown in *Figure 31*.

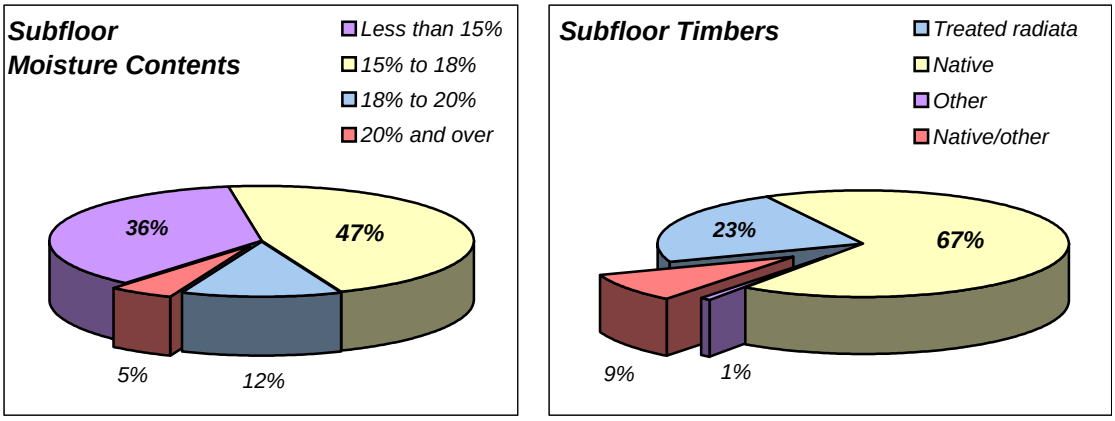

Figure 31: Subfloor Species & Moisture Contents

As shown, a large proportion of houses have high moisture contents - with 5% over the threshold where decay is likely to start. The threshold for borer attack has in the past been considered to be around 18%, but timber scientists are now finding that this may (in some cases) be as low as 12%. As only 1% of the sample had moisture levels below 12%, those with levels between 15% and 18% have been isolated in the pie chart in order to present a more detailed picture. The danger of borer infestation is of particular concern because of the high percentage of native timber use. As shown, around three-quarters of houses have subfloor framing of native timbers.

10.1.2 Subfloor Fasteners

As the surveys were being completed, it was noted that a notable number of houses had no specialised fasteners between concrete piles and framing timbers. It was also noticed that some of these were more recent post-war houses, rather than being restricted to older houses. This has therefore been considered in more detail in order to establish whether a pattern exists. *Figure 32* gives the breakdown of fasteners in timber floor houses, followed by a regional breakdown.

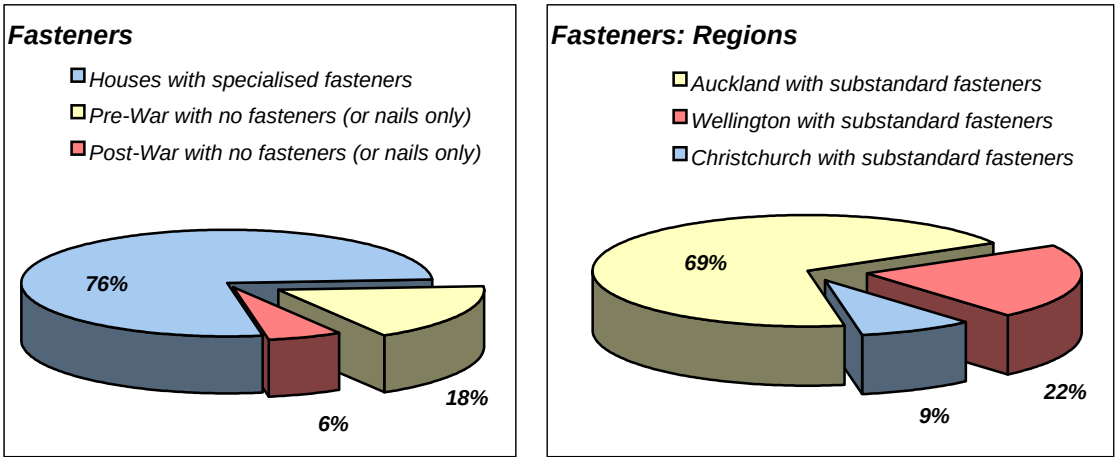

Figure 32: Fasteners

As can be seen, almost a quarter had no fasteners; a quarter of which were in **post-war** houses. The regional breakdown shows that the majority (almost 70%) of the houses with substandard fasteners were in Auckland. Because of this unexpected proportion, Auckland houses have been further broken down into age groups, and the result is given in *Figure 33*.

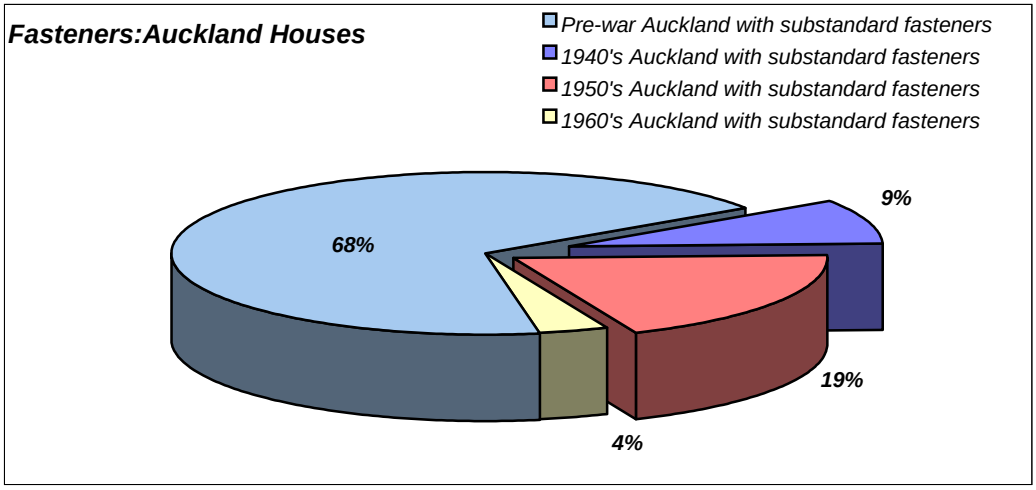

Figure 33: Auckland Fasteners

More than 30% of the Auckland houses with substandard fasteners were built since the Second World War. Almost 20% were built in the 1950's and 4% as late as the 1960's. This would seem unusual, particularly when contrasted to the other two regions, and may warrant further investigation.

10.2 Subfloor Defects

The following charts present the most common defects found in the subfloor area, divided into moisture-related and structural defects. In the chart on moisture, the unshaded areas show the house characteristics or problems, while the shaded areas show what may be associated defects.

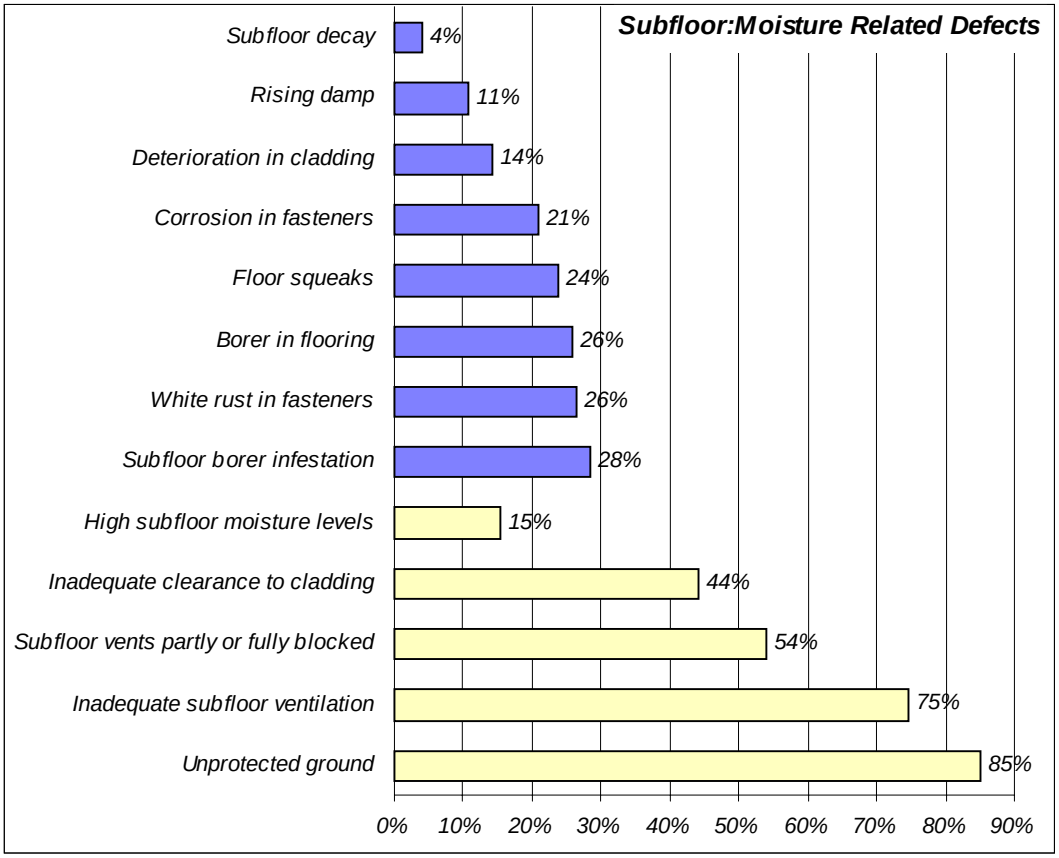

Figure 34: Moisture Related Problems

As may be seen, the presence of moisture-encouraging conditions such as inadequate subfloor ventilation is much more prevalent than the actual defects usually associated with moisture. The level of such defects is nevertheless important (particularly corrosion and borer), and the defects are of the type that will increase in the future if conditions permit.

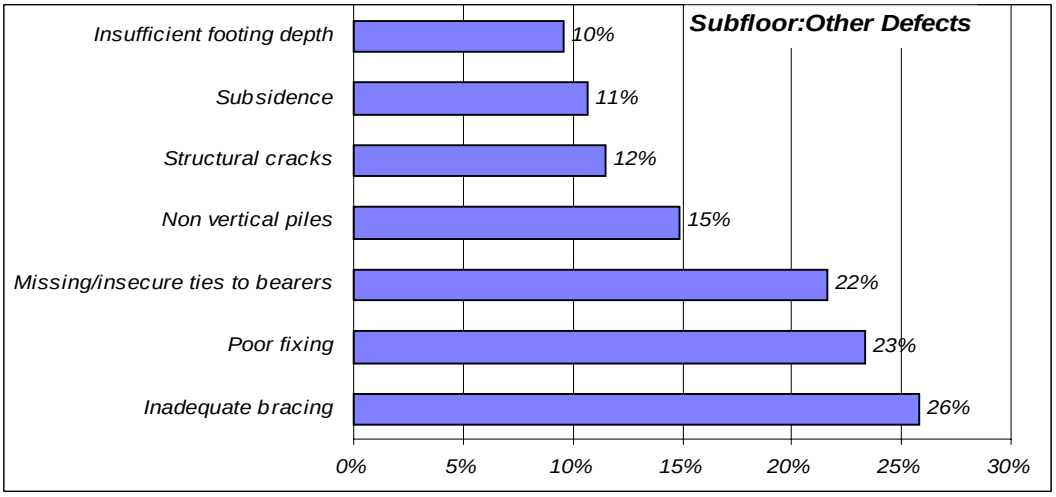

Figure 35: Other Subfloor Defects

The most common structural defects found in the survey were associated with fixings (as discussed earlier) and lack of adequate bracing.

10.3 Spouting & Downpipes Defects

The most common defects identified by the inspectors were uneven falls in guttering and those defects associated with galvanised steel guttering i.e. corrosion and holes. The frequency of defects is shown in *Figure 36*.

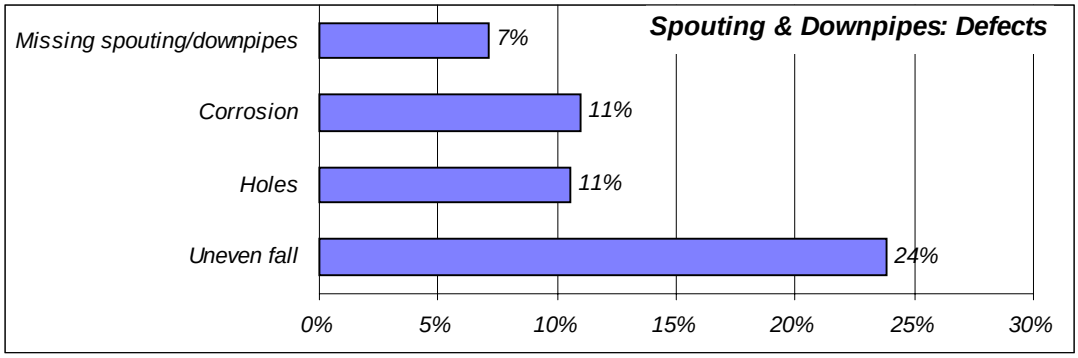

Figure 36: Defects in Spouting & Downpipes

10.4 Roof Space Defects

The most common defects identified by the inspectors were unrestrained header tanks, lack of roofing underlays, minor splitting, and borer infestation[38]. The frequency of defects is shown in *Figure 37*.

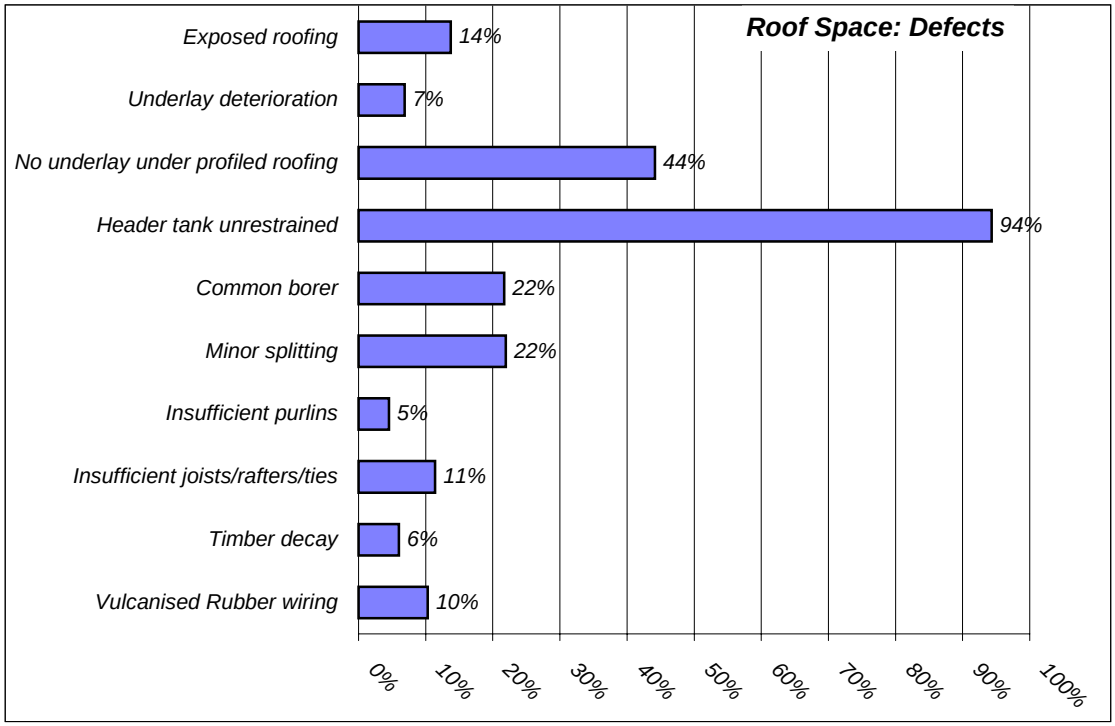

Figure 37: Roof Space Defects

One point worth noting from *Figure 37* is that there are still around 10% of houses using old rubber insulated wiring.

[38] *It should be noted that no problems of high moisture contents in roof space timbers were noted from the readings taken.*

10.5 Defects in Carports, Chimneys & Decks etc

Figure 38 covers the common defects identified in these other components. The light shaded areas relate to carports, while the darker relates to chimneys.

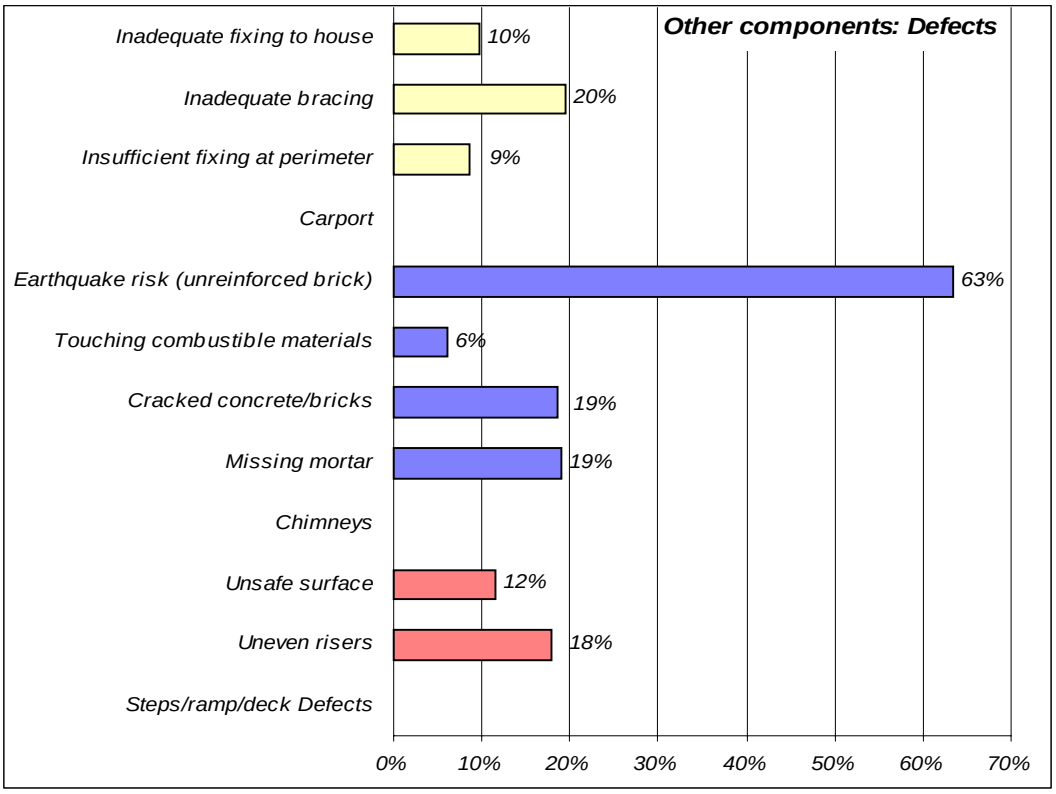

Figure 38: Defects in Other Components

The main point worth noting is that the highest level of defects in chimneys are generally associated with un-reinforced brick chimneys in older houses. While these chimneys were in line with building practices of the time (and are often still in good condition), they do not meet current earthquake standards and are likely to be unsafe in a major earthquake. Many of the oldest also use lime-based mortar that has a tendency to crumble with age. This relates to the high percentage of cases (almost 20%) where chimneys were missing mortar, so creating potential fire hazards. The incidence of cracked concrete or bricks[39] is also high (almost 20%), and this can also be a potential fire hazard.

[39] *These tend to relate mostly to more recent brick chimneys that use cement-based mortars.*

11 INSULATION

During the survey inspectors gathered sufficient detail on ceiling insulation to enable rating of this element on the same basis as the 1994 survey for comparison purposes. However, additional analysis has been carried out in order to present a better indication of the state of insulation in New Zealand houses.

As well as ceiling insulation, the presence of wall insulation was also noted[40], although it was impossible to provide reliable details. The presence of double glazing was also noted[41]. This allowed some further general analysis to be done, although the degree of accuracy of the information on wall insulation must be considered as less than that of the ceiling insulation when considering the results.

11.1 Overall Results

The first analysis considers the presence of any insulation material and its coverage without regard to thickness. ***Figure 39*** gives the overall results for ceiling wall and floor insulation in all the houses in the sample and is broken into groups as follows:

- ***100%*** *coverage*
- ***75% and more*** *coverage*
- ***50% to 75%*** *coverage*
- ***25% to 50%*** *coverage*
- ***Less than 25%*** *coverage*
- ***0%*** *(uninsulated)*
- ***Unknown*** *(no access for inspection)*

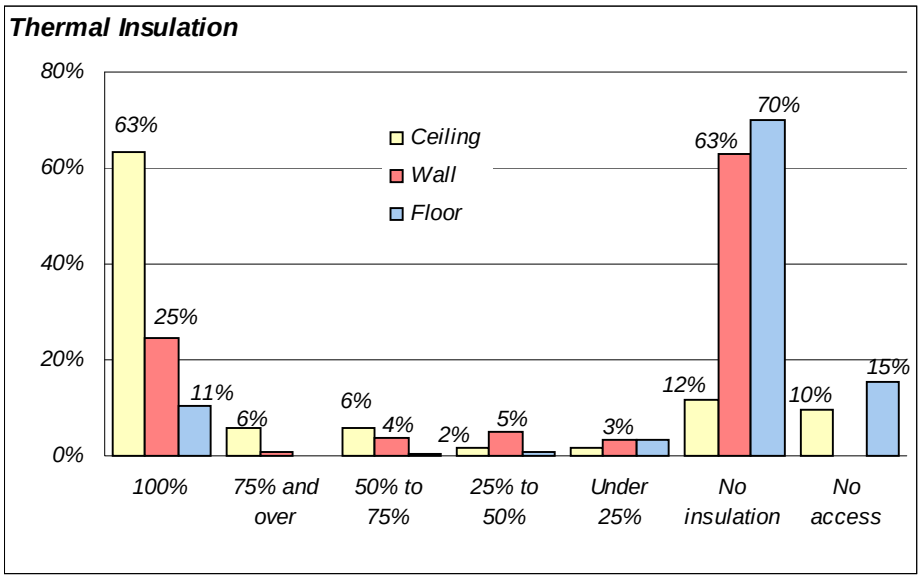

Figure 39: Wall, Ceiling & Floor Insulation

As shown, the ceiling space is the most common zone to be insulated. This is the simplest and least expensive space to retrofit insulation, while giving the highest returns in heat loss savings. Very few houses were without any ceiling insulation, and more than 60% were fully insulated. However wall insulation is difficult and expensive to install in existing walls, and this is reflected in the low figures. Only 25% of houses have all walls insulated (with many of these being foil only), and only 12% had some walls insulated[42].

Floor insulation was even less common with 70% of floors being completely uninsulated. While floors are not the largest contributor to heat losses, the current fashion of polished floors in lieu of carpet makes the lack of floor insulation more important. Only the more recent houses tended to have draped foil, and most of these (being of the era which used particleboard flooring) had carpet and underlay as well.

