STUDY REPORT

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BRANZ 2010 House Condition Survey – Condition Comparison by Tenure

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Preface

This report compares the condition of rental and owner-occupied houses surveyed in the 2010 BRANZ House Condition Survey. Approximately 500 standalone, townhouse or terraced houses / units were inspected throughout New Zealand, and interviews were completed with each occupant concerning their family circumstances and maintenance practices. The results have been weighted for location and tenure in order to be nationally representative of New Zealand's houses.

Acknowledgments

This work was jointly funded by the Building Research Levy, the Department of Building and Housing (DBH) and the Centre for Research Evaluation and Social Assessment (CRESA). BRANZ would like to gratefully acknowledge the contributions made by Kay Saville-Smith and Ruth Fraser from CRESA, who undertook the social survey of homeowners, and John Jowett, who provided statistical analysis for the project. The authors would also like to thank Ian Page for the economic analyses used within this report.

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

Note

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

BRANZ 2010 House Condition Survey

– *Condition Comparison by Tenure*

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1. EXECUTIVE SUMMARY

The BRANZ House Condition Surveys have been carried out every five years since 1994 and provide snapshots of New Zealand's housing stock at different points in time. Previous surveys were centred on the three main centres in Auckland, Wellington and Christchurch. The 2010 House Condition Survey (HCS) was the first nationwide survey, and also the first to include a representative selection of rentals properties, which make up approximately 33% for the New Zealand's total housing stock. This report compares the condition of rental and owner-occupied houses surveyed in the 2010 BRANZ House Condition Survey. Four hundred and ninety one houses[1] standalone, townhouse or terraced houses / units were inspected throughout New Zealand, and interviews were completed with each occupant concerning their family circumstances and maintenance practices. This report analyses any differences in condition between rental and owner occupied houses in the survey. The survey sample included one hundred and eight rented houses.

The survey found that generally rental houses were in worse condition overall than owner-occupied houses, and had a higher incidence of components in poor or serious condition. Owner-occupied houses were nearly twice as likely to be in good condition compared to rental houses. Nearly twice as many rented houses were in poor condition compared to owner occupied houses.

As with previous surveys, there was again a disparity between the actual condition of the house, and the occupant-perceived condition, as shown in Figure 2. For both the rental and owner-occupied properties, the householder perceived the condition of the property to be significantly better than the BRANZ assessors. Owner-occupiers tend to be overly optimistic about the condition of their homes – over 70% believe that their home is in good or excellent condition when BRANZ assessors put 42% into this category. This disparity between perception and assessment may be influenced by a primary focus on cosmetic appearance, which aligns with the condition of the interior tending to be slightly higher than the exterior, with less visible areas considered to be of lower importance.

In the case of the rental properties, approximately 80% of the occupants considered the property in good condition and only 2% believed their home to be in poor condition. This is a remarkable contrast to the assessments made by the BRANZ surveyors, who considered that only 22% of rental properties were in good condition and 44% in poor condition. This suggests that renting households may be more optimistic about the condition of the home they are residing in and have lower expectations surrounding the

[1] *For the purposes of the survey, the term 'house', includes townhouses and terrace houses, and excludes apartments and flats. As such, 'houses' had a maximum of two common walls, allowing the inclusion of terrace housing, but in the most part exclude flats and apartments. The presence of a fire separation from adjoining units meant the dwellings were separate*.

condition of the home, particularly as in most cases the upkeep of the home is not the tenant's responsibility.

The average condition of houses varied depending on when they were built, and the type of tenure. Rentals as a whole have lower average condition ratings than owner occupied houses. More rentals had exterior and envelope components in poor or serious condition than the owner occupied houses. Windows and roof claddings were far more likely to be in poor or serious condition in rentals than in owner occupied houses. Rentals were nearly twice as likely to have foundations in poor to serious condition as owner occupied houses.