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[40] *Together with estimated percentages.*

[41] *Together with relevant orientations of the particular windows if only some were double-glazed.*

[42] *Usually those walls relating to recent additions.*

11.2 Insulation for Age

The next analysis was to simplify the above groups for ceiling insulation, and to break the result down into age cohorts by decade built. *Figure 40* shows the pattern of coverage according to the ages of the houses.

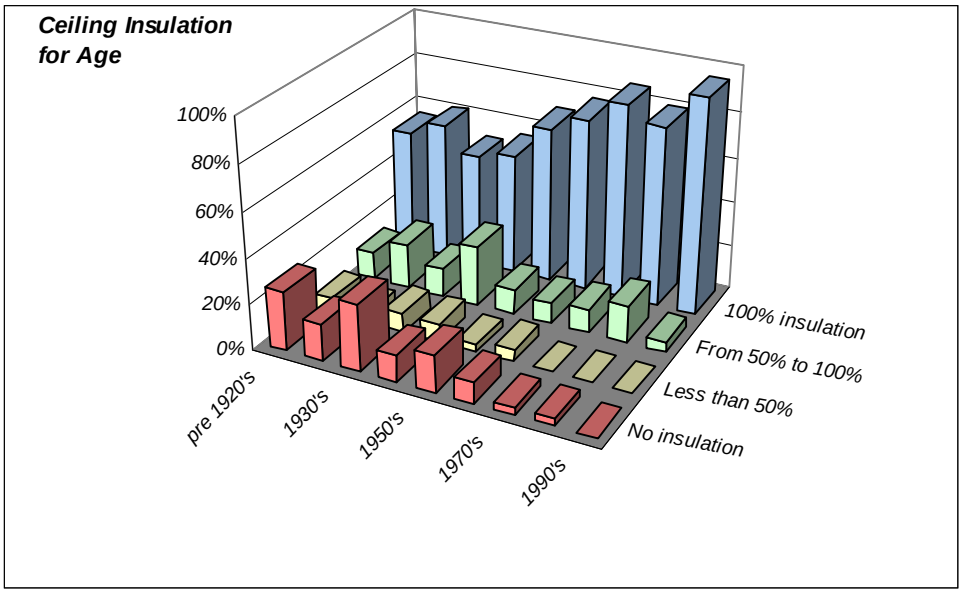

Figure 40: Insulation by Decade

As can be seen, the lowest level of ceiling insulation is found in houses built in the 1930's, although this is still above 40%. Older houses were well over 50%, while newer houses climbed reasonably steadily from more than 60% for the 1950's cohort. The newest decades show less than 100% due to those houses for which access to inspect was not available[43].

11.3 Insulation and Standards

Age cohorts have been grouped according to introduction dates of relevant standards, in order to explore the relationship of insulation and legal requirements. The information supplied by Quotable Value NZ included ages of houses by the decade in which they were built, so there is some overlap when grouping according to dates of standards.

11.3.1 History

The first effective standards to be enforced in New Zealand were in the Christchurch region in the early 1970's[44]. The two standards were different, although applying in different parts of the same city. While other local bodies considered enacting their own by-laws, other areas refrained from doing so as work was proceeding on a national standard. In 1977 the NZ Standards Association introduced a national standard on house insulation (NZS 4218P: 1977), which became effective in 1978, and remained the relevant standard for almost 20 years. Although a new standard was published by Standards NZ in 1996 (7), the 1977 one (5) currently remains as an Acceptable Solution to Clause H1 of the Building Code (6), so is taken as being the minimum requirements for the newer houses in this survey.

11.3.2 Age Grouping

Pre-1970's houses from all regions can be aggregated, as no mandatory standards applied before that time. Consequently, some conclusions can be reached as to the extent of insulation retrofitted into older houses on a voluntary basis.

Christchurch houses built in the 1970's have been split into a sub-group because of the different requirements of that decade and analysed separately. This sub-group can be compared to 1970's houses built in the Auckland and Wellington regions[45]. The comparison has been done on ceiling insulation only (because of the more

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[43] *These were around 17% of post 1970's houses.*

[44] *Waimairi in 1971, then Christchurch City Council in 1972.*

[45] *Where no requirements for insulation existed at the time.*

accurate information collected) that allows us to assess the influence of mandatory requirements during that time. 1980's and newer houses from all regions can again be grouped and analysed against the requirements of NZS 4218P. From this we are able to see what compliance rates appear to be, and also to gain an idea of the degree to which minimum requirements are exceeded.

11.3.3 Pre-Mandatory Standards

Figure 41 shows the extent of ceiling insulation in houses built prior to the 1970's. This has been broken into the three regions in order to assess any influences of differing climatic conditions. As shown earlier, more than 50% of the houses built prior to enforceable standards have ceiling insulation installed.

However, as shown, the split into the regions does not show the expected result of increasing use with increasing severity of winter temperatures. The highest use is in Wellington that is in the more moderate climatic zone[46]. More than 70% of older Wellington houses were fully insulated in the ceiling, compared to only around 60% in Christchurch houses. As expected, Auckland was the lowest with just over 50% having fully insulated ceilings.

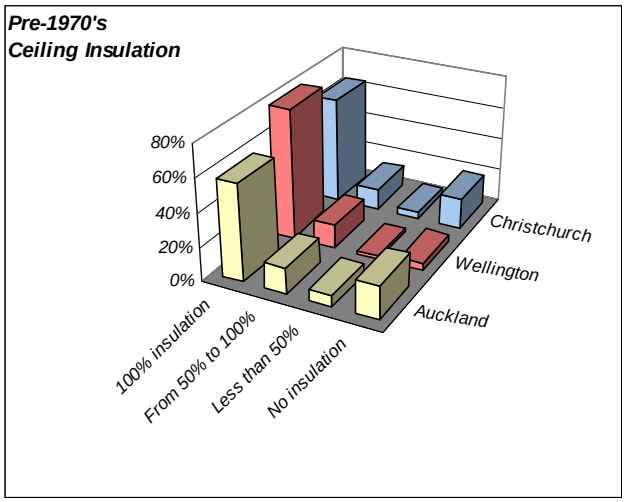

Figure 41: Insulation in Pre-1970's Houses

11.3.4 The 1970's

Figure 42 shows the extent of insulation during the 1970's, for the Christchurch region and the other regions that were still pre-standards.

Interestingly, although the percentage of fully insulated Christchurch houses rose by around 10% compared to previous decades, the use of ceiling insulation was still below that of the other regions[47].

However, the seventies also included the period of the first major oil crisis, and homeowners were offered government incentives to install ceiling insulation. This may well explain the high incidence of voluntary use in the warmer regions. The decade also included several years when a national Standard for insulation was enforced, and this can also be expected to affect the results.

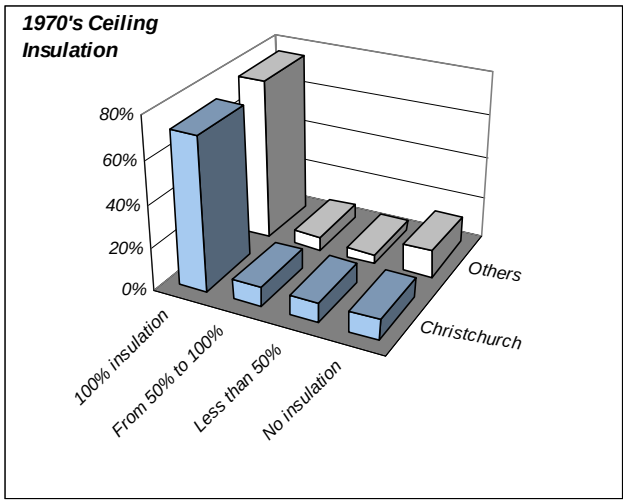

Figure 42: Insulation in 1970's Houses

11.3.5 Post - Mandatory Standards (National)

From 1978, NZS 4218P: 1977 was enforced throughout the country, so the ceiling insulation in those light timber frame houses[48] built during the 1980's and 1990's can be expected to achieve an R-value of 1.9 or more. The next analysis included more detail on the type and thickness of the ceiling insulation, in order to be able to assess whether the R-values achieved could comply with those required by the Standard[49].

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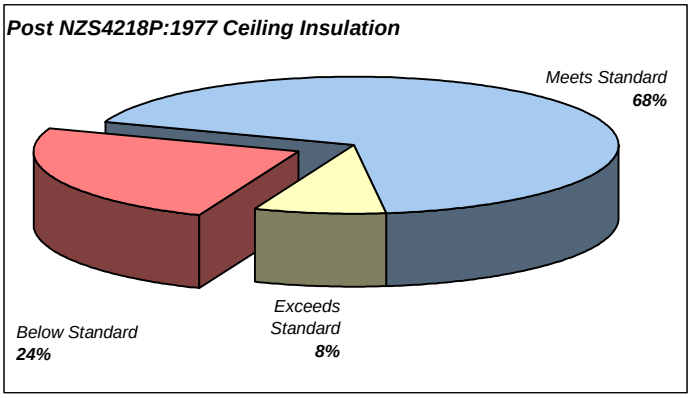
[46] *However, the perception of temperature may be influenced by the wind experienced in the Wellington region.*

[47] *Christchurch houses rose by 9% compared to 11% in the other two regions.*

[48] *Type A construction as defined by NZS 4218P:1977.*

[49] *NZS 4218P:1977 - Table 1:PERMITTED COMBINATIONS FOR TYPE A CONSTRUCTION.*

Figure 43 shows the extent of ceiling insulation in houses built since the 1970's[50] when this national standard was in force. It also shows those houses that appeared[51] to exceed the minimum requirements of the Standard.



An interesting point to note in this analysis is the high incidence of houses that have insulation less than would be expected in order to meet the requirements of NZS4218P.

Almost a quarter are assessed as not complying (usually due to lack of full coverage or required thickness), while only around 8% exceeded the minimum requirements by achieving higher R-values.

Figure 43: Insulation in Post-NZS 4218P Houses

11.3.6 New Houses & NZS 4218:1996

Those houses in the survey built in 1997 and later have been separately identified[52] in order to identify any influence of the voluntary 1996 Standard on the level of ceiling insulation.

Only nine houses in the sample had been built since the publication of the new Standard. Of these, only one house (in Christchurch) had ceiling insulation to the level which would be expected if the requirements of the new Standard had been met, so it would appear that the voluntary Standard is as yet having little impact on newer houses (as 7% of post-1970's houses exceeded the older Standard anyway, as shown earlier).

11.4 Double Glazing

As its use in new houses is increasing, the survey identified those houses with any double-glazed windows and/or joinery with thermal breaks. There were very few (only thirteen in total) which had any double glazing or window joinery with thermal breaks and, of these, ten were in Christchurch. Only two of the thirteen houses had 100% of their windows double-glazed, with the remainder being 50% or less.

This low incidence of energy efficient windows is probably due to the small numbers of newer houses in the survey[53], so future surveys must be relied on to more adequately explore this possible trend.

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[50] *In those houses where inspection was possible - inspectors were unable to gain access to 17%.*

[51] *It is not possible to be certain as to this, as Table 1 permits a combination of R-values, and a higher roof value may be used with a lower wall value. The analysis assumes that walls are R1.5.*

[52] *Using the age of the Hot Water Cylinder as a guide.*

[53] *Only 25 houses in the survey were built during the 1990's.*

11.5 Conclusions

The main features on insulation are:

- *Few houses have no ceiling insulation at all, and more than 60% are fully insulated in terms of coverage.*
- *More than 60% of houses have no wall insulation, and only a quarter have all walls insulated (although this is often merely foil).*
- *70% of houses have uninsulated floors.*
- *The age group for the lowest level of ceiling insulation is the 1930's to 1940's.*
- *More than 70% of pre-1970's houses in Wellington have fully insulated ceilings, in contrast to only 60% in Christchurch and 50% in Auckland.*
- *Almost a quarter of houses built since the introduction of mandatory standards appear to have ceiling insulation which does not comply with the Standard.*
- *As yet, very few houses have thermally efficient windows.*
- *Hot Water Systems*

12 HOT WATER SYSTEMS

The inspectors collected information on the types, sizes, ages, and thermostat settings of hot water cylinders in the houses surveyed. From this, we are able to generally assess the energy efficiency, storage capacity and safety of the hot water systems.

12.1 Types of Hot Water Systems

The inspectors identified the type of system[54] used in each house. As natural gas reticulation is not available in the South Island, the results for Christchurch are shown separately in *Figure 44*.

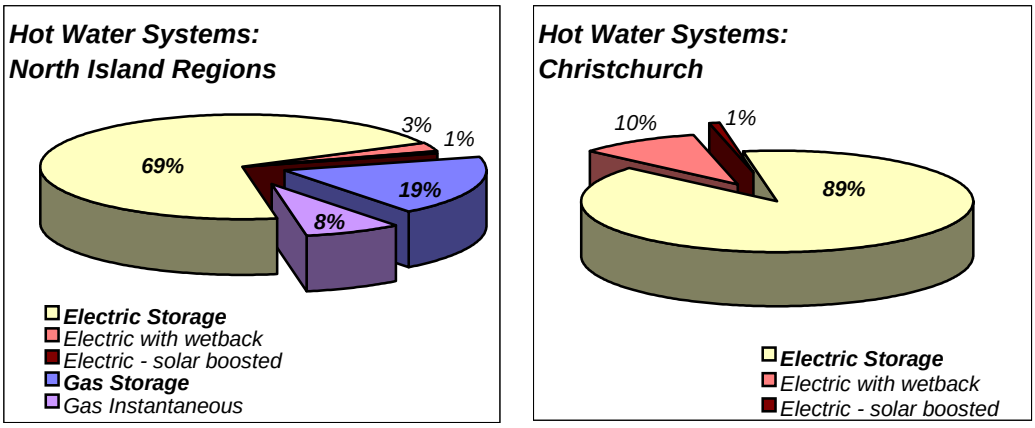

Figure 44: Types of Hot Water Systems

In Auckland and Wellington, electric storage remains the most common means of supplying hot water to households, with nearly 70%[55] of houses using this system. Gas storage is the next most common at almost 20%, followed by gas instantaneous water heaters (8%) and wetbacks at 3%. Solar-boosted systems are still rare at only around 1% of the houses inspected. In the South Island, the notable difference is the increase in the use of wetbacks, with 10% of the houses using them.

12.2 Ages of Cylinders

Inspectors were asked to note the ages of storage cylinders, and the results are given in ***Figure 45***, which shows the total numbers found for gas and electric cylinders.

As expected[56], gas cylinders are generally newer than electric cylinders, with very few being older than 20 years.

What is notable is the high number of very old electric cylinders. Thirty years is considered a reasonable life for a low pressure electric cylinder, yet the survey found around 90 cylinders (more than a quarter) over that age[57].

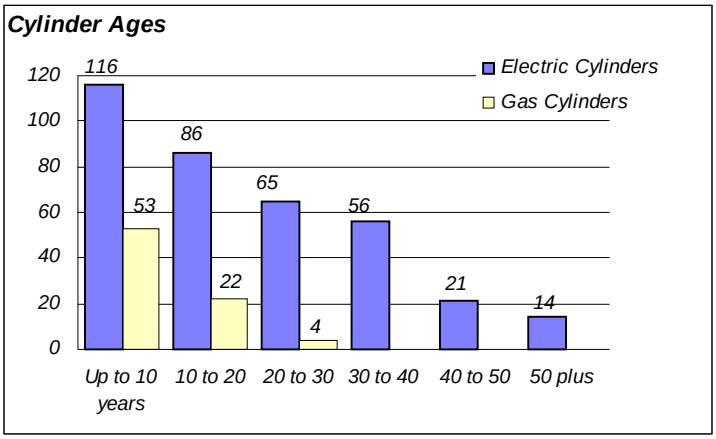

Figure 45: Cylinder Ages

12.2.1 Energy Efficiency

The dominance of electric storage systems makes the efficiency of these particularly important to the national energy use for water heating, so the efficiencies of the electric cylinders in the survey were further explored. In 1997, the efficiency of New Zealand's existing stock of domestic size electric storage water heaters was

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[54] *It should be noted that no solely solar or wetback heated systems, or electric instantaneous water heaters were identified.*

[55] *Almost three-quarters if boosted systems are included. However, the percentages will be higher (more in the order of 85% to 90%) for the whole North Island, as many areas do not have access to natural gas for water hating.*

[56] *In view of the relatively recent introduction of natural gas. The oldest gas cylinder was 25 years old.*

[57] *21 were more than 40 years old, and 14 over 50 years old. The oldest electric cylinder in the survey was 67 years old.*

estimated by the Electrical Development Association(10) according to their age and the standards (if any) applicable at the time. The same figures have been used to compare with the cylinders identified in this survey, and the results are shown in *Table 13*.

		Survey		*National*
Electric Cylinder Ages	***Grade***	*Numbers*	*%*	*EDA estimate*
Pre-1976 (no standard)	Ungraded	121	***32%***	***20%***
1976 to 1986	C	81	***21%***	***33%***
Post-1986	B	129	***34%***	***40%***
A Grade	A	27	***7%***	***7%***
Unknown (no access)		20	***5%***	
		378		

Table 13: Cylinder Age & Energy Rating

A point highlighted by *Table 13* is the higher than expected number of older ungraded cylinders. More than a third of the cylinders in the survey are the most inefficient types, compared to an estimate of only 20% nationally. The aggregate percentage of ungraded and C grade cylinders is the same as the equivalent national percentage at 53%. However, it is likely that the unknown category of cylinders is also in this older group, as it is uncommon to find newer cylinders without reasonable access[58].

Another item noted by inspectors was the use of cylinder wraps[59]. Less than 3% of cylinders used wraps, which indicates (taking into account the percentages of sub-standard cylinders) that many houses are using substantially more energy than necessary to heat their water.

12.3 Storage Capacities of Cylinders

For many years the standard size cylinder used in New Zealand houses was 135 litres (or its predecessor 30 gallons). It is now commonly accepted by the plumbing industry that this size is inadequate for present day demands. The range of cylinder sizes found in the survey is given in *Table 14*.

	Electric		***Gas***	
Cylinder Sizes	***Number***	***%***	***Number***	***%***
135 litres	123	***34%***	7	***13%***
Between 135 and 180 litres	11	***3%***	24	***44%***
180 litres	184	***51%***	15	***28%***
Between 180 and 270 litres	5	***1%***	7	***13%***
270 litres	28	***8%***	0	
Over 270 litres	13	***4%***	1	***2%***
Subtotals	**364**		**54**	
Unknown (no access or n/a)	14		33	
Totals	378		87	

Table 14: Cylinder Sizes

As can be seen, the most common existing size in the survey is 180 litres, although there are still a large number of 135 litre cylinders. Few cylinders with capacities greater than 180 litres were noted, although there were a number of houses that had second cylinders[60]. A second cylinder can often be a method of overcoming distribution problems as well as capacity problems in an existing house, where practical reasons may preclude a redesign of the total hot water system[61].

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[58] *24 of the inaccessible cylinders were in pre-1970 houses and the remaining 4 were built in 1970.*

[59] *Used to decrease heat losses of existing sub-standard cylinders.*

[60] *28 second cylinders, with 22 of these electric. These were usually installed as the result of other major additions or renovation work.*

[61] *Or even just increasing the size of the cylinder.*

12.3.1 Hot Water Delivery of Electric Cylinders

In considering the sizes of electric cylinders in comparison to the demands placed upon them, the number of bedrooms has been used as the base for estimating the potential demands on the hot water system.

The potential number of people in a house is calculated as being the number of bedrooms plus one, and the requirements per person at around 45 litres per day[62]. Based on these premises, ***Figure 46*** gives the range of cylinder capacities required by estimating delivery needs, compared to the actual range of capacities found in the survey.

From this, it can be seen that 27% of houses surveyed are estimated to need a 270 litre capacity whereas only 9% had that capacity. At the other extreme, only 11% of houses could be expected to have sufficient hot water delivery from 135 litres, whereas 34% of houses surveyed had cylinders of this size.

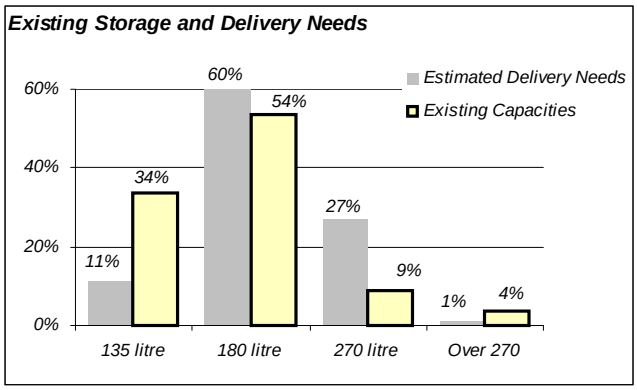

Figure 46: Electric Cylinder Sizes Required

As expected, the results confirm the industry view that New Zealand electric[63] cylinders are undersized for the demands placed on them. Only about 10% of the houses in the survey should have cylinders as small as 135 litres, in contrast to the more than a third which had cylinders of this size. Almost 30% of the houses need cylinders of 270 litres or larger, in contrast to the 13% of houses which reached this capacity.

One of the consequences of undersized cylinders is that storage temperatures are often increased in order to improve the effective capacities of the storage systems, which (without the protection of tempering valves) can lead to dangerously high temperatures at the hot water taps (and also waste energy).

12.4 Safety

The New Zealand Building Code requires that hot water be delivered at a safe temperature (55°C maximum at present, although this is likely to be lowered to 50°C), and stored at a minimum of 60°C to avoid bacterial contamination.

It is widely recognised that many New Zealand homes have their hot water at dangerously high temperatures in order to counteract the effect of undersized hot water cylinders.

As discussed above, a high percentage of houses in this survey have undersized cylinders, so one could expect to see many set to high temperatures. Inspectors were asked to note the thermostat settings on cylinders, and the results are shown in *Figure 47*.

As shown, less than one third of the cylinders in the survey had thermostats set to the currently required level of around 60°C. About 30% were set at **below** the temperature required to avoid the risk of contamination[64], while well over a third were set **above** the temperature required to minimise the risk of scalding.

More than 20% of the cylinders in the survey were set at temperatures in excess of 70°C, with 5% set at over 80°C[65]. The older type of thermostat is likely to have an error of around plus or minus 5 to 10 degrees. Taking into account the high percentage of very old cylinders[66], many houses in the survey have cylinders set at dangerously high temperatures.

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[62] *This is a **conservative average** daily figure which takes no account of particular family circumstances which can result in a much higher **peak** demand for hot water (eg. everyone wanting to shower at the same time).*

[63] *The analysis does not include gas storage cylinders, as these have a much quicker recovery time so can be smaller relative to hot water demands.*

[64] *The Building Code requires the storage temperature to be sufficiently high to prevent the growth of bacteria such as Legionella. In practice this means that the thermostat must be set at 60 degrees C or more. The lowest setting found was 40 degrees C.*

[65] *The highest setting found was 95 degrees C (although the thermostat may well have been unreliable).*

[66] *Which are the most likely to have unreliable thermostats.*

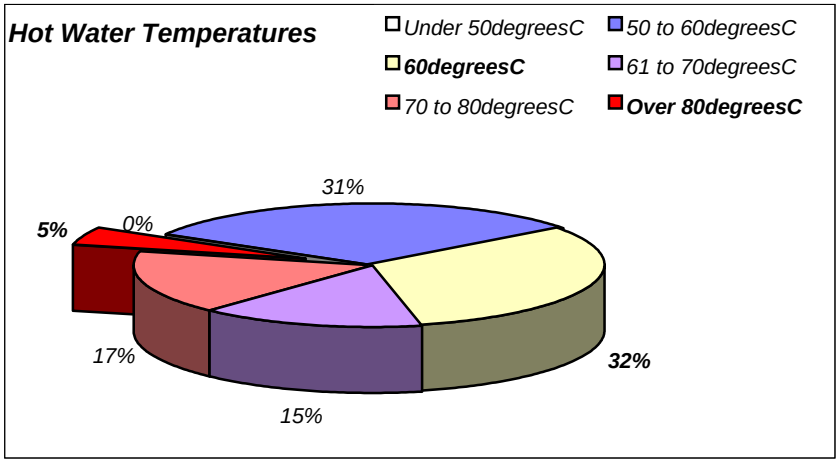

Figure 47: Thermostat Settings

12.5 Conclusions

Commonly held industry opinions on the performance, efficiency and safety of New Zealand's domestic hot water systems appear to be confirmed by the results of the survey, in that:

- *A quarter of houses have electric cylinders older than 40 years.*
- *Over 30% of houses have old (ungraded) cylinders which waste energy.*
- *Over 20% of houses have C grade cylinders, which are also energy inefficient.*
- *More than one third of houses have 135 litre capacity cylinders.*
- *Only 60% of the electric cylinders are adequately sized for the potential demands for hot water delivery.*
- *More than 90% of the gas storage cylinders are adequately sized.*
- *Well over a third of the electric cylinders stored water **above** the temperature required to minimise the risk of scalding, with over 30% at dangerously high temperatures (at least 10 degrees more than a safe level).*
- *About 30% of the electric cylinders were set at **below** the temperature required by the Building Code.*

13 HEATERS

Information on heating was collected for each house in the survey. Inspectors were asked to identify the number and types of heaters and/or heating systems, together with associated equipment such as dehumidifiers and ventilation systems. From this data, it is hoped to form an impression of how New Zealand houses are heated.

13.1 Types of Heating

The first analysis gives a general picture of this by considering the number of types used in each house by the following general categories:

- ***Fixed stand-alone heaters*** *found in houses*
- ***Portable Heaters*** *found in houses*
- ***Central systems*** *found in houses*

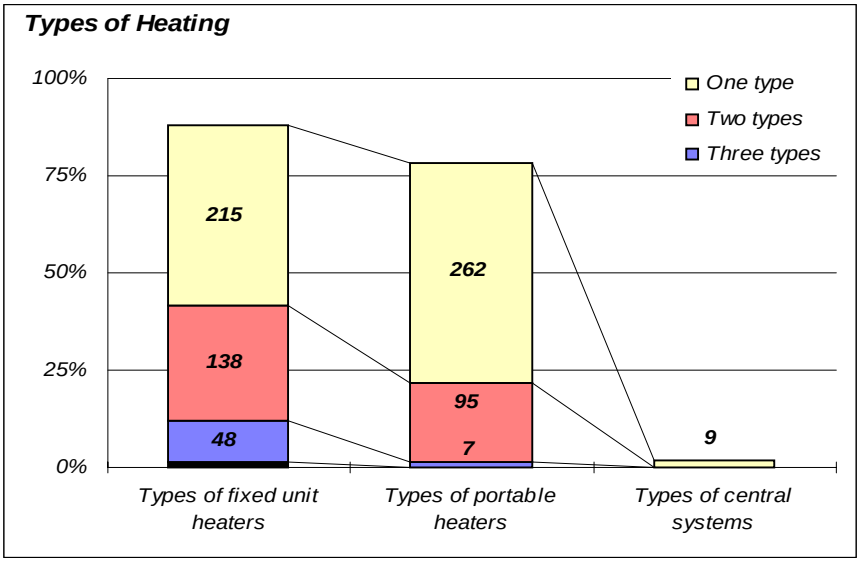

Figure 48: Categories of Heater-use

As shown most houses use one or more types of individual stand-alone heaters (both portable and fixed), with very few central systems.

As it was apparent that many houses use a combination of heater types, this was also considered and the results are shown in ***Figure 49***. As shown, about 85% of houses use two or more types of heaters, with only 13% using just one type. The latter were mainly houses that relied solely on a woodburner

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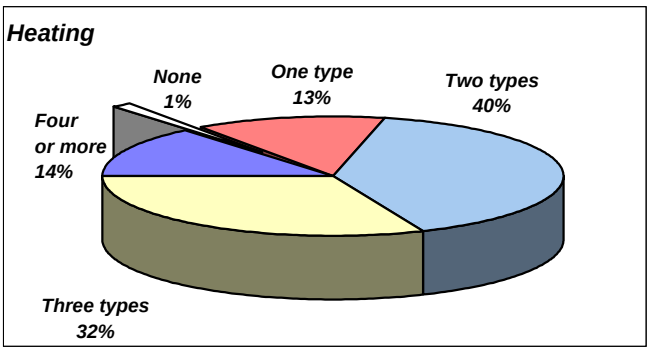

Figure 49: Variety of Heating Types Used

13.1.1 Stand-alone Heaters

Figure 50 shows individual heaters broken down into types:

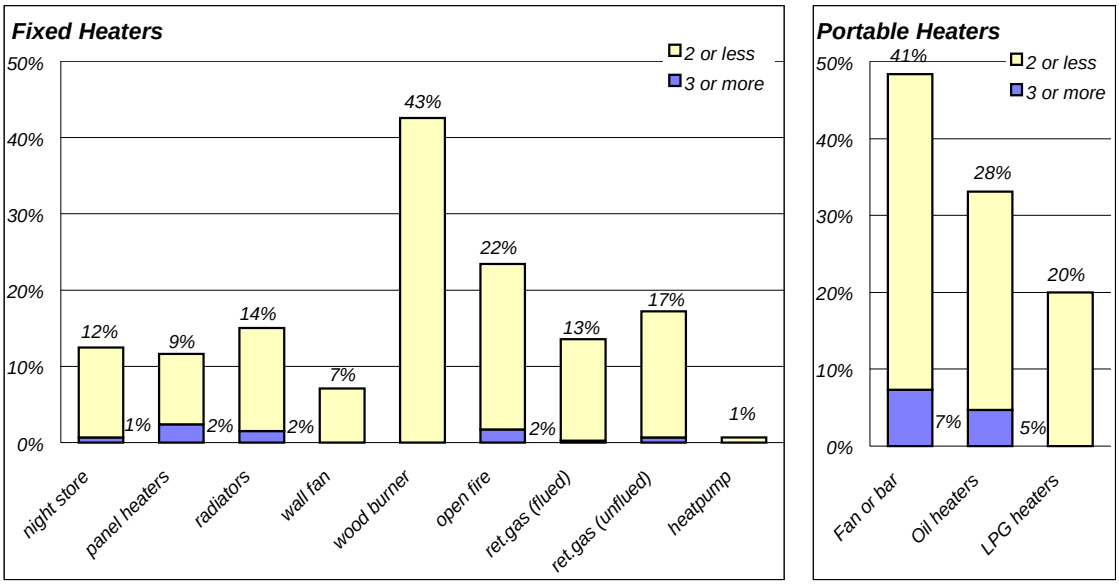

Figure 50: Types of Stand-alone Heaters

As shown, the most common heaters found were woodburners - with more than 40% of houses in the survey having this type of heater. At a similar level were portable fan or bar heaters, followed by portable "oil column" convection heaters at almost 30%. Portable LPG heaters were also common at 20%, and as these are a recent type of heater their use should be followed in future surveys.

One notable point is the number of houses that still have open fires (more than 20%) - a particularly inefficient means of heating.

13.1.2 Other Systems

Figure 51 shows the central systems broken into types, and also the types of other air handling equipment found.

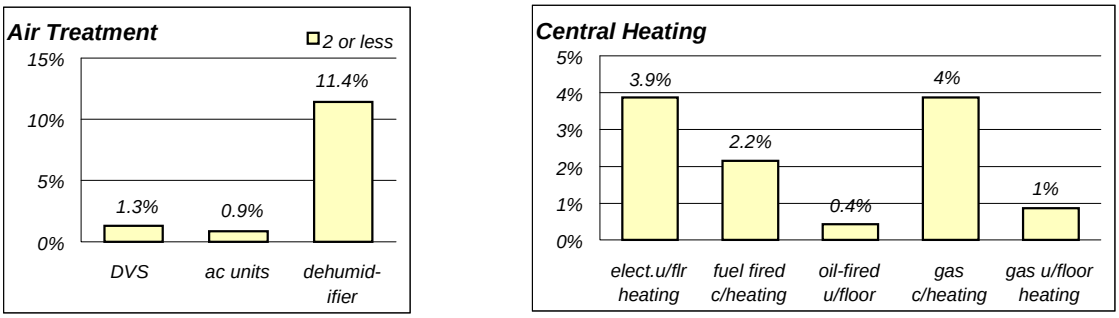

Figure 51: Other systems

Of the few central types of heating systems found, the two most common were electric underfloor heating and gas central heating (both at around 4%).

There were very few air conditioning units or DVS's[67] noted, although the incidence of these may well increase in the future as they are becoming more affordable for domestic use. What is notable is that more than 10% of houses have dehumidifiers, and this appears to be a recent trend that is growing (similar to the use of LPG heaters). This should be followed up in future surveys as it may relate to other problems such as dampness (as discussed earlier).

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[67] *Domestic Ventilation Systems: a controlled supply of air from the ceiling space into the living areas of a house (may or may not be heated).*

13.2 Possible Moisture Problems

About a third of the houses surveyed had unflued gas heaters or LPG heaters, both of which produce large quantities of water vapour. Because of this, together with the apparently growing use of dehumidifiers, the combinations of houses with this type of heating together with dehumidifiers were considered in order to see whether there appeared to be any relationship. *Figure 52* gives the results:

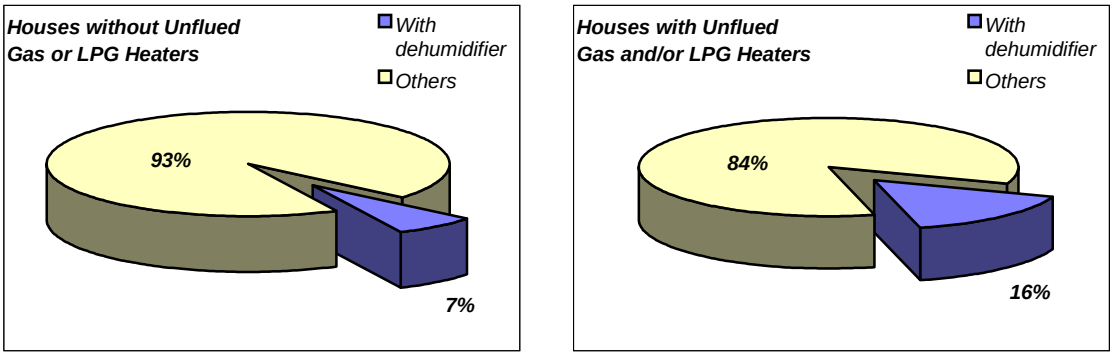


Figure 52: Dehumidifiers and Unflued Gas Heaters

Both pie charts show a large increase in the use of dehumidifiers when either unflued gas heaters or LPG heaters are also used in the house. The largest increase is associated with LPG heaters, where 18% of houses with LPG heaters also have dehumidifiers.

It appears that owners may be using the power savings on one type of heater to pay for the use of another piece of equipment which handles the side effects.

13.3 Conclusions

The main features of the survey on heating were that:

- *Most houses use a combination of individual stand-alone heaters (both portable and fixed).*
- *Very few houses have central forms of heating or ventilation.*
- *The most common form of fixed heater found were woodburners. Over 40% had a woodburner, and about 10% relied on this as the sole form of heating.*
- *More than 20% of houses still had open fires.*
- *The most common form of portable heater found were fan or bar heaters, followed by "oil column" convection heaters.*
- *There is a large number of LPG heaters (20%).*
- *More than 10% of houses have dehumidifiers.*
- *Houses with unflued gas heaters (reticulated or LPG) have more than twice the rate of dehumidifier use, as do houses without this form of heating.*

14 OTHER ATTRIBUTES

During the inspections of rated components, additional information was gathered by the BRANZ inspectors. The results of this add to our understanding of other features of New Zealand housing. In some cases, only simple quantities are available as the items have not been assessed in terms of condition. If aggregated results indicate growing trends, then such items may well be assessed more fully in future surveys. Other information is more subjective, and may be the inspectors overall assessment of a particular attribute eg. the feeling of dampness.

This section presents the findings on these other features and attributes.

14.1 Security Measures

Security measures for each house were noted. Inspectors were asked to indicate whether the following items were present:

- *Burglar alarm*
- *Security lights to entry points*
- *Safety catches to vulnerable windows.*

Figure 53 indicates the use of at least some security measures for houses in the survey.

As can be seen, more than 70% of houses in the three main regions of New Zealand use at least some special measures to increase security.

We are unable to confirm how recent this trend is, although it will be interesting to study changes in future surveys.

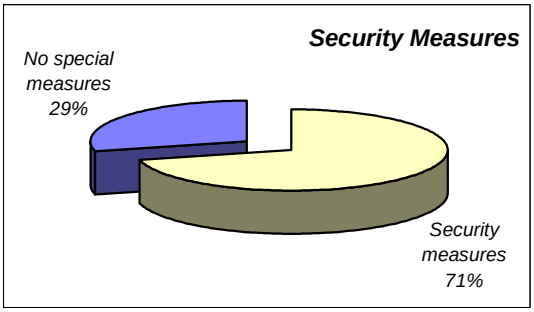


Figure 53: Use of Security Measures

14.1.1 Regional Patterns

The following chart gives more detail by indicating percentages for each type of measure and breaking these further down into the applicable information for each region.

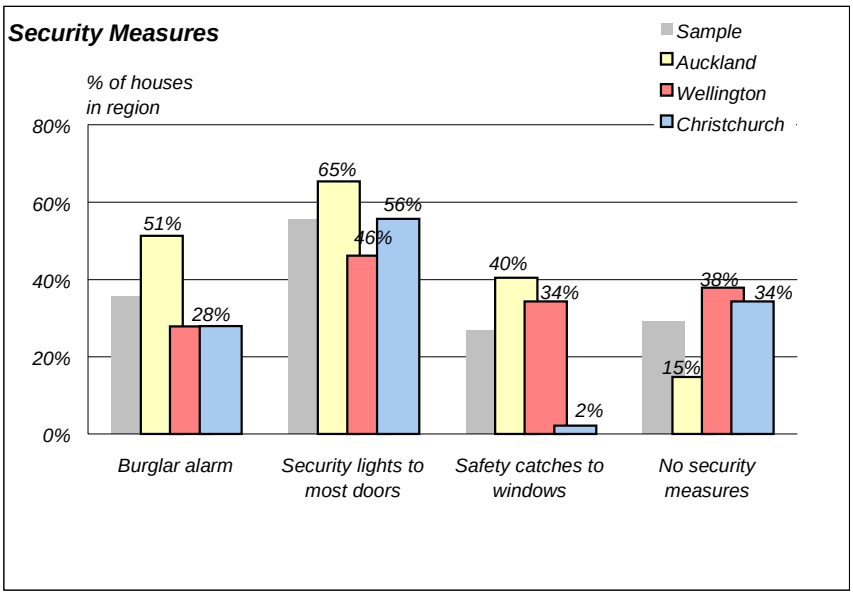


Figure 54: Regional use of Security Measures

There are some interesting points showing from this analysis; in particular the high use of burglar alarms and security lights to doors. Considering that it would have been rare to see these used in domestic settings even a

decade ago, this may indicate a trend towards increasing concern with both personal and property protection by homeowners.

There are also notable differences showing up in the breakdown into regions. The most extreme of these is that more than half of the houses surveyed in Auckland had burglar alarms, while use in the other two regions was just below 30%. The use of security lights to doors shows a different trend, with Wellington having the lowest level of use. On the other hand, the use of safety catches to windows is very low in Christchurch (at only 2%) compared to Auckland and Wellington at 40 and 34% respectively.

14.1.2 Conclusions

The main features on security are:

- *Nearly three-quarters of houses have at least some special security measures.*
- *More Auckland houses have more of each type of security measure than those in the other two regions.*
- *About 40% of houses have burglar alarms.*
- *More than half of the Auckland houses have burglar alarms, compared with more than a quarter in the other two regions.*
- *More than half of the houses have security lights to most or all entry points.*
- *Over a third of Auckland and Wellington houses have safety catches to vulnerable windows, while very few were noted in Christchurch houses.*

14.2 Maintenance Information

Where convenient, owners were asked questions about their sources of information on maintenance of their houses (item 3 on the survey form). Pursuing this was not always appropriate, so inspectors used their own judgement according to the circumstances. Despite this, some information was collected from well over half of the houses surveyed, and the results give us some limited but interesting insights into this area. It must be noted that most owners included multiple responses to both questions, and this should be taken into account when assessing the results.

14.2.1 Prompts for Maintenance

Figure 55 indicates how homeowners know whether their house needs some maintenance.

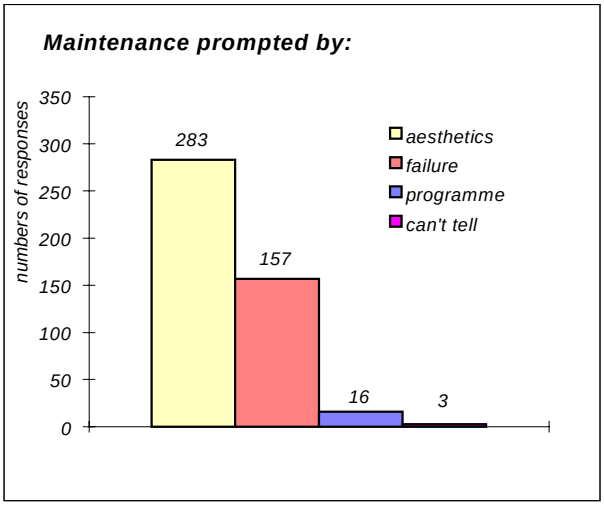


Figure 55: Prompts for Maintenance

The interesting points from this analysis are that most people are prompted either by the surface appearance of the component such as peeling paint, or by a failure such as leaking.

This implies that a condition must either be clearly visible or bad enough to fail before it is remedied.

There appears to be very few owners who follow principles of preventative maintenance which will better preserve the long-term condition of their house, with only 16 people quoting this category.

14.2.2 Information on Maintenance

Homeowners were asked where they would get their maintenance information from, and *Figure 56* shows the results.

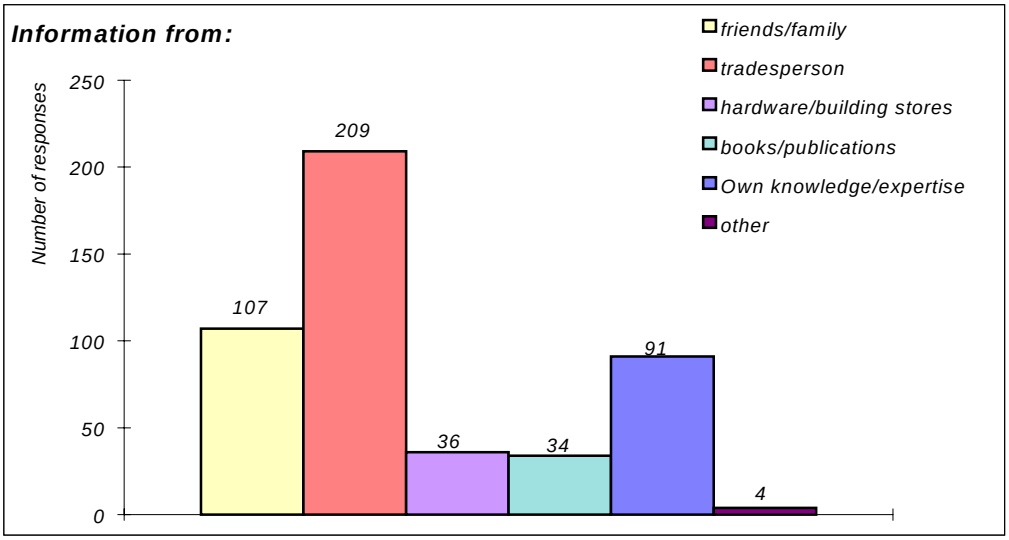


Figure 56: Information Sources

It is interesting to note that one major source was noted originally under the category "*other*". Due to the number of responses indicating that a source of information was the owner's "*own expertise*", this response has been added to the breakdown.

The other points of interest are the use of tradespersons as a main source of information, this being the most quoted source. The other main two sources of information were friends or family and the owner's expertise. Relatively few owners (34) appear to undertake any research into the topic by using books or publications. The result of this is to put most of the responsibility for ensuring that owners get sound information onto the building trade, as their influence on owners' decisions is obviously high.

Due to the unexpected level of owners' perception of their own expertise being a main source of information, it was decided to see whether this confidence was borne out in the condition of the house. The houses of those who claimed expertise were broken into the maintenance levels assessed by the inspectors, and also into the owner's assessment of condition, and the results are given in *Figure 57*.

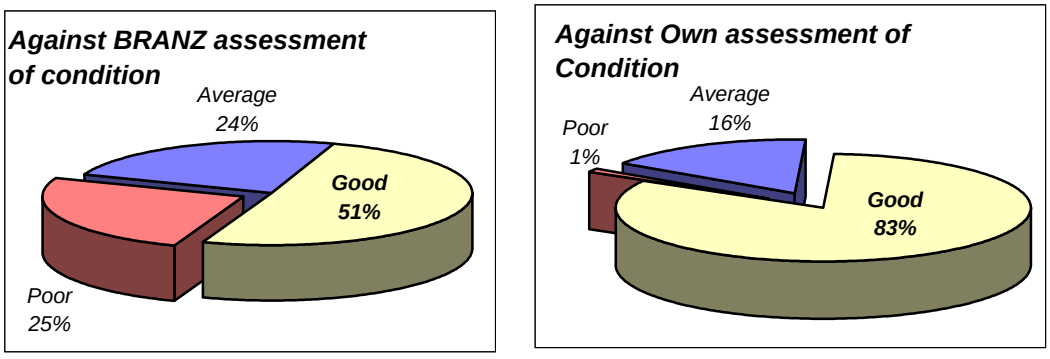


Figure 57: Owners' Expertise compared with Condition

As shown, confidence in one's own abilities is not always backed up by an expert assessment, although it appears that it is usually backed up by one's own assessment of the house's condition[68].

[68] *However, it may also be argued that owners' assessments of the need for maintenance may be justified. If exchange value is paramount, then rehabilitation can be worthwhile only if the costs are less than the subsequent increase in the exchange value of the property. The costs of fully reversing certain types of physical depreciation can be greater than the subsequent increase in value and owners may base their decisions on this.*

Although just over half had houses assessed as *well maintained*, more than a quarter were assessed by BRANZ as *poorly maintained* (compared to just 1% assessed by the owners themselves). Whether this is an indication of a "little knowledge being a dangerous thing", or whether the reasons are more complex cannot be judged on the limited information available, but the subject may warrant further investigation.