Rental houses were also more likely to have interior components in poor condition: kitchen, bathroom and laundry linings and fittings were all in worse condition in rentals than in the owner-occupied houses. Two-thirds of rented houses had hot water cylinders in poor or serious condition, although in many cases this may be due to a lack of seismic restraints.

The trends with insulation levels were not as conclusive. A slightly higher proportion of rentals than owner-occupied houses had full ceiling and floor insulation and more had ceiling insulation over 100mm thick. This may reflect take up of EECA's Warm Up New Zealand scheme for rental properties. However a higher proportion of rentals had no ceiling or floor insulation at all, while more owner-occupied houses had partial ceiling or floor insulation. While it was difficult to ascertain whether houses had wall insulation, it appeared that 80% of rental houses had very little or no wall insulation compared with 45% of owner occupied houses.

Renting households were more likely to use portable heating, such as electric plug-in and portable LPG, than fixed heating, such as solid fuel, heat pumps or fixed gas heaters. A quarter of renting households had unflued gas heaters compared with 17% of owner occupied households.

A higher proportion of rental houses had dampness and mould issues compared to owner-occupied. Nearly three-quarters of rental houses had some mould within the home, compared with just over half of owner-occupied houses. The mould also tended to be more prevalent within the rental properties and more likely to have moderate or high levels of mould than the owner occupied houses.

In addition, the characteristics of households living in the houses were markedly different between the two types of tenure. Once weighted to take into account location and tenure, the household age profile of the House Condition Survey sample was consistent with the New Zealand Census data showing that around half of all New Zealand's children under five years of age live in rental houses, despite rentals representing only a third of the housing stock. Renting households were also less likely to include people over 65 years of age.

Not entirely unexpected, renting households tended to have lower combined incomes than owner-occupying households, and had more members per household on average. However, a higher proportion of renting households consisted of a single member. Renting households also moved more frequently than owner-occupier households, and were more likely to be anticipating a move within 12 months of the survey.

The average cost of repairs and maintenance required to address aspects of the houses in the survey in poor or serious condition was $9,700 for rentals and $8,000 for owner occupied houses. This may be due in part to rentals requiring repairs or maintenance to more expensive components than owner occupied houses.

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2. INTRODUCTION

The BRANZ House Condition Surveys (HCS) provide "snapshots" of New Zealand's housing stock at different points in time. This has been done by investigating a group of houses and their occupants that broadly represent the underlying range of designs, ages and varying conditions of New Zealand houses. As more surveys are completed, and trends and problems identified, a reliable information base is established on which to make comparisons.

Previous surveys were carried out in 1994, 1999 and 2005 and were carried out on predominantly owner-occupied houses in Auckland, Wellington and Christchurch. The 2010 House Condition Survey (HCS) is the first that is nationwide and includes rental properties. Four hundred and ninety one houses were inspected and occupant interviews were completed concerning their family circumstances and maintenance practices. This 'matched' sample, where the property had been inspected and the occupants interviewed, included one hundred and eight rented houses.

BRANZ Study Report SR240 initially reported on the general findings of the sample. The results have subsequently been weighted for location and tenure in order to be nationally representative of New Zealand's houses. This report contains in-depth analysis of the condition of owner-occupied houses and rental houses in the survey. This is the first time this type of analysis has been done in New Zealand. All results are statistically significant, unless stated otherwise. Details about the sample and its selection can be found in 0.

Approximately 33% of New Zealand's total housing stock (1.3 million houses) consists of rental houses, with the other 67% owner-occupied.

All properties in the House Condition Survey were standalone houses or units with apartments and flats excluded from the survey. It was required that each property had no houses above or below it, and that there were no more than two common walls. It was required that there was fire separation from other units if adjoined, thereby constituting an independent dwelling.

Demographic and costing information presented in this report was provided to BRANZ by CRESA. An excerpt from the report is included in the Appendix B for completeness.