14.2.3 Conclusions

Homeowners appear to approach the need for home maintenance in a fairly ad-hoc manner, and seek most of their information from a limited number of sources, mainly based on word of mouth.

The main features of the survey on maintenance information are:

- *Very few owners follow a planned programme of preventative maintenance.*
- *Most owners rely on surface visual prompts that maintenance is required.*
- *Many owners wait for components to fail before realising that work is required.*
- *Most owners rely on advice from tradespeople for particular information.*
- *Few owners used books or publications as an information source.*
- *More than a third of owners rely on their own expertise for information but, of those who do, a quarter live in houses that BRANZ assessed as being poorly maintained.*
- *Of those owners who rely on their own expertise, almost none believed that their house was in poor condition.*

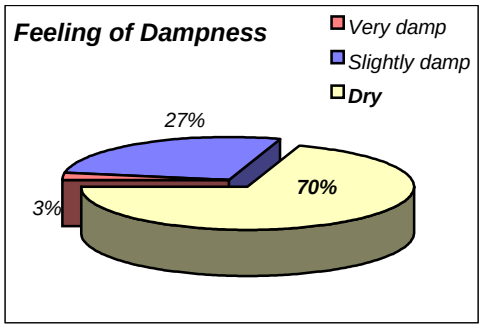
14.3 Dampness

The inspectors were asked to assess the dampness of the interior of the house on a subjective basis (Item 4 of the survey form). Their assessment was put into one of three categories:

- ***Feels very damp, smells musty***
- ***Feels slightly damp***
- ***Feels dry***

The aim of this assessment was to gain some appreciation of the proportion of New Zealand houses that suffer from moisture problems. While it is known that many houses have conditions that can lead to problems of high moisture levels, we do not know whether those problems have necessarily developed to any notable degree.

14.3.1 Overall Dampness Levels



Based on the inspectors' assessments, the results are as shown in Figure 58.

As can be seen, a high proportion (30%) of houses did have a damp "feel". However, considering the numbers of houses with other components which can encourage dampness (insufficient subfloor ventilation, inadequate insulation and indoor ventilation etc.), this proportion still appeared to be less than expected.

The majority of the surveys were performed during and at the end of a relatively hot, dry summer, so the seasonal variation was explored.

Figure 58: Dampness Levels

14.3.2 Seasonal Dampness Levels

As the surveys were completed and received for collating, it was noted that the number of houses feeling damp seemed to start increasing around April or May. The sample was therefore split into those houses inspected prior to May and those after; with the former classed as *"summer"*, and the latter as *"winter"*. The analysis was then repeated to see how the classes compared to the whole sample. The results are shown in *Figure 59*.

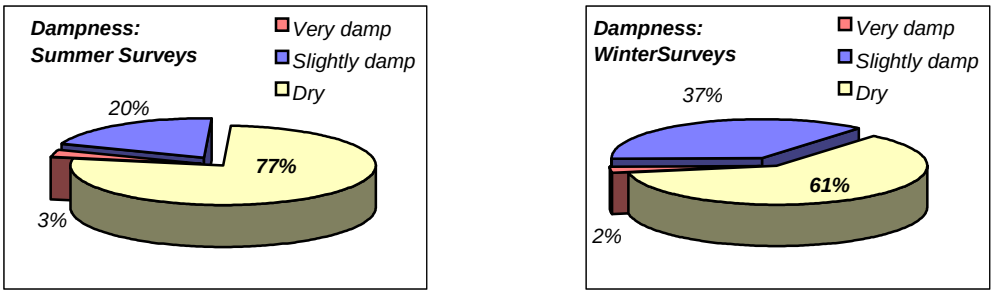


Figure 59: Seasonal Dampness

As suspected, notable differences appeared between the summer and winter houses, with 70% more houses assessed as damp in winter than in summer. If the winter figures are taken as being more indicative of the overall moisture problem, then we can assume that almost 40% of houses exhibit moisture problems which are high enough to make the interior feel damp or smell musty.

This is probably still conservative, as inspections of houses in the Christchurch region were substantially complete prior to the end of April, so that those falling into the damper season were very limited in number and had little affect on the winter analysis. With high ground moisture levels common in many areas of Christchurch, we could expect to see up to an extra 10% showing winter moisture problems if these houses had been better represented in the winter surveys. This would bring the problem closer to affecting half the houses.

14.3.3 Relationship to Dehumidifiers

It was noted that a large number of houses had dehumidifiers, and these obviously decrease the moisture problem significantly without altering the original causes. In order to gain some idea on the influence of these, an adjusted sample was constructed to try to exclude the influence of dehumidifiers. 13 houses in the sample had dehumidifiers but still felt slightly damp - so these houses were reclassified as being very damp for the purposes of this exercise. 38 houses had dehumidifiers and were assessed as feeling dry, so these were reclassified as being slightly damp. The results of the adjusted sample are shown as potential dampness[69] in ***Figure 60***.

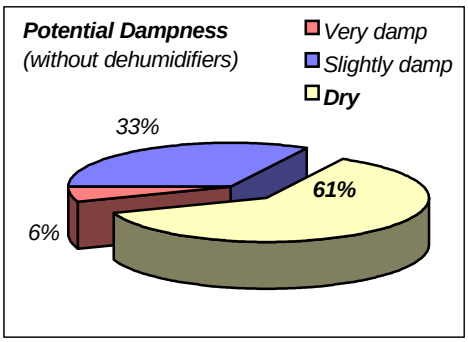


Figure 60: Dampness & Dehumidifiers

This adjustment increases the potential proportion with dampness problems by almost 10%. This is a notable amount as the use of dehumidifiers is a recent trend, and one that is growing.

The concern with this trend is that, as increasing numbers of dehumidifiers are purchased to cope with the problem, the causes may increasingly be ignored and possibly worsen. Such devices may well cure the symptoms, but they cannot cure the causes.

It will be interesting to revisit this area in the next survey to see what increases in use there are in another five years, and what effects this might have on the buildings surveyed at that time.

14.3.4 Other Correlations

Dampness was also considered on a regional basis, and in relation to the assessed "air tightness[70]" of the house construction. However results were inconclusive. Out of houses assessed as damp, less than half of these were classified as "tight".

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[69] *Note that this potential dampness should be compared with the original analysis in* **Figure 60**.

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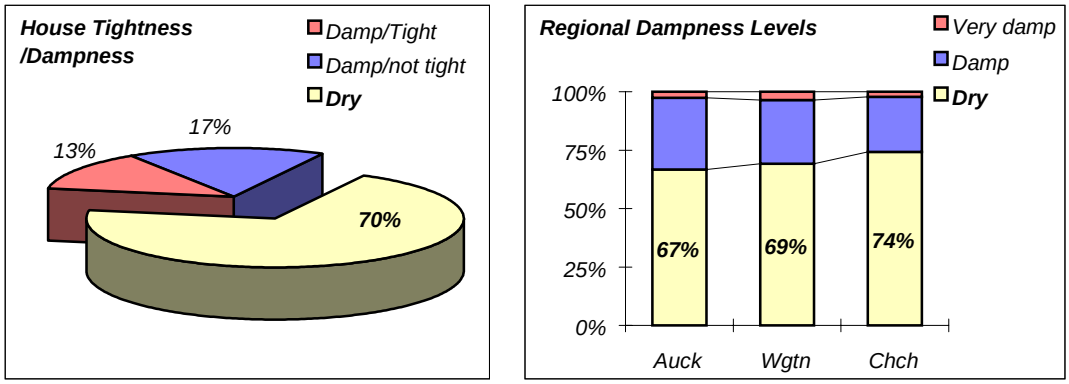

Figure 61: Regions & House Tightness

No major differences in dampness between the three regions are apparent, as shown in *Figure 61*. However, as discussed above, Christchurch had very few houses inspected during the winter in contrast to the other two regions, which could explain its lower numbers of damp houses.

14.3.5 Conclusions

Many New Zealand houses feel damp, which is to be expected from the high incidence of conditions that can lead to such problems.

The main features of the survey on dampness are:

- *30% of houses were assessed as damp or smelt musty.*
- *At least 40% of houses are concluded as being damp during winter months, and this is likely to be as high as 50%.*
- *A notable number of houses have at least one dehumidifier. Without these, it is estimated that a further almost 10% of houses would be damp.*
- *There are concerns that, as dehumidifier use increases, causes of moisture problems may be ignored.*

[70] *Air tightness in terms of the draughtiness of the house construction eg. a 1910's house with high stud, double-hung timber windows, floorboards, and weatherboard walls would be classified as "draughty", whereas a compact 1980's house with aluminium windows and particle board floor would be classified as "airtight".*

14.4 Fire Safety

The survey covered the area of fire protection devices in Item 35.0 of the survey form. Inspectors were asked to count smoke detectors (and other equipment), check that detectors were operational, give locations, and inquire as to owners' monitoring habits.

14.4.1 Use of Smoke Detectors

The results for smoke alarm numbers are shown in *Figure 62*.

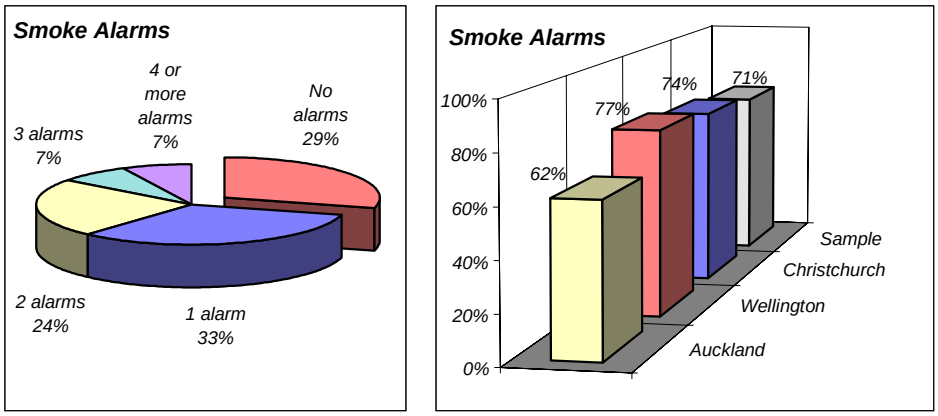

Figure 62: Use of Smoke Detectors

As shown, the use of one or more smoke detectors is now very high with less than 30% of houses having no detectors. A third have one detector, a quarter have two and a notable proportion have three or more. Their use has now become the norm in houses, presumably in line with increased marketing and decreased purchase costs.

14.4.2 Regional Patterns

Figure 62 also gave the breakdown of use between the three regions. As shown, Wellington has the highest use of smoke detectors, followed closely by Christchurch. Auckland is well below the other two regions in the use of detectors. The reasons for this marked difference is not known, and may warrant further investigation.

14.4.3 Details of Detectors

As shown in *Figure 64*, the survey found that almost all smoke detectors were individual "stand-alone" battery alarms. Out of those houses with detectors, 24 houses had some or all alarms not working. 14 of these had no alarms working. These are high numbers, representing over 7% with some operational malfunction, and over 4% with alarms that would all malfunction in the case of a fire. Owners were asked how often the alarms were checked and the responses are shown below.

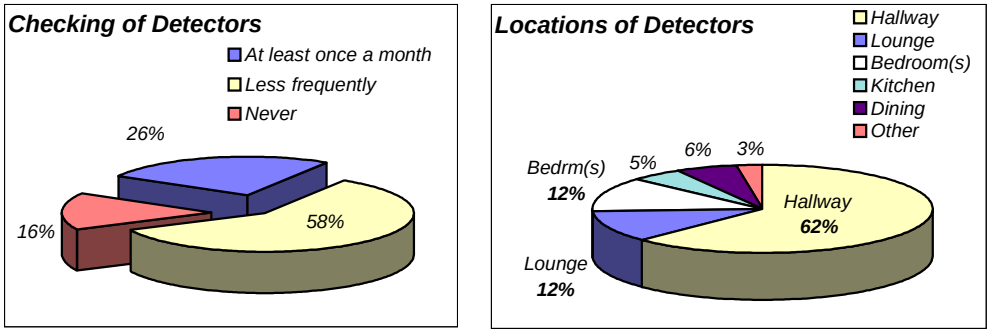

Figure 63: Locations & Monitoring

This may explain the high incidence of malfunction, as around 16% indicated that the alarms were never checked. On checking as to frequency of battery changing, most alarms beeped when the battery was low, so most owners relied on this function to prompt them.

14.4.4 Locations of Detectors

Inspectors noted the locations of the smoke detectors and the results are given in *Figure 63:* ***Locations & Monitoring***

As shown, the most popular position is the hallway. The next most frequent locations were the living room or a bedroom. The only other locations of note were the kitchen and dining room.

14.4.5 Other Equipment

The other main devices noted in the survey are fire extinguishers, with 90 houses having at least one (usually small disposable domestic models). *Figure 64* includes the incidence of other equipment.

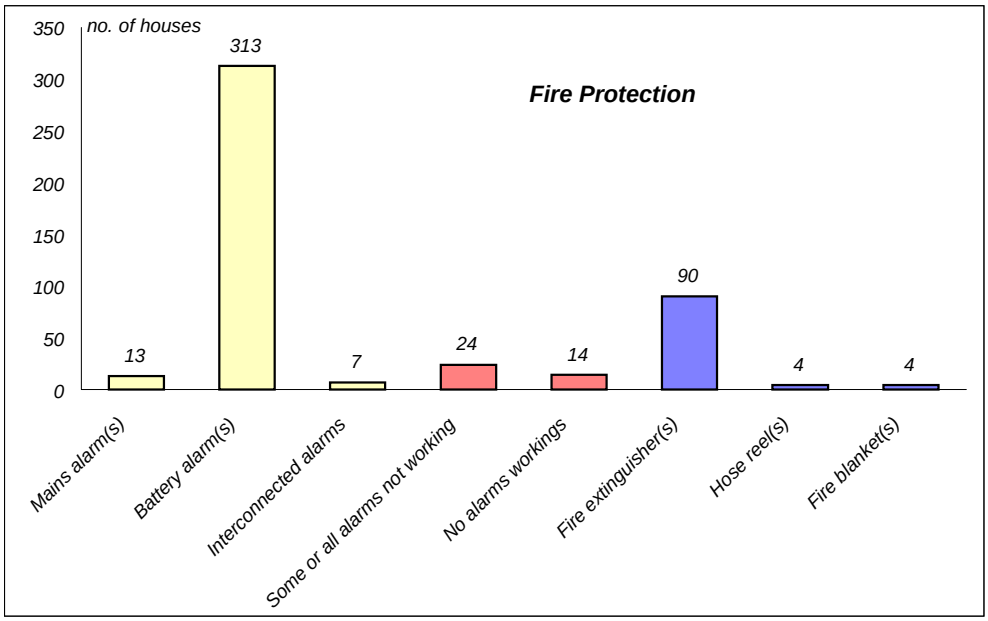

Figure 64: All Fire Protection Measures

As shown, very few (4) were noted as having hose reels or fire blankets.

14.4.6 Conclusions

It appears that messages on fire safety in the home are having results as most New Zealand houses now have some form of fire protection device.

The main features of the survey on fire safety are that:

- *More than 70% of houses have one or more smoke detectors.*
- *More than 95% of these are stand-alone battery-operated units.*
- *More than 7% of houses with detectors have at least one detector that is not working (more than half of these have no alarms working).*
- *16% of owners have never checked their detectors.*
- *The most popular position for detectors is in the hallway.*
- *A notable number of houses have fire extinguishers.*

15 DISCUSSION

15.1 Average Condition

The average condition of houses in the survey[71] ranges from 3.2[72] (*1994:3.0*) for the pre-1930's cohorts up to 4.5[73] (*1994: 4.5*) for the 1990's cohort. Average condition over all age ranges is 3.6[74] (*1994: 3.5*).

15.1.1 Comparison to Last Survey

The results show little overall change since the last survey. However there is some sign of change at the more detailed level - in particular the improvement in condition of houses in the oldest age groups. The 1994 survey found that the average condition tended to continue to decrease with age throughout all age groups, whereas ***Figure 13: Average Condition for Age*** indicates that there is a stabilising of condition for the pre-1940's cohorts, and these older houses are showing improvement in condition in comparison with those of the 1994 survey[75]. ***Figure 14: Regional Condition for Age*** shows that this improvement is occurring in the Auckland and Wellington regions but not in Canterbury, where condition continues to deteriorate with age.

15.1.2 Incidence of Defects

A more important aspect than overall average condition is the incidence of defect by component. The table showing Average Component Condition (refer***: Appendix 4***) indicates that the average condition of some components is less than *"moderate"* (below a rating of 3), and that the incidence of some components in *"poor"* or *"serious"* condition is high. The latter includes subfloor ventilation, clearance of cladding above the ground, subfloor fasteners, header tanks and hot water cylinders. More than 20% of houses have one or more of these components in *"poor"* or *"serious"* condition.

15.1.3 Subfloor Ventilation & Ground Clearance

The component with the highest incidence of *"poor"* or *"serious"* ratings is the same one as found in the 1994 survey: subfloor ventilation. Three-quarters (*1994:60%*) of houses with timber-framed floors have poor or seriously deficient ventilation of subfloor spaces. As reported in the 1994 report, it is surprising to find this level of serious inadequacy as the current code requirement for ventilation has been in existence since the 1940's[76]. It seems that few local authorities were using or enforcing these vent requirements. ***Figure 20: Component Condition for Age*** shows that these this problem is not limited to older houses, as the inadequacy remains present right up until the 1980's cohort[77]. In addition to the inadequacy of constructed vents, owners themselves have often contributed to the problem by blocking vents. Despite code non-compliance, houses will not necessarily have problems in other components as factors such as exposure, soil conditions, wind zone, ground clearance, and alternative air leakage paths will affect the impact.

The provision of adequate ground clearance is an associated problem, with more than 40% of houses having poor or seriously deficient clearance between the wall cladding and adjacent soil. A disturbing trend shown by ***Figure 20*** is that this average rating has decreased markedly in younger post-1960's houses. This is very similar to the results found in 1994, and it is interesting to speculate on the reasons. One factor may well be changes in the way that New Zealanders use their houses, and the increasing attention given to achieving good "indoor/outdoor flow", where changes in levels may be minimised at the expense of good building practice. This appears to be an area that could do with some attention in terms of educating the building trades. However, it may well be more

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[71] *Averaged over the same components as those rated in 1994, and then over all houses in the particular age group.*

[72] *Just above* ***"moderate"*** *condition.*

[73] *Midway between* ***"good"*** *and* ***"excellent".***

[74] *Midway between* ***"moderate"*** *and* ***"good"*** *condition.*

[75] *The difference between exterior and interior average condition also changes with age; with increasing discrepancy for older houses. The older the house is, the more the interiors are notablely better than exteriors*

[76] *The 1924 NZ State Forest Service Building Conference Recommendations (8) were adopted by the NZ Institute of Standards in 1944 in its Model Building By-law (9).*

[77] *In fact, pre-1920's houses commonly used spaced baseboards at subfloor levels, which normally provided more than sufficient ventilation (although they were often built too close to the ground). Later, solid perimeter walls became more common and vents were limited to "holes" in these walls, which were often too small and too few in number.*

important to educate landscapers, gardeners, and the owners themselves. The problem may well be that later effects of inadequate clearance, while possibly severe, are too far in the future to engender immediate concern.

15.1.4 Header Tank & Hot Water Cylinder Restraints

Another area that is also similar to the findings of the 1994 survey is the lack of earthquake restraints on header tanks and hot water cylinders. More than 60% (*1994:50%*) of houses surveyed had inadequate restraints on water tanks. This is less surprising as restraints were not mandatory for new houses until the introduction of the Building Code in 1993, so it is unlikely that many pre-code cylinders will have restraints. Nevertheless, it is disturbing that the incidence of this defect has increased since the last survey, as we would expect to see some gradual improvement as older cylinders are replaced.

15.2 Costs of Repair

Figure 23: Outstanding Maintenance Costs per House shows the estimated costs of repairs of *"poor"* or *"serious"* defects at about $4,000 (*1994:$3,800*). This is the estimated cost needed to remedy those defects that need urgent repair for health and safety reasons or to prevent other consequential damage to the house. This represents just over 3% of the average valuation of houses[78] (excluding land) in this survey. Data collected by CRESA in their telephone survey of owners indicates that an average of around $1,500 only (1%) is currently spent on house maintenance. The implication is therefore that these houses are not being adequately maintained and their physical condition is likely to be deteriorating.

15.2.1 Expensive Components

As shown in the components which are the most expensive to repair or remedy are the subfloor vents at $970, wall cladding at $900, windows at $860 and roofing at $750. The necessity of remedying inadequate ventilation by retrofitting additional vents is debateable as the potential hazard depends on the specific circumstances of each house. ***Figure 34: Moisture Related Problems*** indicates common defects that may be associated with high subfloor moisture levels, and this shows that two of these (borer and corrosion of fasteners) have a high incidence in the surveyed houses. It may be unreasonable to include the full costs of vent installation in the outstanding maintenance costs but poor ventilation remains a problem[79]. If subfloor moisture is not extracted, it will be absorbed by the floor timbers and cause eventual decay. ***Figure 31: Subfloor Species & Moisture Contents*** indicates that 5% of the survey houses have timber moisture levels over the threshold where decay is likely to start, and 17% over the level where borer infestation is likely[80]. Subfloor moisture can also make its way into living areas, causing mould problems. ***Section 14.3: Dampness*** concluded that the interiors of half of the surveyed houses are potentially damp.

15.2.2 Cost Implications of Delay

Table 11: Additional Costs of Delay sets out the likely extra costs involved in delaying maintenance. Delays in repairing defects lead to the condition of the particular component worsening, so costing more to remedy. A delay of five years is estimated to add an extra $4,100 per house on average to the eventual repair cost, in addition to the existing outstanding maintenance costs. This does not include consequential damage to other components from defects such as inadequate subfloor ventilation, poor flashings, missing spouting etc.[81]. The most critical components in terms of repair are windows, spouting, claddings, and interior bathroom, kitchen and laundry fittings as they can deteriorate quickly after reaching a *"moderate"* condition (rating of 3), and can often cause damage to other components if not repaired quickly.

15.3 Other Attributes

15.3.1 Sample Characteristics

The telephone survey conducted by CRESA was able to provide data which can be compared to the total population, and which provides us with some key characteristics of the owners of houses in the survey sample. As shown in ***Table 2: Sample Characteristics*** the sample is largely representative of the total population in terms

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[78] *Average house valuation for surveyed houses:* ***$130,000*** *(average for original larger QV sample****: $115,000****, and for NZ:* ***$104,000****).*

[79] *Research indicates that an average 100 square metre house has an evaporation of 40 litres/day of water vapour.*

[80] *Of concern due to the high use of native timbers in our existing houses.*

[81] *The incidence and extent of this type of damage is too difficult to reliably assess, but omitting it from the estimates does not imply that there will be no damage.*

of household size, and mortgage status. 60% of owners had owned their house for more than seven years. 55% had a family income of more than $50,000, suggesting that the sample is likely to be biased towards those with higher incomes than the national average[82]. This is reinforced by house size, with the average house area of the surveyed sample being about 10% above that derived from the total QV random sample. It is also reinforced by comparisons between the average building valuations of the inspected sample, the initial (large) QV sample, and the total New Zealand housing stock[83].

This indicates that some self-selection bias had taken place between the original random sample and the surveyed sample. It is possible that owners with houses in poor condition were less likely to offer their houses for inspection, whereas those with better houses (and higher valuations and incomes) were more likely to allow inspection. This suggests the 1999 survey may **under-estimate** the extent of deterioration in the housing stock. However, the differences indicated in the charts are not major, so it is unlikely that the results will differ markedly from those expected for the total population of the original sample.

15.3.2 Households Related to Conditions

The survey hoped to be able to relate households to the physical condition of their houses, with the aim being to explore the probability that particular households will own the best or the worst houses. ***Figure 17: Households in Worst Houses*** and ***Figure 18: Households in Best Houses*** show the household characteristics associated with the upper and lower decile of houses in the survey.

The conclusion is that there appears to be no one single group which is over-represented in the worst houses, with the strongest variances being: lower numbers of higher income households, higher numbers of younger owners, and higher numbers of mortgages.

However for the best houses, there are more associated characteristics. In this group we find higher numbers of high income households, only about one third holding mortgages, smaller households than the sample, and higher numbers of older (over fifty) owners than the sample.

15.3.3 Insulation

The survey gathered sufficient detail on ceiling insulation to enable rating of this element on the same basis as the 1994 survey for comparison purposes. However, additional analysis has been carried out in order to present a better indication of the state of insulation in New Zealand houses.

As well as ceiling insulation, the presence of wall insulation was also noted (with estimated percentages), although it was impossible to provide accurate details. Double glazing was also noted (with relevant orientations).

For ceilings, the main findings were that most houses (60%) have full coverage of ceiling insulation[84], and very few are completely uninsulated. However, almost a quarter of houses built since the introduction of mandatory standards have ceiling insulation which does not fully comply. More than 70% of pre-1970's houses in Wellington have fully insulated ceilings, in contrast to only 60% in Christchurch. Houses with the lowest level of ceiling insulation are those built in the 1930's to 1940's.

More than 60% of houses have no wall insulation, and only a quarter have all walls insulated. 70% of houses have uninsulated floors, and very few houses have thermally efficient windows.

15.3.4 Hot Water Systems

The survey collected information on the types, sizes, ages, and thermostat settings of hot water cylinders in the houses surveyed. From this information, the energy efficiency, storage capacity and safety of hot water systems was assessed.

Commonly held industry opinions on the performance, efficiency, and safety of domestic hot water systems appear to be confirmed by the results. As far as storage capacity is concerned, more than half of the houses with electric storage systems have 180 litre cylinders, although more than one third still have 135 litre cylinders. Only 60% of the electric cylinders are adequately sized to meet the potential demands for hot water delivery. Most

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[82] *However, this must be balanced by the fact that a significant proportion of owners have partners also in paid employment.*

[83] *Average house valuation for surveyed houses:* ***$130,000*** *(average for original larger QV sample****: $115,000****, and for NZ:* ***$104,000****).*

[84] *Regardless of the particular material or thickness.*

cylinders waste energy: over 30% of houses have old (ungraded) cylinders, over 20% have C grade cylinders. Only 7% have A grade cylinders (the most efficient type of electric cylinder readily available). Many houses have very old electric cylinders (a quarter are over 40 years old), which are well past the average expected life[85]. Many cylinders stored water at unsafe temperatures: well over a third stored water at temperatures above that required to minimise the risk of scalding at taps (with about 30% at dangerously high levels). Another 30% were set at below the temperature required by the Building Code[86].

15.3.5 Heating

Information on heating was collected for each house in the survey. The number and types of heaters and/or heating systems were identified, together with associated equipment such as dehumidifiers and ventilation systems. This data should help to form an impression of how New Zealand houses are heated.

The conclusions are that most houses use a combination of individual stand-alone heaters (both portable and fixed). The most common portable heaters are fan or bar heaters, followed by "oil column" convection heaters. The most common fixed heaters were woodburners, with more than 40% of the houses having a woodburner. More than 20% of houses still have open fires.

20% of houses have LPG heaters, and more than 10% have dehumidifiers. Houses with unflued natural gas or LPG heaters have more than twice the rate of dehumidifier use than houses without this form of heating.

15.3.6 Security Measures

Information on security measures such as burglar alarms, window security catches and security lights was collected for each house.

Security is obviously becoming a greater concern to homeowners: it was found that nearly three-quarters of houses have at least some form of special security measures. More Auckland houses have each type of measure than Wellington and Christchurch houses. More than 40% of houses have burglar alarms (more than half of the Auckland houses have burglar alarms, while more than a quarter have them in the other two regions). More than half of the houses have security lights to most or all entry points. Over a third of Auckland and Wellington houses have safety catches to vulnerable windows, while very few were noted in Christchurch houses.

15.3.7 Maintenance Information

Responses from owners on their maintenance practices and sources of information were collected from well over half of the houses surveyed, and the results give limited but interesting insights into this area.

Analysis of the findings tell us that homeowners appear to approach the need for home maintenance in a fairly ad-hoc manner, and seek most of their information from a limited number of sources, mainly based on word of mouth.

The main features of the survey on maintenance information are that very few owners follow a planned programme of preventative maintenance, most rely on surface visual prompts that maintenance is required, and many wait for components to fail before realising that work is required. Most owners rely on advice from tradespeople for particular information, and few use books or publications as an information source. The result of this is to put most of the responsibility for ensuring that owners get sound information onto the building trade, as their influence on owners' decisions is obviously high. More than a third of owners rely on their own expertise for information but of those who do, over a quarter live in poorly maintained houses.

Due to the unexpected level of owners' perception of their own expertise being a main source of information, it was decided to see whether this confidence was borne out in the condition of the house. *Figure 57: Owners' Expertise compared with Condition* shows that only half of those houses were assessed as being well-maintained, although 80% of the relevant owners thought that their houses were in good or excellent condition. While a quarter were assessed by BRANZ as being poorly maintained, only 1% of the owners themselves assessed their house as being in *"poor"* condition.

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[85] *Usually around 30 years - owners should be encouraged to replace these with adequately sized, energy efficient models.*

[86] *60 degrees C.*

15.3.8 Interior Dampness

The aim of the assessment of the feeling of dampness was to gain some appreciation of the proportion of New Zealand houses that suffer from moisture problems. While it is known that many houses have conditions that can lead to high moisture levels, we do not know whether problems have necessarily resulted to any notable degree.

The study showed that many New Zealand house interiors are damp, which is to be expected from the high incidence of conditions that can lead to such problems. 30% of houses were assessed as feeling damp or smelling musty. At least 40% of houses are concluded as being damp during winter months, and this is likely to be as high as 50%. A large number of houses have at least one dehumidifier. Without these, it is estimated that a further almost 10% of houses would be damp. There are concerns that, as dehumidifier use increases, the causes of moisture problems may be ignored.

15.3.9 Fire Safety

The inspectors were asked to count smoke detectors (and other equipment), check that they were operational, give locations and check owners' monitoring habits.

From this information, it appears that messages on fire safety in the home are having results as most New Zealand houses now have some form of fire protection device. More than 70% of houses have one or more smoke detectors (the most popular location being hallways). More than 95% of these are stand-alone battery-operated units. However, more than 7% of houses with detectors have at least one detector which is not working (more than half of these have no alarms working), and 16% of owners have never checked their detectors.

16 CONCLUSIONS

16.1 What is the average physical condition?

The average condition over the 29 components[87] inspected and rated for the survey was 3.6 on the condition scale, or between *"moderate"* and *"good"*. The composite condition deteriorated with the age of the house from between *"good"* and *"excellent"* (4.5) for the newest age group to just over *"moderate"* (3.2) for houses built prior to the 1930's. Deterioration in average condition is fairly steady for about 50 years at which age the condition appears to level out, with the older cohorts having similar average composite conditions. The difference between exterior and interior average condition also changes with age; with increasing discrepancy for older houses between the better interior condition and the worse exterior condition.

In terms of the regions surveyed, houses in Auckland were generally in the worst condition, followed by those in Wellington, with Canterbury houses on average in the best condition. This is the same pattern as observed in the 1994 survey. However, the notable difference is that Christchurch houses did not follow the pattern over age groups as described above; instead condition continued to deteriorate with age to well under the moderate level for the oldest houses, whereas the oldest houses in Auckland and Wellington remained well above that level.

16.2 Has the condition changed since the last survey?

The average condition of houses in the survey, when taken over all age cohorts, is very similar to that found in the 1994 survey. There is a slight improvement, but this is less than 3%, and therefore should not be regarded as significant. More interesting differences appear when the composite or overall average condition is broken down into interior and exterior, age groups, and regions.

Beyond an age of 60 years the condition of the average house appears constant over a large age span. This stabilising of condition (not evident in the last survey) is not due to a cessation in the deterioration of building components, rather it seems to be the consequence of renovation of the older housing stock. As older houses have become more popular over the past decades (as illustrated by the increase in building valuations of this group), many have been repaired, modernised, and upgraded; in some cases to the extent that their condition becomes comparable to that of a much newer house (particularly in the interior components). These houses counteract the effect of those that continue to deteriorate, and the net result is that the average condition stabilises and an equilibrium state is established.

However, although the average level of deterioration appears to have stabilised, the **range** of condition of these older houses appears to be increasing with age. This "polarising" effect is a result of selective renovation, and was not as evident in the last survey. This selective renovation appears to be happening in Auckland and Wellington, but is less evident in Christchurch.

16.3 What are the common maintenance problems?

The exterior components with the main problems in order of defect severity were: inadequate subfloor ventilation (or blocked existing vents), header tanks unrestrained against earthquake movement, venting from bathrooms and kitchens into roof spaces, inadequate clearance from the ground level to wall cladding, poor maintenance and deterioration of timber windows, missing or corroding subfloor fasteners, and corroding spouting. Other defects included deterioration of wall and roof claddings, and inadequate bracing of, and high moisture levels, borer and decay in subfloor timbers.

In the interior, the main problems were unrestrained hot water cylinders, and linings in bathrooms, kitchens and other areas in poor condition.

16.4 Have these changed since the last survey?

The problems highlighted in this survey remain much the same as those shown up in the last survey. Subfloor ventilation, ground clearance, and lack of earthquake restraints remain the major areas of concern with very high percentages of houses being rated as *"poor"* or serious for these components.

The incidence of inadequate clearance from ground to wall cladding has increased markedly since the last survey, but the incidence of serious defects in foundations, claddings, windows and doors, and roof framing has decreased since 1994. Internally, there are also notable decreases in the incidence of serious defects in bathroom and kitchen linings and fittings, and in laundry fittings.

16.5 Is the housing stock being adequately maintained?

Current expenditure on maintenance by owners of the houses in the survey is about $1,500 per house per year. The estimated cost required now for repairing serious or poor conditions is around $4,000. At current rates of

[87] *Composite condition.*

expenditure, this will take almost three years to repair; and in the meantime damage will be accumulating, amounting to an extra $3,000.

Based on these estimates, the housing stock is not being adequately maintained.

16.6 What is the effect of deferred maintenance?

As discussed previously, this report gives a general overview of the condition of houses in the survey. It does not investigate the issue of an appropriate backlog of maintenance work, which may reflect the owner's view on maintenance priorities. This report treats all maintenance items as equal in importance, and further work in this area to recognise and understand the variable nature of components would be worthwhile.

For example, a delay in upgrading a kitchen may well cause no added later cost, whereas the same delay in upgrading roofing, windows or cladding could cause substantial additional costs due to consequential water damage to other components. However, an owner may place the kitchen upgrade higher in priority order either due to ignorance or to the immediate effect on day-to-day living. On the other hand, an owner may be fully aware of potential repercussions of delaying maintenance and still judge that the risk is worth incurring.

In reality, all maintenance work **need** not be done all of the time – as some items may be appropriately deferred with little risk of incurring increased future costs due to consequential damage from the delay. This could be useful in targeting non-technical perceptions that may need correction, which in itself could lead to changes in approach from owners. It is important to have sufficient knowledge of the risks that may be involved in deferring maintenance work.

16.7 Is BRANZ research in the right areas?

As in the last survey, no unidentified problems in component deterioration or building performance were uncovered in this survey. All problems can be resolved using existing building techniques. Similar problems to those in 1994 of owner use were highlighted, including the blocking of vents by plants, gardens and paths, ventilation of kitchen and bathroom moisture into roof spaces, storage of waste materials in subfloor areas, and ignorance of the importance of restraints to water tanks, and of the benefits of hot water cylinder energy-saving wraps.

16.8 What else can be learned from the database?

The survey information is maintained in a computer database that will continue to provide a valuable resource for analysing component performance, and as a yardstick against which to measure future developments. This report covers only the general aspects that may be learned from the analysis of information in the database - much more detail is available than has been used by this overview, and that detail is stored on the database.

16.9 How does the data on homeowners relate to the physical data?

The data on homeowners allows us to attempt to relate the characteristics of the houses in the survey with the characteristics of their owners, and to therefore to find some of the reasons behind the results of the physical inspections. That data is also maintained in a computer database, and includes information on all of the questions asked of the homeowners. Again, more detail is available than it has been possible to use in this overview, which has attempted only to consider some of the broad general issues regarding owner characteristics and behaviour.

The information on both the physical data and the sociological data remains as a library resource available for further analysis.

16.10 Are the surveys worth continuing in the future?

This survey was well worth carrying out, in order to maintain and improve the availability of reliable information on current typical conditions of New Zealand housing. As in the first survey in 1994, vital data has been obtained on the incidence of defects by component, and on the amount of outstanding maintenance. This data confirms and adds to the findings of the first survey, and future surveys can be expected to do the same.

Over time, an increasing base of information on this critical national asset should be maintained and built on, with each survey highlighting areas of concern for future surveys. It is believed that this survey is generally representative of the average New Zealand house, although it does not include the reputed worst regions for housing conditions. As a reflection of the average house, it provides a base against which regions of concern may be measured.

16.11 Are there extra issues for future surveys?

16.11.1 Increased Objectivity

Although the survey forms were very detailed and provide valuable detailed data, future surveys should investigate the establishment of a benchmark standard. The maintenance condition could then be measured on a more objective basis in order to minimise variability between inspectors conducting the surveys, and to allow more reliable quantification of maintenance exposure.

Other methods of reducing the inherently subjective nature of the inspection process such as the use of instruments to measure relative humidity, temperatures etc. should be considered. With the increasing use of monolithic claddings, non-destructive methods of fault detection also need to be investigated in order to pick up problems that cannot be seen from surface inspection. This would also aid in the assessment of internal wall damage resulting from older stucco finishes in poor condition.

16.11.2 Life Cycle Issues

This survey did not consider life cycle issues. Some faults identified may be considered capital works rather than maintenance issues, as current building standards tend to be used as a measure of compliance. However, it may be argued that such compliance should only be considered when costing the life cycle replacement of a particular component. Renovation of a property is a mix of capital upgrade and life cycle maintenance – particularly in cases where the owner considers that upgrading adds value. Such issues should be considered in more detail in future surveys.

16.11.3 Benefits of deferred maintenance

The benefits as well as the costs of deferred maintenance can be explored further. Money not spent on maintenance can be used to reduce a mortgage thus reducing interest payments, a tangible benefit. Deferred maintenance may incur an additional cost in the future, but this additional future cost should be discounted against the present value of reductions in interest payments. The value of forgoing utility by deferring maintenance can also be addressed. An owner may place low value on repainting a house if it means that the mortgage can be reduced more quickly, even if it means a higher painting cost in the future due to additional preparation and perhaps even replacement of weatherboards.

Another issue worth considering for investigating in future surveys is whether there is a backlog of deferred maintenance that remains constant or whether this backlog is increasing over time, and also whether there are national social costs due to under-maintenance.

16.11.4 New survey components

There are several areas in this survey that are new. These should be re-examined in the light of the findings and further details added as necessary. Other components were noted but not rated on their condition. Components such as plumbing waste pipes should be considered for rating, as many such defects were noted but did not contribute towards average condition ratings.

Other items have been noted in this report as warranting further monitoring in future surveys eg. dampness, dehumidifiers, thermally efficient windows, LPG and unflued gas heaters, fire detector condition etc. Five years is a long time in terms of new products and trends, and there will be other components around in 2004 which are not anticipated now, and which may need to be added to the list of items to be considered. At the same time, older components will be showing effects of further ageing, and will need to be monitored for performance over time.

The particular items or areas highlighted in this report as warranting further investigation or monitoring in future surveys are as follows:

a) Owner perception of condition in relation to:
- *i) valuations*
- *ii) regional differences*
- *iii) ages of houses*

b) Changes of condition with age in relation to:

i) improvements in older housing stock
ii) regional differences (in particular Christchurch)
iii) interior versus exterior (increasing discrepancy)
iv) increasing polarisation between best and worst houses (selective renovation)

c) Monitoring of newer products

i) paint finishes to old concrete tiles
ii) new cladding materials eg. External Insulation and Finishing Systems (EIFS)
iii) equipment use eg. dehumidifiers, LPG heaters, Domestic Ventilation Systems (DVS's)
iv) increasing use of security devices
v) increasing use of fire protection devices
vi) energy efficient windows
vii) structural systems eg. galvanised steel framing, reconstituted wood fibre sheeting, concrete filled polystyrene blockwork etc.

d) Monitoring of newly added components

i) changes in decks/ramps/steps
ii) changes in carports
iii) changes in second bathrooms

e) Monitoring of older components

i) adequacy of subfloor fasteners (in Auckland houses particularly)
ii) rating of condition of plumbing wastes
iii) earthquake restraints to water tanks
iv) deterioration of older products eg. loss of chip coating to metal tiles
v) ages, storage capacities, energy efficiency and safety of hot water cylinders

f) Monitoring of moisture-related conditions

i) subfloor ventilation
ii) moisture-related defects
iii) interior dampness

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B1 Structure

B2 Durability

C3 Spread of Fire

E2 External Moisture

E3 Internal Moisture

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18 APPENDIX 1 MAIL OUT ENCLOSURES

18.1 Initial Letter

Dear Homeowner

HOME MAINTENANCE RESEARCH

The Building Research Association of New Zealand (BRANZ) is a research and development organization funded by the building industry. It is the main building research and advisory organization in New Zealand and has been in existence for over 25 years.

We are surveying the maintenance condition of the New Zealand housing stock which has an estimated value of $90 billion. This survey is part of BRANZ's ongoing work to improve the quality and performance of housing in New Zealand. To complete such a survey requires the assistance of the New Zealand public.

The survey is in two parts:

1. 10 -15 minute telephone survey ;
2. Physical inspection of your property by BRANZ technical surveyors.

Your property is of the particular age group that we are interested in surveying and has been chosen from a random sample of houses in your region. BRANZ would like access to your property for a two hour inspection by one of our staff. The inspection involves checking the physical condition of various components such as the roof, walls, foundations, and also the interior aspects such as the floor, walls ceiling, roof space and services.

Information obtained from both the telephone survey and the physical house inspection will remain confidential. It will not be provided to any other organisation (not builders, local councils, government departments). A report will be published on the results of the survey but individual houses will not be identifiable.

Rewarding you for your assistance
In return for you agreeing to participate BRANZ offers you a choice of:

- The BRANZ Home Maintenance Guide (245 pages)
- $20 Scratch and Win tickets

What happens next?

An interviewer from the Business Research Centre (BRC), an independent research company, may call you over the next couple of weeks. If you have any questions, you are welcome to call Jo Parr on 0800 500 168. Thank you for your assistance.

Regards

Sarah Bishop

Building Technologist

18.2 Follow-up Letter

(date)

(address)

Dear Sir/Madam

Thank you very much for agreeing to take part in the house condition survey being conducted by the Building Research Association of New Zealand.

As you know the survey is made up of two parts. The first part was the telephone survey and this has been completed. The physical house inspection is the second part of the survey and it will be carried out in 500 houses over the next three months. You will be contacted by a BRANZ technical surveyor to organise a time that is convenient to you for this house inspection.

The surveyors will be:

Bill Irvine	**-Auckland**
Mike O'Malley	**-Wellington**
Bill Ash	**-Christchurch**

Once again thank you very much for your time and the information you have provided.