3. OVERALL CONDITION

3.1 BRANZ Assessed Condition

A subjective overall condition assessment was made for each dwelling by assessors, and was based on a three point scale. Assessors may give more importance to critical components that may have more serious long-term effects, such as a leaking roof, than components which will not have detrimental effects to the structure if left as they are; for example a broken kitchen bench.

The assessed condition of owner occupied houses was higher than that of rented houses. As seen in Figure 1, owner occupied houses were nearly twice as likely to be in good condition as rented houses. Nearly twice as many rented houses were in poor condition than owner occupied houses.

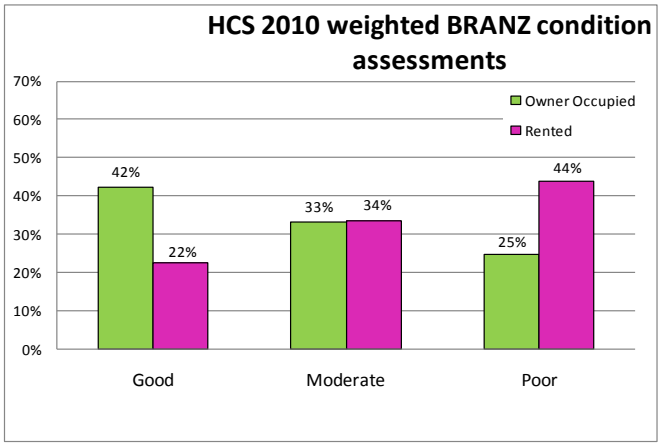

Figure 1: The assessed overall condition of houses in the 2010 HCS by tenure

3.2 QV assessed condition

As with previous surveys, the assessed condition of each property has been compared with the QV assessment data. Quotable Value Limited (QV) provides valuation data to local government and the public. QV bases their assessments on the exterior of the house only, unless a valuation is appealed and the inside is inspected. BRANZ assessments cover the condition of the house as a whole.

Similar to previous BRANZ House Condition surveys, there is a large disparity between the BRANZ-assessed house conditions and the QV-assessed conditions due to the nature of the survey (see Figure 2). The aim of the comparison is for information purposes only.

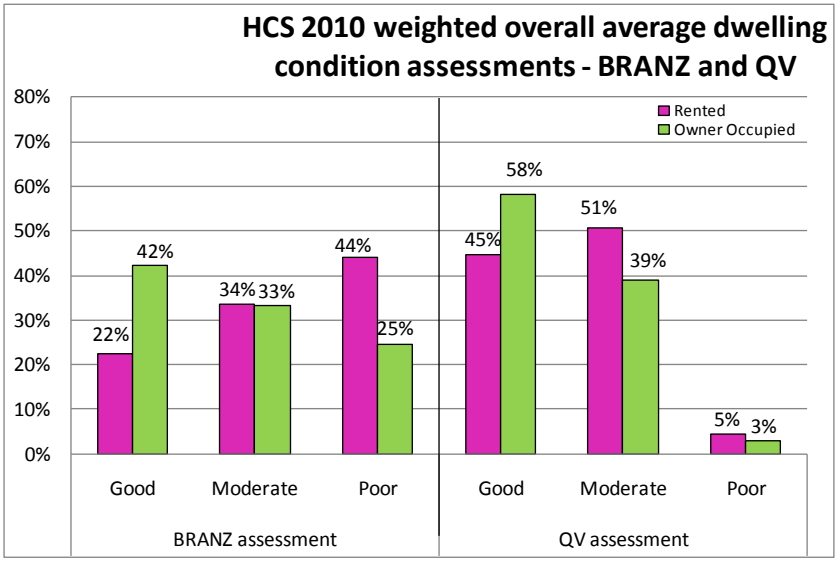

Figure 2: BRANZ assessed house maintenance versus QV assessed conditions

3.3 Occupant perceived condition

There is a disparity between the actual condition of the house, and the occupant-perceived condition, as shown in Figure 3. For both the rental and owner-occupied properties, the householder perceived the condition of the property to be significantly better than the BRANZ assessors.