Yours faithfully

Sarah Bishop
Building Technologist

19 APPENDIX 2 BRANZ SURVEY FORMS

House ID: ……. DR0071

Surveyor: _____

Name: _____

Address: _____

_____

Date: **Start time:** **Finish time:**

1. Number of storeys
ignore un-lived-in spaces ☐

2. No. of rooms

Bedrooms	☐
Bathrooms	☐
Lounge/Sitting	☐
Separate dining	☐
Rumpus/Games	☐
Study/Sewing, etc	☐

Photos taken:
attach photo of exterior of house below
☐ front
others _____

3. Generally the building was
☐ Well maintained
☐ Reasonably maintained
☐ Poorly maintained
☐ Under construction

4. Subjective 'dampness' feel
☐ Feels very damp, smells musty
☐ Feels slightly damp
☐ Feels dry

5. Shade
☐ House always in shade
☐ House in shade throughout winter
☐ House loses sun in late afternoon or early morning
☐ House never shaded

6. Security
☐ Burglar alarm
☐ Security lights to all entry points
☐ Security lights to most entry points
☐ Safety catches on all vunerable windows
☐

If convenient ask the homeowner the following questions:
7. Maintenance information

How do you know your home needs maintaining?
☐ aesthetics, ie. peeling paint a sign that it needs re-painting
☐ failure of components, ie. leaking
☐ following a maintenance programme, requiring a particular component to be maintenance every 5 years
☐ can't tell if the home needs maintaining

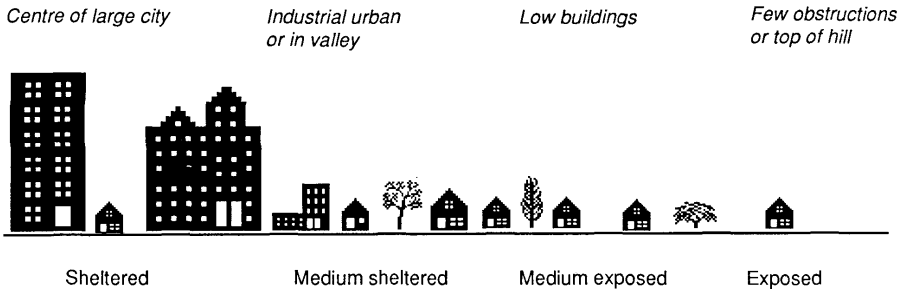
If you required information about, for example, painting the cladding/roofing of your home where would you get it from?
☐ friends or family
☐ tradesperson
☐ hardware/building stores
☐ books or publications
☐ other

BRANZ House Condition Survey **© 1998** 1

8.0 Wind exposure

Circle the wind exposure class of the house:

Wind Exposure Classes



9.0 House air tightness

tick appropriate category

		Typical example:
☐	**airtight**	post 1960, simple design, airtight joinery and windows
☐	**average**	post 1960, larger than 120 m²
☐	**leaky**	post 1960, complex shape, generally larger than 200 m² or pre 1960 with sheet lining etc
☐	**draughty**	pre 1960, strip lining (weather boards etc.), strop floors, often high stud

10.0 Surrounding area

9.1 Predominant land use in area
- ☐ residential
- ☐ industrial
- ☐ commercial
- ☐ rural
- ☐

9.2 Extent of repair/improvement activity in area
- ☐ high level of improvement activity
- ☐ some improvement activity
- ☐ no improvement activity

9.3 External condition of dwellings in area
- ☐ serious external condition
- ☐ poor external condition
- ☐ moderate external condition
- ☐ good external condition
- ☐ excellent external condition

9.4 Predominant building age in area
- ☐ less than 5 years
- ☐ between 5 and 15 years
- ☐ between 15 and 25 years
- ☐ greater than 25 years

11.0 House layout

draw plan of house (exterior walls only)
indicate overall dimensions (including height to eave)
indicate percentage glazing to each elevation

12.0 Foundations

- [ ] Concrete slab — perimeter insulation [ ] / underslab insulation [ ] / no insulation [ ]
- [ ] Continuous concrete perimeter walls
- [ ] Corner concrete perimeter walls
- [ ] Concrete pile
- [ ] Concrete block
- [ ] Brick
- [ ] Treated timber piles
- [ ] Untreated timber piles
- [ ] Jack stud

Ground clearance

Min. clearance to cladding: _____ mm

Min. clearance to bearers: _____ mm

Unprotected ground? **yes / no**

Cladd deteriorating near ground? **yes / no**

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes, indicate frequency of each defect

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
[ ] subsidence				
[ ] water ponding under house				
[ ] non vertical piles				
[ ] missing pile(s)				
[ ] unsafe excavation				
[ ] timber decay				
[ ] two tooth borer				
[ ] common borer				
[ ] structural cracks				
[ ] non structural cracks				
[ ] deep spalling or holes				
[ ] broken blocks				

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
[ ] missing mortar				
[ ] rising damp				
[ ] dpm missing				
[ ] insufficient footing depth				
[ ] inadequate bracing				
[ ] missing/rotten baseboards				
[ ] exterior plaster spalling				
[ ] missing/insecure ties to bearers				
[ ] nail plates/fasteners deformed				
[ ] poor fixing				
[ ] minor blemishes				

13.0 Fasteners

- [ ] No.8 Wire & Staples
- [ ] Wire dogs
- [ ] Galv nail plates
- [ ] Galv bolts
- [ ] Galv strip
- [ ] Non galv rod
- [ ] None

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
[ ] base mat. >50% corroded thru				
[ ] failure of coating				
[ ] white rust				

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
[ ] some corrosion				
[ ] incorrect fixing of fasteners				

14.0 Steps/Ramps including deck surfacing and handrails

- [ ] deck
- [ ] steps
- [ ] ramp

Surface and structure — timber [ ] / concrete [ ] / metal [ ]

Handrail — timber [ ] / metal [ ]

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes

- [ ] missing treads
- [ ] rotting timber
- [ ] uneven risers
- [ ] unsafe surface
- [ ] unsafe structure

15.0 Subfloor

☐ No access to subfloor

Ground covering

☐ plastic
☐

% covered ☐

Floor insulation

☐ none
☐ foil
☐

Plumbing wastes

☐ copper
☐ pvc
☐

Water reticulation

☐ copper
☐ polybutylene
☐ galvanised steel
☐

16.0 Joists/Bearers

☐ Treated radiata
☐ Untreated radiata
☐ Native
☐

Sub floor moisture

readings on 2 joists (5m apart)
2 readings from floor (5m apart)

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes, indicate frequency of each defect

		0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐	timber decay				
☐	two toothed borer				
☐	common borer				
☐	insufficient joists/bearers				

		0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐	structural cracks				
☐	minor cracks/checking				
☐	insulation decaying				
☐					

17.0 Floor

☐ T&G
☐ Particle board
☐

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes, indicate frequency of each defect

		0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐	timber decay				
☐	two toothed borer				
☐	common borer				
☐	cupped boards				
☐	floor squeeks				

		0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐	holes				
☐	minor gaps bet. partbd sheets				
☐					
☐					
☐					

18.0 Vents (sub floor)

☐ **No subfloor ventilation**

Type

☐ Baseboards ☐ Continuous 20 mm ventilation gap

☐ Concrete
☐ Pressed metal
☐ Wire
☐

Number of vents:

Clear area of a typical vent:

Floor area of house:

Spacing

☐ vents not on all sides
☐ vents not within 0.75m of corner
☐ vents greater than 1.8m spacing

Vegetation

☐ vegetation blocking all vents
☐ vegetation blocking some vents
☐ no vegetation blocking vents

19.0 Wall Cladding

	Painted		Painted
☐ Weatherboards - Unknown	☐	☐ Fibre cement sheet	☐
☐ Pine	☐	☐ Fibre cement plank	☐
☐ Native	☐	☐ EIFS	☐
☐ Cedar/Redwood	☐	☐ Corrugated steel	☐
☐ Clay brick	☐	☐ Solid timber	☐
☐ Concrete brick	☐	☐ Plywood	☐
☐ Concrete block	☐	☐	☐
☐ Stucco	☐	☐	☐

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes, indicate frequency of each defect

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %		0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐ missing cladding	☐	☐	☐	☐	☐ corrosion of reinforcing	☐	☐	☐	☐
☐ dislodged boards	☐	☐	☐	☐	☐ drummy reinforcing	☐	☐	☐	☐
☐ broken blocks/sheets	☐	☐	☐	☐	☐ corrosion of metal components	☐	☐	☐	☐
☐ missing bricks	☐	☐	☐	☐	☐ loose fibres	☐	☐	☐	☐
☐ missing plaster	☐	☐	☐	☐	☐ paint deterioration	☐	☐	☐	☐
☐ missing mortar	☐	☐	☐	☐	☐ top coat deterioration	☐	☐	☐	☐
☐ efflorescence	☐	☐	☐	☐	☐ fungi growth	☐	☐	☐	☐
☐ insecure cladding	☐	☐	☐	☐	☐ unflashed paraphets	☐	☐	☐	☐
☐ full depth holes/cracks	☐	☐	☐	☐	☐ faulty flashings	☐	☐	☐	☐
☐ checking	☐	☐	☐	☐	☐ leaking at joints	☐	☐	☐	☐
☐ minor cracks	☐	☐	☐	☐	☐ joint cracking	☐	☐	☐	☐
☐ decay	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐ two toothed borer	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐ common borer	☐	☐	☐	☐	☐	☐	☐	☐	☐

20.0 Exterior Doors

Number of:

- Solid timber
- Timber/Part glass
- French
- Sliding aluminium
- Aluminium
- Composite

Surface treatment

- painted
- anodised
- powder-coated
- polyeurethane/stain
- none

ZZ (circle)

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes, indicate frequency of each defect

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100
missing glass				
missing/inoperative hardware				
poor hardware				
paint deterioration				
top coat deterioration				

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100
holes				
sticking door				
cracks				

21.0 Windows

%

- Timber
- Anodised aluminium
- Powder coated aluminium

%

- Percentage of thermally broken windows?
- What percentage are double glazed windows?

Which directions do the double glazed windows face? (ie. N, NE, E, SE, S, SW, W, NW)

ZZ (circle)

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes, indicate frequency of each defect

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100
decay				
leaking flashing				
no flashings				
significant pitting				
broken hinges				
windows sticking				
broken/cracked panes				
glazing mouldings in poor cond				
loose rubber				
missing rubber				
checking in timber				

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100
putty cracks				
dislodged /missing putty				
metal corrosion				
nail rust staining				
stressed joints				
joint cracks				
paint deterioration to bare timber				
minor coating/anodising failures				
drain holes plugged up				

22.0 Basement/garage (One or more walls below ground)

- Concrete Block
- Not known
- Insitu concrete

Basement Room Use

- Garage
- Laundry
- Living/Bedroom
- Bathroom

Leaks

yes / no / don't know

23.0 Roof

Inspect 2 sides of roof where possible from ladder

- ☐ Metal Tiles
- ☐ Galv Corru Steel
- ☐ Coil Coated Steel
- ☐ Concrete Tile
- ☐ Clay Tiles
- ☐ Asbestos
- ☐ Membrane

Painted ☐

Roof Type

- ☐ Gable
- ☐ Hip
- ☐ Dutch Gable
- ☐ Flat
- ☐ Mansard

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes, indicate frequency of each defect

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐ missing sheets/tiles	☐	☐	☐	☐
☐ cracked/dislodged tiles	☐	☐	☐	☐
☐ corrosion of base metal	☐	☐	☐	☐
☐ holes/cracks/dents	☐	☐	☐	☐
☐ rust in internal gutters	☐	☐	☐	☐
☐ internal gutters leaking	☐	☐	☐	☐
☐ chip coat missing	☐	☐	☐	☐

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐ dislodged pointing	☐	☐	☐	☐
☐ deterioration of fixings	☐	☐	☐	☐
☐ missing/loose fixings	☐	☐	☐	☐
☐ insufficient fixings	☐	☐	☐	☐
☐ top coat deterioration	☐	☐	☐	☐
☐ paint flaking	☐	☐	☐	☐
☐ moss growth	☐	☐	☐	☐

24.0 Spouting and downpipes

- ☐ PVC
- ☐ Galv Steel
- ☐ Copper

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes, indicate frequency of each defect

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐ missing spouting/downpipes	☐	☐	☐	☐
☐ uneven fall	☐	☐	☐	☐
☐ missing supports	☐	☐	☐	☐

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐ holes	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐

25.0 Carport (attached to house)

Roofing

- ☐ as house

Cladding

- ☐ as house

Structure

- ☐ timber
- ☐ steel
- ☐ concrete block

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes, indicate frequency of each defect

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐ insufficient fixing at perimeter	☐	☐	☐	☐
☐ missing connectors	☐	☐	☐	☐
	☐	☐	☐	☐

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐ inadequate bracing	☐	☐	☐	☐
☐ inadequate fixing to house	☐	☐	☐	☐
	☐	☐	☐	☐

26.0 Roofspace

☐ **No access to roofspace**

☐ Skillion roof (percentage)

☐ Truss

Rafters/Purlins/Ceiling joists

☐ Treated radiata
☐ Untreated radiata
☐ Native
☐

☐ Roof Sarking
☐ Ceiling Sarking

Roof Slope

☐ 0-15 degrees
☐ 16 -30 degrees
☐ > 30 degrees

Ceiling Insulation

% cover	%
Fibreglass	
Macerated paper	
Rocwool	
Other (State)	
None	

Thickness	tick
50 mm	
75	
100	
150	

Wiring

Tough Plastic Sheath ☐
Tough Rubber Sheath ☐
Vulcanised Indian Rubber ☐

27.0 Rafters, Purlins & Ceiling joists

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes, indicate frequency of each defect

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐ timber decay				
☐ insufficient joists				
☐ insufficient purlins				
☐ minor splitting				

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100 %
☐ two tooth borer				
☐ common borer				
☐				
☐				

Roofspace moisture

reading from one ceiling joist

28.0 Header Tank/Ties/Underlay

☐ internal header tank
☐ external header tank

Z ZZ (serious, poor, moderate, good, excellent)

Header tank	
Roofing ties	
Underlay	

tick appropriate defect boxes

☐ header tank unrestrained
☐ no tray
☐ leaking
☐ no lid
☐ hazards in tank
☐ insufficient ties to concrete tiles

☐ no underlay
☐ underlay deterioration
☐ exposed roofing
☐
☐
☐

29.0 Bathroom

When was the bathroom last refurbished:

- ☐ in the last 5 years
- ☐ between 5 -10 years ago
- ☐ between 10 -25 years ago
- ☐ more than 25 years

Linings

	Main			Second		
	Ceiling	Walls	Floor cover	Ceiling	Walls	Floor cover
Plasterboard	☐	☐	☐	☐	☐	☐
Hardboard	☐	☐	☐	☐	☐	☐
Softboard	☐	☐	☐	☐	☐	☐
Particleboard	☐	☐	☐	☐	☐	☐
Seratone/Riotone	☐	☐	☐	☐	☐	☐
Hardiglaze	☐	☐	☐	☐	☐	☐
Carpet	☐	☐	☐	☐	☐	☐
Ceramic tiles	☐	☐	☐	☐	☐	☐
Vinyl	☐	☐	☐	☐	☐	☐
none	☐	☐	☐	☐	☐	☐

Fittings

	Main	Second
Bath	☐	☐
Shower over bath	☐	☐
Sep. shower cubicle	☐	☐
Toilet in bathroom	☐	☐
Sep. toilet cubicle	☐	☐
Heated towelrail	☐	☐

heater type …… …… …… …… …… …… …… …… ……

Mechanical ventilation

- ☐ none
- ☐ to outside
- ☐ to roof space
- ☐ to another room

29.1 Bathroom fittings

Z ZZ *(circle)*

Main	Serious	Poor	Moderate	Good	Excellent
Second	Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes

- ☐ cracked/chipped enamel
- ☐ rotten shower linings
- ☐ staining of surfaces
- ☐ shower tray pitted
- ☐ broken seat or cistern
- ☐ leaking outlets

29.2 Bathroom linings

Z ZZ *(circle)*

Main	Serious	Poor	Moderate	Good	Excellent
Second	Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes

- ☐ decay
- ☐ chipped/peeling paint/paper
- ☐ reveals/sills cracked
- ☐ coating/lining blemishes
- ☐ two tooth borer
- ☐ common borer
- ☐ water stains

Z

Main	Second	
☐	☐	extensively blackened areas, damaged linings
☐	☐	extensive mould
☐	☐	large patches of mould
☐	☐	very little mould visible
☐	☐	no mould

30.0 Kitchen

When was the kitchen last refurbished:

- ☐ in the last 5 years
- ☐ between 5 -10 years ago
- ☐ between 10 -25 years ago
- ☐ more than 25 years

Linings

	Ceiling	Walls	Floor cover
Plasterboard	☐	☐	☐
Hardboard	☐	☐	☐
Softboard	☐	☐	☐
Particleboard	☐	☐	☐
Timber strip	☐	☐	☐
Formica	☐	☐	☐
Vinyl	☐	☐	☐
Ceramic tiles	☐	☐	☐
Carpet	☐	☐	☐
Cork tiles	☐	☐	☐
none	☐	☐	☐

Joinery/Bench

- ☐ Stainless Steel
- ☐ Formica
- ☐ Timber
- ☐

Range

- ☐ Electric
- ☐ Gas
- ☐ Coal/Wood

Mechanical ventilation

- ☐ None
- ☐ Rangehood
- ☐ Positive ventilation e.g. expelair

- ☐ venting to outside
- ☐ venting to roof space
- ☐ venting to another room

30.1 Kitchen linings

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes

- ☐ holes in linings
- ☐ damaged wiring/outlet/switches
- ☐ decay
- ☐ paint deterioration to bare timber
- ☐ unsafe floor cover
- ☐ chipped/peeling of paint/paper
- ☐ discoloured paint/paper

- ☐ holes in floor
- ☐ fat build up in rangehood/fans
- ☐ worn timber edges
- ☐ reveals/sills cracked
- ☐ water stains
- ☐
- ☐

Z

- ☐ extensively blackened areas, damaged linings
- ☐ extensive mould
- ☐ large patches of mould
- ☐ very little mould visible
- ☐ no mould

30.2 Kitchen joinery/bench

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes

- ☐ cracked/dented surfaces
- ☐ poor seals at bench top
- ☐ worn joinery edges
- ☐ leaking outlets
- ☐ taps deterioration
- ☐

30.3 Range including separate oven and hobs

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes

- ☐ damaged elements
- ☐ damaged seals
- ☐ fire risk
- ☐

31.0 Laundry

Linings

	Ceiling	Walls	Floor cover
Plasterboard	☐	☐	☐
Hardboard	☐	☐	☐
Softboard	☐	☐	☐
Particleboard	☐	☐	☐
Timber strip	☐	☐	☐
Formica	☐	☐	☐
Vinyl	☐	☐	☐
Ceramic tiles	☐	☐	☐
Carpet	☐	☐	☐
Cork tiles	☐	☐	☐
None	☐	☐	☐

Fittings

- ☐ Tub, Stainless Steel
- ☐ Tub, Concrete
- ☐ Washing Machine
- ☐ Dryer
- ☐

Mechanical ventilation (room)

- ☐ none
- ☐ to outside
- ☐ to roof space
- ☐ to another room

Dryer ventilation

- ☐ none
- ☐ to outside
- ☐ to roof space
- ☐ to another room

31.1 Laundry linings

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes

- ☐ holes in linings
- ☐ damaged wiring/outlet/switches
- ☐ paint deterioration to bare timber
- ☐ unsafe floor cover
- ☐ discoloured/peeling paint/paper
- ☐ water stains

- ☐ holes in floor
- ☐ worn timber edges
- ☐ mdf skirting swelling
- ☐ reveals/sills cracked

Z

- ☐ extensively blackened areas, damaged linings
- ☐ extensive mould
- ☐ large patches of mould
- ☐ very little mould visible
- ☐ no mould

31.2 Laundry fittings

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes

- ☐ cracked/dented surfaces
- ☐ poor seals at sink top
- ☐ taps deterioration

- ☐ leaking outlets
- ☐ worn joinery edges

31.3 Hot Water Cylinder

- ☐ Electric
- ☐ Gas
- ☐ Wetback

Age	
Size	
Grade	
Insulated	yes/no
Thermostat setting	

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes

- ☐ leaking at connections
- ☐ wiring damage
- ☐ no effective EQ restraint

- ☐ gas flue damage

32.0 Interior Linings

(Excl. kitchen/bathroom/laundry)

Linings

	Ceiling	Walls	Floor covering
Plasterboard	☐	☐	☐
Hardboard	☐	☐	☐
Particleboard	☐	☐	☐
Fibrous plaster	☐	☐	☐
Softboard	☐	☐	☐
Timber strip	☐	☐	☐
Formica	☐	☐	☐
Vinyl	☐	☐	☐
Ceramic tiles	☐	☐	☐
Carpet	☐	☐	☐
Cork tiles	☐	☐	☐
none	☐	☐	☐

Wall Insulation

- ☐ Fibreglass
- ☐ Macerated Paper
- ☐ RocWool
- ☐ Foil
- ☐ None

- inspect by removing switch at one location

Surface treatment

Painted/Stained	☐	☐	☐
Papered	☐	☐	☐
Polyeurethane	☐	☐	☐

MDF Reveals Z

yes / no

32.1 Linings/Finishes/Sills

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes

- ☐ holes in linings
- ☐ holes in floor
- ☐ damaged wiring/outlet/switches
- ☐ discoloured/peeling paint/paper
- ☐ minor coating / lining blemishes
- ☐ water stains
- ☐ borer in sills/mouldings
- ☐ worn timber edges
- ☐ unsafe floor covering
- ☐ reveals/sills cracked
- ☐ minor cracking in wall and ceiling lining
- ☐ nail popping
- ☐ peaking

Z

- ☐ extensively blackened areas, damaged linings
- ☐ extensive mould
- ☐ large patches of mould
- ☐ very little mould visible
- ☐ no mould

32.2 Internal doors/hardware

Internal Doors

- ☐ Hollowcore
- ☐ Solid timber
- ☐ Timber & glass
- ☐

☐ % of windows with ventilators

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes

- ☐ holes in door
- ☐ missing/broken hardware
- ☐ minor cracks/wear
- ☐ borer
- ☐ worn hardware

33.0 Heating *(Excl. kitchen/bathroom/laundry)*

Fixed heaters (number)

- electric night store
- electric panel heaters
- electric radiators
- electric central heating
- electric under-floor heating
- electric wall fan
- enclosed wood burner/pot belly
- open fire
- solid or liquid fuel fired central heating
- reticulated natural gas (flued), non central
- reticulated natural gas (unflued), non central
- gas central heating
- gas underfloor heating
- air conditioner

Portable heaters (number)

- electric fan / bar radiator
- portable convection heater
- portable kerosene
- LPG heater
- dehumidifier

34.0 Fireplace/Chimney

Chimney

- Clay brick
- Concrete
- Pumice
- Steel

Z ZZ *(circle)*

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes, indicate frequency of each defect

- missing bricks
- missing mortar
- broken/missing bricks (chimney)
- cracked concrete/bricks (chimney)
- chimney touching combustible materials
- poor flue installation
- spalling reinforcing

35.0 Fire Safety

Total number of smoke alarms

Mains/battery powered? (circle)

yes/no Are the smoke alarms interconnected?
yes/no Are the smoke alarms operational?