Owner-occupiers tend to be overly optimistic about the condition of their homes – over 70% believe that their home is in good or excellent condition when BRANZ assessors

put 42% into this category. This disparity between perception and assessment may be influenced by a primary focus on cosmetic appearance, which aligns with the condition of the interior tending to be slightly higher than the exterior, with less visible things considered to be of lower importance.

In the case of the rental properties, approximately 80% of the occupants considered the property in good condition and only 2% believing their home to be in poor condition. This is a remarkable contrast to the assessments made by the BRANZ surveyors, who considered that only 22% of rental properties were in good condition and 44% in poor condition. This suggests that renting households:

- Are more optimistic about the condition of the home they are residing in
- Have lower expectations surrounding the condition of the home
- Are less critical about the state of the home than owner-occupiers, potentially because the upkeep of the home is not the tenant's responsibility.
- Have higher tolerance for poor conditions, or accept lesser conditions as 'the norm'

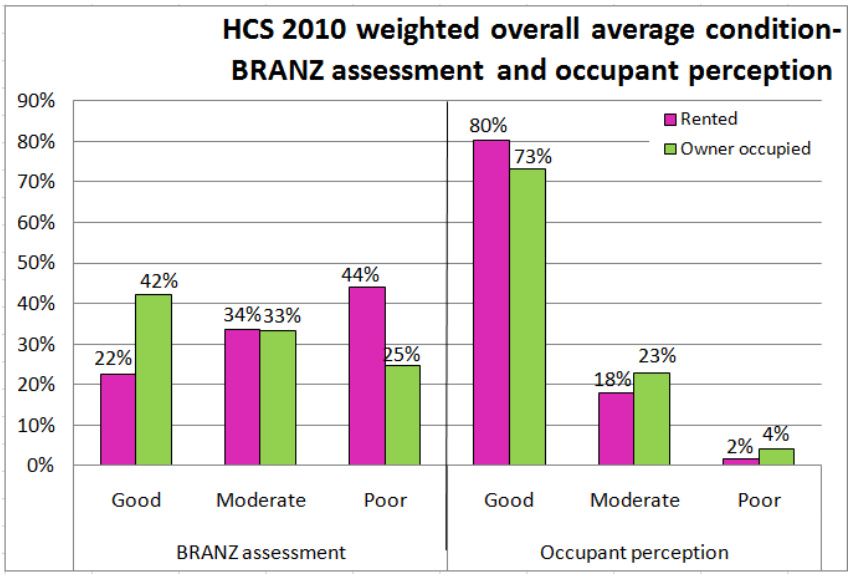

Figure 3: Occupant perceived condition versus BRANZ assessed condition

4. SAMPLE CHARACTERISTICS

4.1 Houses

There are differences between rented and owner occupied houses in respect to physical characteristics, dwelling age, and demographics.

As shown in Figure 4, the age profile of the two types of tenure were markedly different. The majority of the 2010 HCS rental dwelling sample were built between 1940 and 1990. Owner occupying households are more likely to live in houses built before 1940 or after 1990 than renting households.