Additional fire protection equipment:

- Fire Extinguisher
- Hose Reel
- Fire Blanket

Number of smoke alarm in these locations:

- Hallway
- Lounge
- Bedrooms
- Kitchen
- Dining
- Garage

How often do the occupiers check if the smoke alarms are functioning: (circle) once a week / once a fortnight / once a month / less frequently / never

How frequently do the occupants change the batteries:_____

36.0 Separate garage

Usage

- used for living in
- used for storage
- car garage

COMPLETE THE REST OF THIS SECTION ONLY IF THE GARAGE IS LIVED IN

Floor

- concrete slab
- timber
- height of concrete slab above ground

Cladding

- concrete block
- metal weatherboard
- fibre cement sheet/planks
- corrugated steel
- timber weatherboard

External doors

- solid timber
- timber part glass
- aluminium
- metal clad

Windows

- timber
- anodised aluminium
- powdercoated aluminium

Roofing

- coilcoated steel
- galvanised corrugated steel
- metal tiles
- painted
- asbestos
- concrete tiles
- painted

Framing and internal linings

- treated radiata framing, no lining
- untreated radiata framing, no lining
- native timber framing, no lining
- hardboard
- particleboard
- plasterboard
- softboard
- timber strip

Internal partitioning

- timber partitions
- curtains

Internal fixtures/fittings

- shower
- toilet
- sink unit
- laundry tub
- washing machine
- dryer

ZZ (circle)

Serious	Poor	Moderate	Good	Excellent

tick appropriate defect boxes, & indicate frequency of each defect

	0 - 10 %	10 - 25	25 - 50	50 - 100
dpm (plastic sheet) missing				
water lying around floor from dp's				
missing cladding sheets				
corrosion of base metal				
significant pitting				
moss growth				
deterioration of fixings				
missing/loose fixings				
top coat deterioration (exterior)				
exterior paint flaking				
broken glass				

	0 - 10 %	10 - 25 %	25 - 50 %	50 - 100
missing internal linings				
holes in internal linings				
damp/mouldy floor coverings				
damp/mouldy internal linings				
damage/peeling of internal paint coating				
chipped/broken fixtures				
staining of surfaces				
damaged surfaces				
leaking outlets				
borer				

20 APPENDIX 3 CLADDING & WINDOW DEFECTS

WALL CLADDING DEFECTS

	missing cladding	dislodged boards	missing plaster	efflorescence	insecure cladding	full depth holes/cracks	checking	minor cracks	decay	common borer	nail/metal corrosion	paint deterioration	top coat deterioration	fungi growth	faulty flashings	leaking at joints	joint cracking
1 (<10%)	9	11	8	14	13	60	64	112	43	24	52	52	18	40	14	7	47
2 (10 to 25%)	0	0	0	5	1	4	13	20	3	6	7	24	14	17	6	2	12
3 (25 to 50%)	0	0	0	3	0	1	0	5	0	5	6	13	6	1	2	1	3
4 (>50%)	0	0	0	0	0	1	2	2	0	1	2	68	51	4	3	2	2
Totals	**9**	**11**	**8**	**22**	**14**	**66**	**79**	**139**	**46**	**36**	**67**	**157**	**89**	**62**	**25**	**12**	**64**
% of sample	2%	3%	4%	24%	3%	19%	24%	30%	14%	11%	15%	35%	19%	13%	5%	3%	19%

ROOF DEFECTS

	base metal corrosion	holes/cracks/dents	rust in internal gutters	chip coat missing	dislodged pointing	deterioration of fixings	missing/loose fixings	insufficient fixings	top coat deterioration	paint flaking	moss growth
1 (<10%)	28	39	12	14	21	18	41	3	11	7	64
2 (10 to 25%)	18	15	3	13	1	15	6	1	4	13	18
3 (25 to 50%)	9	4	0	6	1	6	3	2	11	6	14
4 (>50%)	7	3	3	3	2	12	2	3	72	14	5
Totals	**62**	**61**	**18**	**36**	**25**	**51**	**52**	**9**	**98**	**40**	**101**
% of sample	17%	13%	4%	44%	22%	14%	14%	2%	26%	14%	49%

WINDOW DEFECTS

	decay	leaking flashing	no flashings/scribers	broken hinges/stays	windows sticking	broken/cracked panes	poor glazing mouldings	loose rubber	checking in timber	putty cracks	dislodged/missing putt	metal corrosion	nail rust staining	cracked/stressed joints	paint deterioration	coating failures
1 (<10%)	33	9	15	7	47	37	4	19	75	129	71	54	83	111	71	20
2 (10 to 25%)	6	1	3	1	19	0	3	5	20	59	15	18	23	52	30	6
3 (25 to 50%)	1	0	2	1	3	0	2	4	7	24	2	7	4	27	19	6
4 (>50%)	1	2	1	0	2	0	3	1	2	18	2	5	7	10	25	16
Totals	**41**	**12**	**21**	**9**	**71**	**37**	**12**	**29**	**104**	**230**	**90**	**84**	**117**	**200**	**145**	**48**
% of sample	13%	3%	5%	2%	15%	8%	3%	18%	33%	73%	28%	18%	37%	63%	46%	30%

NOTE: *Only those defects occurring in more than 1% of applicable claddings are shown above.*

Table 15: Cladding & Window Defects

21 APPENDIX 4 AVERAGE COMPONENT CONDITION

AVERAGE COMPONENT CONDITION 94/99

EXTERIOR	*FOUNDNS*		*CLEARCE*		*FASTENERS*		*JOISTS etc*		*FLOOR*		*VENTS*		*CLADDING*		*DOORS (ext)*		*WINDOWS*		*ROOFING*		*GUTTERS*		*INSULATN*		*ROOF*		*RF SPACE*		*CHIMNEY*	
(using 1999 scale)	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*
AUCKLAND	*2.0*	3.4	*3.7*	3.5	*3.2*	3.1	*3.8*	3.9	*3.8*	3.8	*2.2*	2.3	*3.0*	3.6	*3.1*	3.6	*2.9*	3.5	*2.9*	3.5	*3.2*	3.5	*3.1*	3.3	*3.4*	3.8	*3.0*	3.1	*3.6*	3.7
WGTON	*3.4*	4.0	*3.6*	3.0	*3.7*	3.7	*3.7*	3.9	*3.9*	4.0	*2.5*	2.5	*3.0*	3.6	*3.6*	3.5	*3.1*	3.5	*2.9*	3.6	*3.3*	3.8	*3.2*	3.4	*3.7*	3.8	*2.7*	2.8	*3.4*	3.7
CHCHURCH	*3.9*	4.3	*4.1*	3.8	*3.2*	4.0	*3.7*	4.1	*3.7*	4.0	*2.8*	2.0	*3.8*	3.9	*3.4*	3.9	*3.8*	3.6	*3.6*	3.9	*3.2*	3.7	*4.2*	4.2	*3.9*	4.1	*3.1*	2.4	*3.3*	3.9
ALL	***3.2***	**3.9**	***3.8***	**3.4**	***3.5***	**3.6**	***3.7***	**3.9**	***3.8***	**4.0**	***2.5***	**2.3**	***3.2***	**3.7**	***3.4***	**3.7**	***3.3***	**3.5**	***3.1***	**3.7**	***3.2***	**3.6**	***3.5***	**3.6**	***3.7***	**3.9**	***2.9***	**2.8**	***3.4***	**3.8**
SERIOUS OR PR	*40%*	***11%***	*30%*	***44%***	*23%*	***21%***	*13%*	***7%***	*9%*	***4%***	*60%*	***75%***	*28%*	***13%***	*22%*	***8%***	*27%*	***14%***	*28%*	***11%***	*14%*	***14%***	*30%*	***26%***	*17%*	***5%***	*56%*	***59%***	*11%*	***9%***

INTERIOR	*BATHROOM FITTINGS*		*BATHROOM LININGS*		*KITCHEN LININGS*		*KITCHEN FITTINGS*		*OVEN*		*LAUNDRY LININGS*		*LAUNDRY FITTINGS*		*HWC*		*OTHER ROOMS LININGS*		*OTHER ROOMS DOORS*		*FPL*
	1994	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	*1994*	*1999*	
AUCKLAND	*3.3*	3.9	*3.1*	3.7	*3.4*	3.7	*3.5*	3.9	*3.7*	3.9	*3.3*	3.5	*3.3*	3.7	*2.4*	*2.4*	*3.3*	3.6	*3.7*	3.8	
WGTON	*3.3*	3.9	*3.4*	3.8	*3.5*	4.0	*3.5*	3.9	*4.2*	4.3	*3.4*	3.8	*3.4*	4.0	*3.2*	*3.3*	*3.5*	3.8	*3.7*	3.9	
CHCHURCH	*3.9*	4.1	*3.9*	4.0	*4.2*	4.2	*4.1*	4.1	*4.4*	4.3	*3.9*	3.8	*4*	3.9	*4.3*	*2.9*	*4.0*	3.8	*4.0*	4.1	
ALL	*3.5*	4.0	*3.5*	3.8	*3.7*	3.9	*3.7*	3.9	*4.1*	4.2	*3.5*	3.7	*3.6*	3.9	*3.2*	*2.9*	*3.6*	3.7	*3.8*	3.9	
SERIOUS OR PR	*28%*	**9%**	*28%*	**11%**	*24%*	**7%**	*22%*	**9%**	*8%*	**4%**	*22%*	**15%**	*24%*	**8%**	*50%*	**64%**	*17%*	**9%**	*7%*	**5%**	*4%*

	1994	*1999*
AUCKLAND	3.3	3.5
WGTON	3.5	3.7
CHCHURCH	3.8	3.8
ALL REGIONS	**3.5**	**3.6**
AUCKLAND	3.3	3.4
WGTON	3.4	3.5
CHCHURCH	3.6	3.7
ALL REGIONS	**3.4**	**3.6**
AUCKLAND	3.5	3.6
WGTON	3.7	3.9
CHCHURCH	4.0	3.9
ALL REGIONS	**3.7**	**3.8**

ALL COMPONENTS *using adjusted figures* *excluded in 1999*

EXTERIOR COMPONENTS

INTERIOR COMPONENTS

Table 16: Average Component Conditions 1994/1999

22 APPENDIX 5 MAINTENANCE COSTS

22.1 Maintenance Costs to bring to "As New" Condition

MAINTENANCE COSTS TO BRING TO "AS NEW" CONDITION

(1994 rates - updated to 1999 dollars)

EXTERIOR	FLOOR										WALLS						ROOF							
	FOUNDATIONS		FASTENERS		JOISTS		FLOOR		VENTS		CLADDING		WINDOWS		CHIMNEY		CLADDING		SPOUTING		RAFTERS		OTHER	
	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**
EXCELLENT	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**
GOOD	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**
MODERATE	300	**361**	150	**180**	300	**361**	400	**481**	300	**361**	1200	**1442**	1000	**1202**	1000	**1202**	1000	**1202**	200	**240**	200	**240**	100	**120**
POOR	400	**481**	300	**361**	400	**481**	3000	**3606**	400	**481**	2500	**3005**	1500	**1803**	1200	**1442**	2000	**2404**	400	**481**	600	**721**	200	**240**
SERIOUS	5000	**6010**	500	**601**	4000	**4808**	3000	**3606**	1000	**1202**	8000	**9616**	7100	**8534**	1500	**1803**	5000	**6010**	600	**721**	3000	**3606**	500	**601**

	(conc)		(fibre cem)		(aluminium)	
EXCELLENT	0	**0**	0	**0**	0	**0**
GOOD	0	**0**	0	**0**	0	**0**
MODERATE	700	**841**	800	**962**	1000	**1202**
POOR	1000	**1202**	2000	**2404**	1500	**1803**
SERIOUS	2000	**2404**	5000	**6010**	5200	**6250**

INTERIOR	BATHROOM				KITCHEN						LAUNDRY						OTHER ROOMS			
	fittings		linings		linings		fittings		oven		linings		fittings		HWC		linings		Doors	
	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**	1994	**1999**
EXCELLENT	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**
GOOD	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**
MODERATE	300	**361**	400	**481**	400	**481**	500	**601**	50	**60**	300	**361**	300	**361**	50	**60**	800	**962**	300	**361**
POOR	900	**1082**	800	**962**	800	**962**	1000	**1202**	100	**120**	500	**601**	400	**481**	150	**180**	1500	**1803**	600	**721**
SERIOUS	1500	**1803**	1500	**1803**	1500	**1803**	2000	**2404**	800	**962**	800	**962**	800	**962**	800	**962**	3000	**3606**	1000	**1202**

NOTE *The above costs are for repair of the component according to its assessed condition, with costs for serious being 100% replacement*
Costs are based on a standard 130 sq.m. house. Above unit costs are factored by the ratio of the actual area to the standard area.

Table 17: Base Unit Maintenance Costs

23 APPENDIX 6 OUTSTANDING MAINTENANCE - AVERAGE COSTS

Table 18: 1999 Average Component Costs of Outstanding Maintenance

EXTERIOR

	FOUNDATION	*FASTENERS*	*JOISTS*	*FLOOR*	*VENTS*	*WALL CLADDING*	*WINDOWS*	*CHIMNEY*	*ROOFING*	*SPOUTING*	*RAFTERS*	*OTHER*	***TOTAL EXTERIOR***
All conditions	**$225**	**$127**	**$155**	**$272**	**$970**	**$898**	**$861**	**$321**	**$746**	**$149**	**$109**	**$136**	**$4,971**
Serious only	$55	$15	$42	$0	$498	$239	$191	$30	$126	$38	$20	$0	$1,254
Poor/serious	$138	$97	$97	$188	$933	$548	$405	$101	$386	$88	$51	$122	$3,155

	Bathroom linings	*Bathroom fittings*	*Kitchen linings*	*Kitchen fittings*	*Kitchen oven*	*Laundry linings*	*Laundry fittings*	*Hot Water Cylinder*	*Other linings*	*Doors & hardware*	***TOTAL INTERIOR***	***TOTAL /HOUSE***
All conditions	$239	$176	$193	$276	$19	$195	$119	$138	$444	$119	$1,917	$6,888
Serious only	$39	$13	$19	$34	$4	$15	$4	$10	$17	$2	$157	$1,411
Poor/serious	$125	$105	$70	$125	$8	$93	$40	$135	$167	$37	$906	$4,061

Table 19: Outstanding Exterior Maintenance Costs 1999/1994

	FOUNDATION	*FASTENERS*	*JOISTS*	*FLOOR*	*VENTS*	*WALL CLADDING*	*WINDOWS*	*CHIMNEY*	*ROOFING*	*SPOUTING*	*RAFTERS*	*OTHER*	***TOTAL EXTERIOR***
1999 costs	**$225**	**$127**	**$155**	**$272**	**$970**	**$898**	**$861**	**$321**	**$746**	**$149**	**$109**	**$136**	**$4,971**
1994 costs in 1999$s	$194	$23	$46	$81	$809	$282	$278	$367	$332	$42	$38	$125	$2,616

	Bathroom linings	*Bathroom fittings*	*Kitchen linings*	*Kitchen fittings*	*Kitchen oven*	*Laundry linings*	*Laundry fittings*	*Hot Water Cylinder*	*Other linings*	*Doors & hardware*	***TOTAL INTERIOR***	***TOTAL /HOUSE***
1999 costs	**$239**	**$176**	**$193**	**$276**	**$19**	**$195**	**$119**	**$138**	**$444**	**$119**	**$1,917**	**$6,888**
1994 costs in 1999$s	$385	$375	$313	$365	$31	$219	$175	$97	$543	$143	$2,647	$5,262

24 APPENDIX 7 CRESA TELEPHONE SURVEY

24.1 HOME MAINTENANCE QUESTIONNAIRE

START TIME:_____.

1. How long have you lived at this address?

   1 Less than one year

   2 1 - 4 years

   3 5 - 7 years

   4 More than 7 years

2. Do you own this house **READ**

   1 With a mortgage? or

   2 Mortgage Free?

3. Do you intend to sell and move out of this house within the next 12 months?

   1 Yes

   2 No

   3 Unsure

4. When you first bought this house, how would you describe its overall condition, both inside and out? **READ**

   1 Excellent - No immediate repair and maintenance needed

   2 Good - Minor maintenance needed

   3 Average - Some repair and maintenance needed

   4 Poor - Immediate repair and maintenance needed, or

   5 Very poor - Extensive and immediate repair and maintenance needed

5. How would you describe the current condition of your house? **READ**

   1 Excellent - No immediate repair and maintenance needed

   2 Good - Minor maintenance needed

   3 Average - Some repair and maintenance needed

   4 Poor - Immediate repair and maintenance needed

   5 Very poor - Extensive and immediate repair and maintenance needed

6. During the last 12 months, have you had any repairs, painting or replacement to any parts of your house? We do not want to hear about re-modelling, unless it was prompted by a need for repair.

   1 Yes

   2 No **→ Go to Question 9**

CRESA © 1998 1

6(a) Which parts of your house were those? I'll start with outside parts.
IF NEEDED: Did you paint, repair, or replace?

READ	**Paint**	**Repair**	**Replace**	**None**
(a) Roof - paint, repair, replace	1,	2,	3,	4,
(b) Outside walls	1,	2,	3,	4,
(c) Windows	1,	2,	3,	4,
(d) Guttering/downpipes	1,	2,	3,	4,
(e) Outside doors	1,	2,	3,	4,
(f) Foundation piles	1,	2,	3,	4,

Now I'll read some inside parts **READ**	**Paint**	**Repair**	**Replace**	**None**
(g) Kitchen fitting (cupboards/benches etc)	1,	2,	3,	4,
(h) Kitchen walls, ceilings, floor coverings	1,	2,	3,	4,
(i) Bathroom fittings (cupboards, basin, shower etc)	1,	2,	3,	4,
(j) Bathroom walls, ceilings or floor coverings	1,	2,	3,	4,
(k) Living room walls, ceilings, floor covering	1,	2,	3,	4,
(l) Bedroom walls, ceilings, floor covering	1,	2,	3,	4,
(m) *Other (specify)*_____	1,	2,	3,	4,

7. Who did the repairs, painting or replacements on your house over the last 12 months?
READ

1 Yourself

2 Other family members living in the house

3 Paid tradesmen

4 Other paid people

5 Other unpaid people

8. How much did you spend on maintenance or repairs over the last 12 months?
READ

1 $0

2 $1-$650

3 $651-$1300

4 $1301-$2600

5 Over $2600

6 *Don't know*

9. Did you decide to delay or defer any maintenance in the last 12 months?

1 Yes

2 No → ***Go to Question 10***

9(a) What was the main reason for delaying or deferring maintenance?
READ, CODE ONE

1 Inconvenient

2 Wanted better information

3 Too expensive

4 Maintenance not serious

5 Other

IF NEEDED: What was the one most important reason?

10. How much do you expect to spend on maintenance or repairs in the next 12 months?
READ

1 $0

2 $1-$650

3 $651-$1300

4 $1301-$2600

5 Over $2600

6 *Don't know*

11. **[INTENTIONALLY OMITTED]**

12. What age group are you? **READ**

1 Under 24 years

2 25 - 49

3 50 - 64

4 65 or over

5 Refused

13. Which of the following BEST describes you? **READ**

1 Wage and salary earner

2 Self-employed with no employees

3 Self-employed with employees

4 Homemaker

5 Not in paid work, seeking employment

6 Other

14. Do you have a partner living with you?

1 Yes

2 No **→ Go to Question 16**

15(a) Which of the following BEST describes your partner? **READ**

1 Wage and salary earner

2 Self-employed with no employees

3 Self-employed with employees

4 Homemaker

5 Not in paid work, seeking employment

6 Other

15(b) Last year, what was the COMBINED annual income before tax for you and your partner? **READ**

1 $10,000 or less

2 $10,001-$20,000

3 $20,001-$30,000

4 $30,001-$40,000

5 $40,001-$50,000

6 Over $50,000

7 *Refused*

8 *Don't know*

→ SKIP TO Q17

16. Last year, what was your annual income before tax? **READ**

1 $10,000 or less

2 $10,001-$20,000

3 $20,001-$30,000

4 $30,001-$40,000

5 $40,001-$50,000

6 Over $50,000

7 *Refused*

8 *Don't know*

17. How many people, 15 years and older usually live in your house? [_____]

18. How many people less than 15 usually live in your house? [_____]

CHECK Q14, IF RESPONDENT LIVES WITH A PARTNER, AND Q17 IS CODED "2" AND Q18 IS CODED "0", OR IF PERSON ALONE IN HOUSE, THEN →SKIP TO Q2O.

19. Which of these people live in your house with you? **READ**

1, Your mother or mother-in-law

2, Your father or father -in-law

3, Son(s) and/or partner's son(s)

4, Daughter(s) and/or partner's daughter(s)

5, Sister(s) and/or partner's sister(s)

6, Brother(s) and/or partner's brother(s)

7, Other relatives of you or of a partner

8, Other people

20. Do you, or your partner, receive government income support payments?

1 No → ***Finish***

2 Yes

20(a). Which government payments are these? **READ**

1, National superannuation

2, Unemployment benefit

3, Domestic Purposes Benefit

4, Sickness or invalid's benefit

5, Other

6, Refused

24.2 CRESA Results

Question 1

Years lived at current address

Years lived at current address	***Homeowners***	***%***
1 - 4 years	134	26
5 - 7 years	72	14
More than 7 years	304	60
Total	510	

Missing cases: 0

Question 2

Mortgage status

Mortgage status	***Homeowners***	***%***
Mortgage	267	52
Mortgage-free	242	48
Total	509	

Missing cases: 1

Question 3

Intention to move/sell in the next 12 months

Intention to move/sell	***Homeowners***	***%***
Yes	34	7
No	435	85
Unsure	41	8
Total	510	

Missing cases: 0

Question 4

Assessment of condition of house when first acquired

Acquired house condition	***Homeowners***	***%***
Excellent	137	27
Good	147	29
Average	148	29
Poor	58	11
Very Poor	19	4
Total	509	

Missing cases: 1

Question 5

Assessment of the current condition house

Current house condition	***Homeowners***	***%***
Excellent	124	24
Good	264	52
Average	109	21
Poor	11	2
Very Poor	2	0
Total	510	

Missing cases: 0

Question 6

Maintenance in the last 12 months

Performed maintenance	***Homeowners***	***%***
Yes	283	56
No	227	45
Total	510	

Missing cases: 0

Question 6A - M

Types of home maintenance in the last 12 months

	Paint		*Repair*		*Replace*		*None*		*Total*
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	
Roof	50	18	53	19	19	7	178	63	300
Walls	97	34	14	5	17	6	176	62	304
Windows	80	28	35	12	33	12	156	55	304
Guttering	11	4	28	10	47	17	204	72	290
Doors	46	16	9	3	18	6	216	76	289
Foundation piles	n/a	n/a	2	1	6	2	275	97	283
Kitchen fittings	22	8	13	5	28	10	233	83	296
Kitchen surfaces	41	15	11	4	25	9	217	77	294
Bathroom fittings	22	8	25	9	71	25	193	69	311
Bathroom surfaces	59	21	23	8	50	18	187	66	319
Living surfaces	56	20	12	4	28	10	201	72	297
Bedroom surfaces	76	27	9	3	25	9	195	69	305
Others	20	7	16	6	40	14	207	73	283
	580		250		407		2,609		3,875

Missing cases: 0 Multiple response

Question 7A - E

Maintenance workers

Maintenance Worker	*Reponses*	*% responses*	*% homeowners*
Yourself	180	38	64
Other family members	74	16	26
Paid tradesmen	170	36	60
Other paid people	19	4	7
Other unpaid people	32	7	11
Total	475		

Missing cases: 0 Multiple response

Question 8

Maintenance Expenditure in the last 12 months

Maintenance Expenditure	*Homeowners*	*%*
$0	5	2
$1 - $650	91	33
$651 - $1,300	55	20
$1,301 - $2,600	37	13
Over $2,600	88	32
Total	276	

Missing cases: 7

Question 9

Delayed or deferred maintenance in the last 12 months

Delayed or deferred	*Homeowners*	*%*
Yes	240	47
No	270	53
Total	510	

Missing cases: 0

Question 9A

Reason for delayed or deferred maintenance in the last 12 months

Reason for delay or deferment	*Homeowners*	*%*
Too expensive	106	44
Other	56	23
Maintenance not too serious	35	15
Inconvenient	32	13
Wanted better information	11	5
Total	240	

Missing cases: 0

Question 10

Maintenance expenditure in the next 12 months

Intended Maintenance Expenditure	***Homeowners***	***%***
$0	59	13
$1 - $650	129	28
$651 - $1,300	96	21
$1,301 - $2,600	77	16
Over $2,600	108	23
Total	469	

Missing cases: 41

No Question 11

Question 12

Age group

Homeowner's age	***Homeowners***	***%***
Under 25 years	1	0
25 - 49 years	285	56
50 - 64 years	140	28
65 years or over	84	17
Total	510	

Missing cases: 0

Question 13

Homeowner labour force status

Homeowner labour force status	***Homeowners***	***%***
Wage & salary earner	252	49
Other	109	21
Self-employed (with no employees)	65	13
Homemaker	43	8
Self-employed (with employees)	31	6
Not in paid work, seeking employment	10	2
Total	510	

Missing cases: 0

Question 14

Reside with their partner

Live their partner	***Homeowners***	***%***
Yes	409	80
No	101	20
Total	510	

Missing cases: 0

Question 15A

Partner's labour force status

Labour force status of partner	***Homeowners***	***%***
Wage & salary earner	226	55
Other	66	16
Self-employed (with no employees)	60	15
Homemaker	34	8
Self-employed (with employees)	15	4
Not in paid work, seeking employment	7	2
Total	408	

Missing cases: 1

Question 15B

Annual family pre-tax income

Family income	***Homeowners***	***%***
$10,000 or less	2	1
$10,001 - $20,000	19	5
$20,001 - $30,000	40	11
$30,001 - $40,000	45	12
$40,001 - $50,000	28	7
Over $50,000	244	65
Total	378	

Missing cases: 31

Question 16

Homeowner's personal pre-tax income

Homeowner's income	***Homeowners***	***%***
$10,000 or less	8	9
$10,001 - $20,000	22	25
$20,001 - $30,000	16	18
$30,001 - $40,000	20	23
$40,001 - $50,000	11	13
Over $50,000	10	11
Total	87	

Missing cases: 14

Question 17

Number of household members 15 years and over

Adults in household	***Homeowners***	***%***
1 adult	57	11
2 adults	293	58
3 adults	102	20
4 adults	41	8
5 adults	11	2
6 adults	1	0
7 adults	1	0
8 or more adults	1	0
Total	507	

Missing cases: 3

Question 17 + 18

Number of household members

Household members	***Homeowners***	***%***
1	42	8
2	170	33
3	104	20
4	119	23
5	54	11
6	11	2
7	6	1
8 or more members	1	0
Total	507	

Missing cases: 3

Question 18

Number of household members under 15 years

Children in household	***Homeowners***	***%***
No children	307	61
1 child	78	15
2 children	82	16
3 children	34	7
4 children	5	1
5 or more children	1	0
Total	507	

Missing cases: 3

Question 19A - H

Household members

Household members	***Reponses***	***% responses***	***% homeowners***
Mother and/or mother-in-law	8	2	3
Father and/or father-in-law	2	0	1
Son(s) and/or partners son(s)	227	48	70
Daughter(s) and/or partners daughter(s)	194	41	60
Brother(s) and/or partners brother(s)	3	1	1
Sister(s) and/or partners sister(s)	4	1	1
Other relatives of you and/or partner	7	2	2
Other	29	6	9
Total	474		

Multiple responses

Question 20

Respondent and/or partner in receipt of income support payments

Receiving income support	***Homeowners***	***%***
Yes	127	25
No	383	75
Total	510	

Missing cases: 0

Question 20A

Type of income support received

Type of income support	***Responses***	***% responses***	***% homeowners***
National superannuation	83	62	65
Other	22	7	17
Domestic purposes benefit	11	8	9
Unemployment benefit	9	7	7
Sickness or invalid's benefit	8	6	6
Total	133		

Missing cases: 0 Multiple responses

24.3 CRESA Summary

Extracted from the full report on the Telephone Survey

Some Key Findings

- Homeowners assess their houses as currently being in better condition than when they first acquired them.
- 56 percent of homeowners assessed their house when first acquired as in *Good* or *Excellent* condition compared to 76 percent of homeowners who consider their houses as currently in *Good* or *Excellent* condition.
- Wellington homeowners (29 percent) are more likely to assess their house as in *Average*, *Poor* or *Very Poor* condition compared to Auckland homeowners (24 percent) and Christchurch homeowners (20 percent).
- Just over half of homeowners have undertaken maintenance work in the last twelve months.
- Wellington homeowners (61 percent) are more likely to do maintenance than Auckland homeowners (56 percent) and Christchurch homeowners (48 percent).
- Home maintenance expenditure patterns in Auckland tend to be higher than in Wellington, and higher in Wellington than in Christchurch.
- Of the 47 percent of homeowners who reported deferring maintenance in the last twelve months:
    - 35 percent delayed all maintenance
    - 65 percent delayed some maintenance
- Maintenance activities were concentrated around painting, with the most common activities being:
    - Painting outside walls
    - Painting windows
    - Painting bedroom walls
    - Replacement of bathroom fittings
- Homeowners (64 percent) and tradesmen (60 percent) are most heavily involved in undertaking maintenance work.
- Patterns of maintenance expenditure tend to be consistent from year to year - intended maintenance expenditure reflects past maintenance expenditure.
- Homeowners assessment of their current condition is inversely related to their intended expenditure - the poorer the condition, the higher the intended expenditure.
- Mortgage-free homeowners have patterns of lower maintenance expenditure than homeowners with mortgages.
- Those on lower incomes spend less than those on higher incomes.
- Older homeowners have lower expenditure patterns than younger homeowners.
- Those between 25-49 years of age have the highest expenditure patterns.

Conclusions and Remaining Questions

The results of the Home Maintenance Survey suggest that most New Zealanders are satisfied with the condition of their houses. It is, perhaps, this high level of satisfaction with, and confidence in, the condition of their houses that has led such a significant proportion of homeowners not to have undertaken any maintenance on their house in the twelve months prior to their participation in the Home Maintenance Survey. It may also explain why almost half of homeowners reported delaying or deferring house maintenance in the last year.

Essentially, homeowners act relatively predictably in relation to home maintenance. Those homeowners who believe their houses to be in *Poor* or *Very Poor* condition, demonstrate higher patterns of maintenance expenditure than those who assess their houses as being in *Excellent* or *Good* condition. Those patterns are modified by some other key variables including:

- Mortgage status
- Age
- Income, and
- Intention to sell

Homeowners appear to establish a certain level of maintenance expenditure which remains relatively consistent from year to year. Neither that, nor the higher expenditure of homeowners on higher incomes, should be interpreted as simple a matter of income. For higher proportions of higher income homeowners actively involve themselves in home maintenance compared to lower income groups.

A number of key questions are yet to be explored and can only be examined when data from BRANZ's NZ House Condition Survey is added to the analysis. We can current conclude that homeowner maintenance practices appear to be responsive to the perceived condition of a house, but we do not know whether:

- The condition assessments of homeowners are an accurate reflection of the actual condition of a house.
- Some groups of homeowners have a more realistic appreciation of the condition of their house than other groups.
- Levels of maintenance expenditure are adequate to maintaining stock condition
- The expectations of maintenance expense that appear to prompt a large proportion of homeowners to defer maintenance are well-founded
- Those that defer maintenance because they believe their maintenance needs not to be serious are accurate in their perceptions.

What we do know from the Home Maintenance Survey is that New Zealanders are confident that they understand the maintenance needs of their houses. After all, only 5 percent of homeowners reported delaying maintenance because they needed more information. We also know that New Zealanders believe their houses to be in good and even excellent condition. At the same time, New Zealanders are concerned with issues of cost - some 44 percent of those deferring maintenance did so because they believed that the expense of maintenance was too onerous. Under those circumstances, if New Zealanders perceptions prove to be inaccurate and their maintenance expenditure and activity inadequate, changing those patterns of behaviour is not going to be easy. Change will only be accomplished through substantial re-education of homeowners about house maintenance.

25 APPENDIX 8 PHOTOGRAPHS OF DEFECTS

25.1 Subfloor Defects

25.1.1 Dampness in subfloor spaces

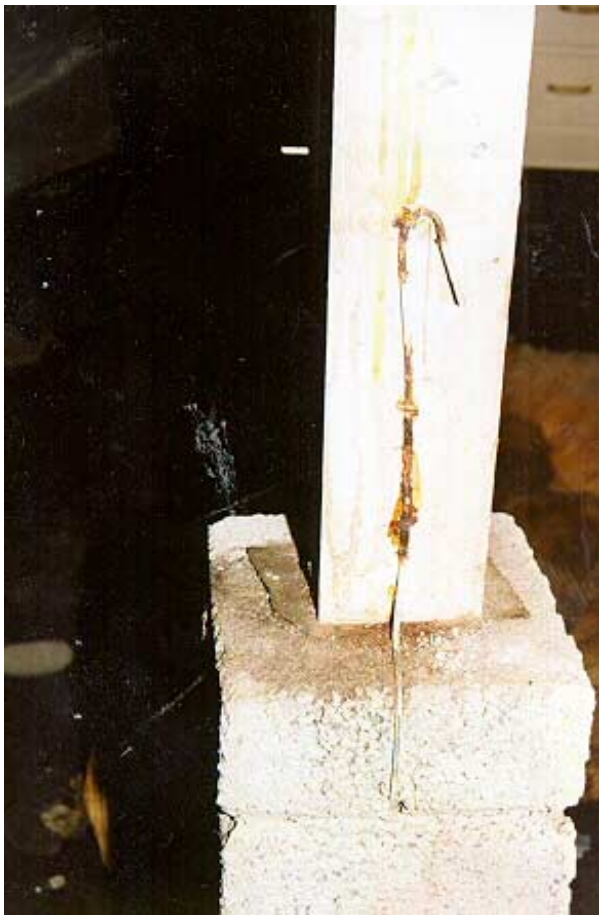
1 Above: Borer infestation in rubbish left in subfloor space. Also, high moisture levels in subfloor timbers from water seepage under house, and borer in floor joists.

2 Above: 1960's house which felt damp inside. Fungal growth on soit under house indicating high moisture levels. House also had sub-standard subfloor ventilation, with some vents blocked off as shown in photograph 13.

3 Left: Timber pile showing water stains. Concrete pile is level with surrounding soil.

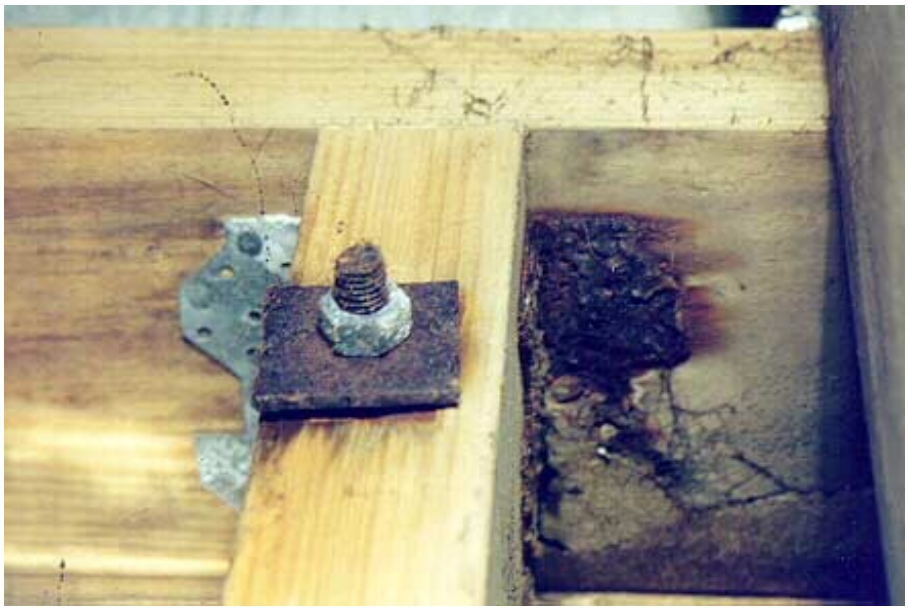
4 Below: Decay in bottom wall plate and moisture damage to back of basements linings. Large 1980's Auckland house. No subfloor ventilation and high moisture levels.

25.1.2 Corrosion in subfloor fasteners



5 Left: Corrosion of wire foundation ties in damp subfloor conditions. 1960's house with native timber framing. (high moisture levels, but not yet attacked by borer).

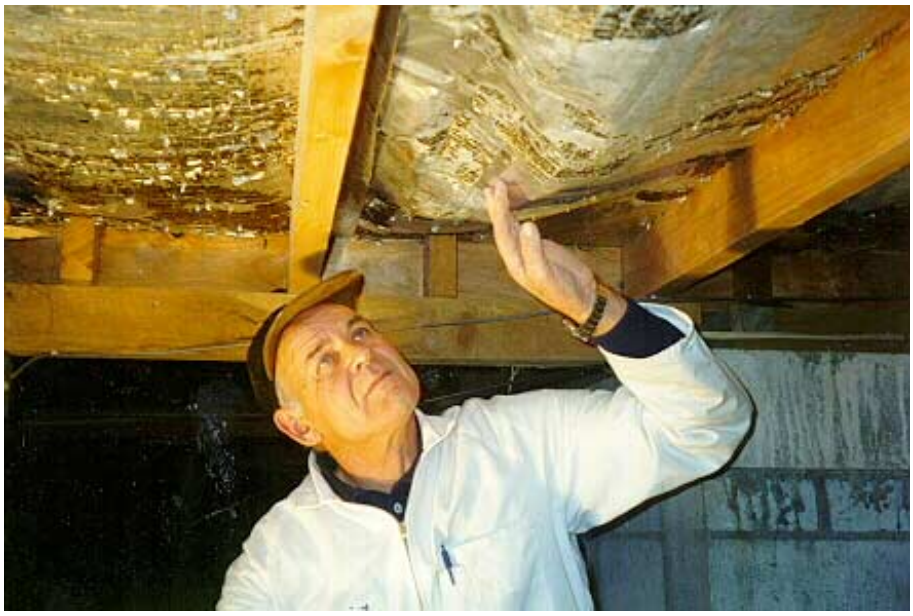
6 Below: Severe corrosion in galvanised steel nail plates and bolts. 1980's house with sufficient subfloor ventilation but in severe marine environment.



7 Left: Treated timber piles less than 10 years old, but galvanised wire and staples already corroding from damp subfloor conditions.

25.1.3 Foil defects

8 Below: Underfloor foil insulation degrading. 1980's house exposed to severe marine environment.

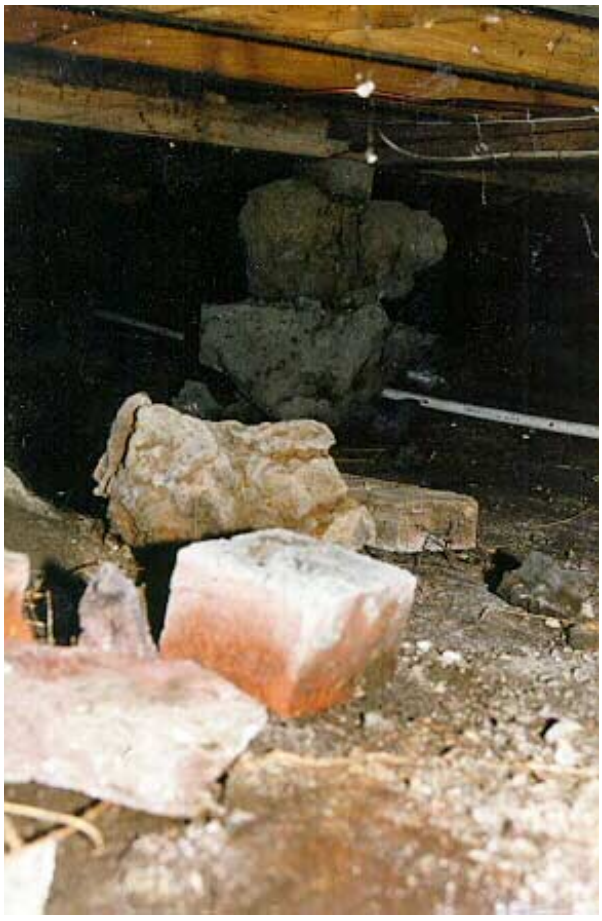


9 *Above: Same house as shown in photograph 6. Breakdown of foil backing to particleboard flooring in house in severe marine environment (with sufficient subfloor ventilation).*

10 *Above: Rats' nesting in drooped foil insulation (beneath hot water cylinder).*

25.1.4 Other subfloor defects

11 Above: Old timber jack stud rebated for water pipe.



12 Left: Seventy year old Auckland house with stacked rocks as supports to floor joists (along with a variety of other types).

25.1.5 Defects in subfloor vents

13 Above: Same house as shown in photograph 2. Subfloor vents purposely blocked off, resulting in high moisture levels and rising damp inside the house.

14 Above: 1910's Christchurch house with inadequate cast iron foundation vents. Subfloor ventilation that is already deficient is aggravated by vents blocked with garden soil, grass clippings and vegetation.

25.2 Defects in Exterior Walls

25.2.1 Weatherboards

15 Left: Deterioration of paintwork on 1930's Christchurch house. Cladding has rusting nails, major splitting of boards and severe borer.

16 Below: Severe decay in weatherboards and windows in 1900's Christchurch house.

25.2.1 Windows

17 Above: Severe deterioration of paintwork in 1900's Auckland house. Note popping of dowel at joint, missing putty and splitting of timber.

18 Left: Severe decay in weatherboards and windows in 1920's Auckland house. (Refer photograph 47 for interior moisture damage to same house)

25.2.3 Other Exterior Defects

19 Left: Crack showing movement of chimney away from timber wall.

20 Below: Severe decay endangering fixing of handrail support.

25.3 Defects in Roof Spaces

25.3.1 Discharge fans

21 Above: Bathroom extractor fan discharging into roof space. Note damage to building paper above fan.

22 Above: Extractor fan discharging into roof space. Note insulation not replaced after installation.

25.3.2 Fire hazard

23 Above: Light fitting installed too close to timber causing a fire hazard. Note scorching of timber and paint materials stored alongside light.

25.3.3 Insulation

24 Above and below: Fibreglass insulation damaged or not put back after work done in ceiling space, allowing unnecessary heat losses.

25 Above: Loose fill macerated paper insulation settling with age and deteriorating in efficiency (average thickness is now less than 50mm)

25.3.4 Nests in roof spaces

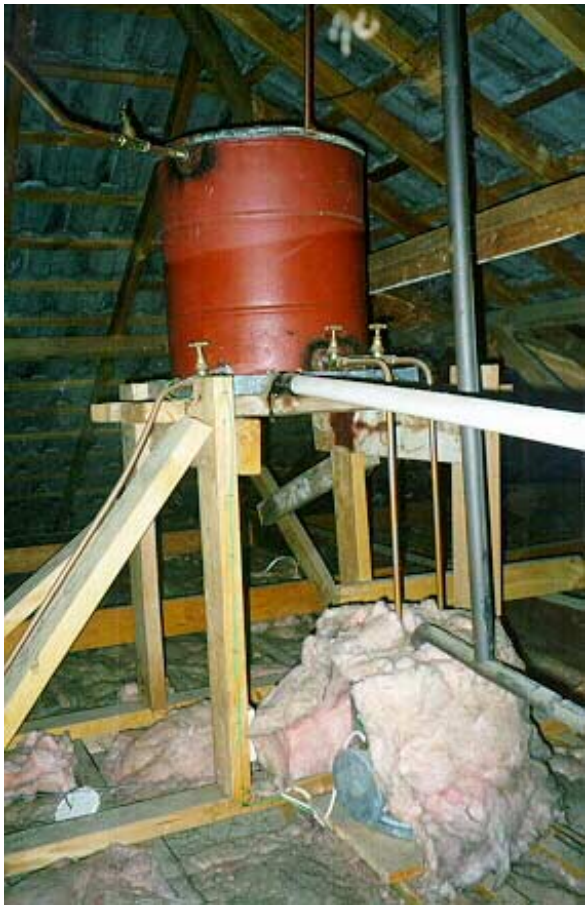
26 Above: Rats' nest near eaves.

27 Above: Wasps' nest.

28 Above: Birds' nests.

25.3.5 Unrestrained Header Tanks

29 Above: Heavy concrete header tank not restrained against earthquake movement (note also the state of the pipe lagging and ceiling insulation).



30 Above: Unrestrained header tank on high poorly constructed tank stand (note also the attempt to wrap the hot water cylinder).

25.4 Plumbing Defects

25.4.1 Wastepipes

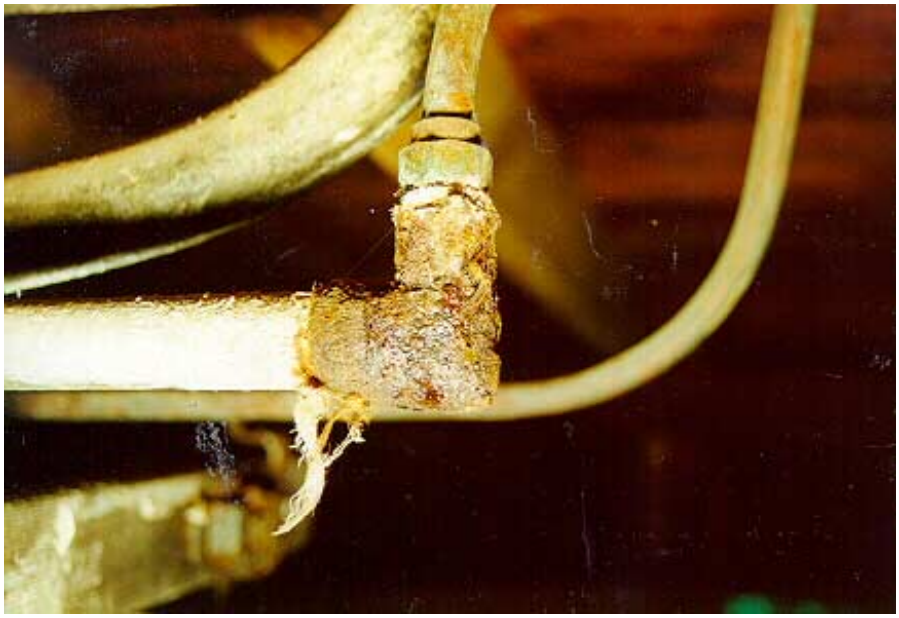
31 Above: Joint failure in PVC waste pipe allowing undetected discharge of wastewater into subfloor space (note pipe support).

32 Above: Joint failure in PVC waste pipe allowing undetected discharge of wastewater into subfloor space (note also state of hot water pipe lagging).

33 Left: Water staining from leak under shower. Leak was detected and repaired before much damage was done to particle board flooring.

34 Below: Deterioration in 60 year old lead waste pipes lead to undetected discharge into subfloor space. Unable to detect how long pipe had been leaking, but moisture levels were high and the native timbers were heavily infested with borer.

25.4.2 Water supply pipes



35 Above: Corrosion in joint of galvanised steel water pipe likely to cause a leak.

36 Above: Joint failure in polybutylene hot water supply pipework (note drips and wet timber).

25.5 Roofing Defects

25.5.1 Corrosion

37 Above: Severe corrosion to old galvanised steel roof in Auckland house (note: same house as shown in photograph 18).

38 Above: Severe corrosion to old galvanised steel roof in Wellington house (note: same house as shown in photograph 35).

39 Above: Faulty ridge flashing leading to corrosion.

40 Above: Severe corrosion to longrun galvanised steel roofing in 1980's Wellington house (exposed to severe marine environment).

25.5.2 Chip-coated metal tiles

41 Above: Deterioration of chip coating (note also the dented tiles due to lack of protection when roof walked on).

25.5.3 Guttering

42 Above: Poor falls in galvanised steel guttering causing ponding and subsequent corrosion and holes (note also the cracks in the stucco cladding)

43 Above: Damaged PVC downpipe allowing stormwater discharge onto soil and subsequent moisture problems in adjacent subfloor space.

25.6 Interior Defects

25.6.1 Dampness Problems

44 Above: Extreme levels of mould and mildew on lathe and plaster linings to bathroom of 1900's Christchurch house (same house as in photograph 16).

45 Above: Lack of bathroom ventilation causing high levels of mould and mildew on painted hardboard linings.

46 Above: Extreme levels of mould and mildew on lathe and plaster linings to 1920's Auckland house (same house as in photograph 18).

25.6.2 Other defects

47 Left: Poor condition of exterior shell causing decay visible inside the 1940's Wellington house (same house as in photograph 39).