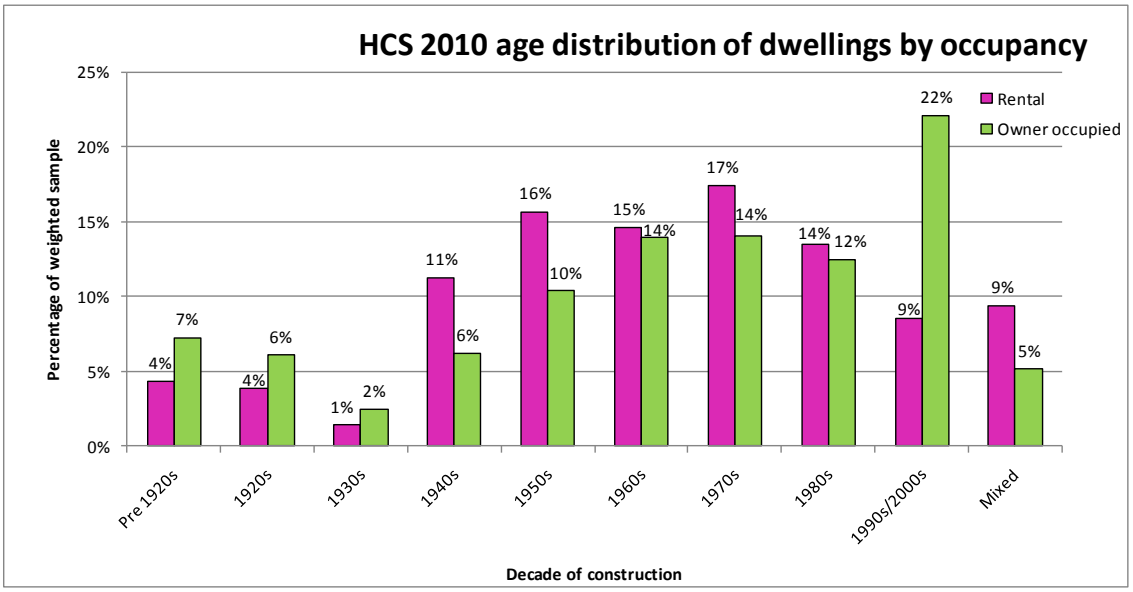

Figure 4: Age distribution of houses by occupancy

Over half of all rentals surveyed were owned by private landlords, followed by social housing eg Councils and Housing New Zealand Corporation (28%), as shown in Figure 5. Relatives as landlords were also relatively common, at 17% of rental houses.

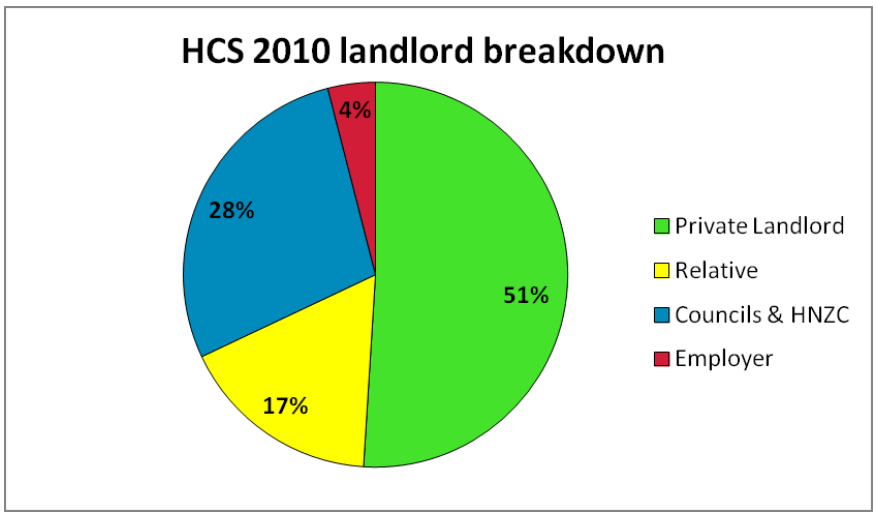

Figure 5: Breakdown of landlord type

4.2 Demographics

In addition, the characteristics of households living in the houses are markedly different between the two types of tenure. Once weighted to take into account location and tenure, the HCS data is consistent with Census data (also see 0). Despite representing 33% of the houses in New Zealand, rented houses house approximately half of New Zealand's children under five years of age, as shown in Figure 6. Owner occupation for adults over 65 years of age is far more common than renting at 79%. Children under five years of age, and adults over 65 years of age are defined as 'vulnerable' age populations due to their susceptibility to illness and health issues caused by environmental factors.

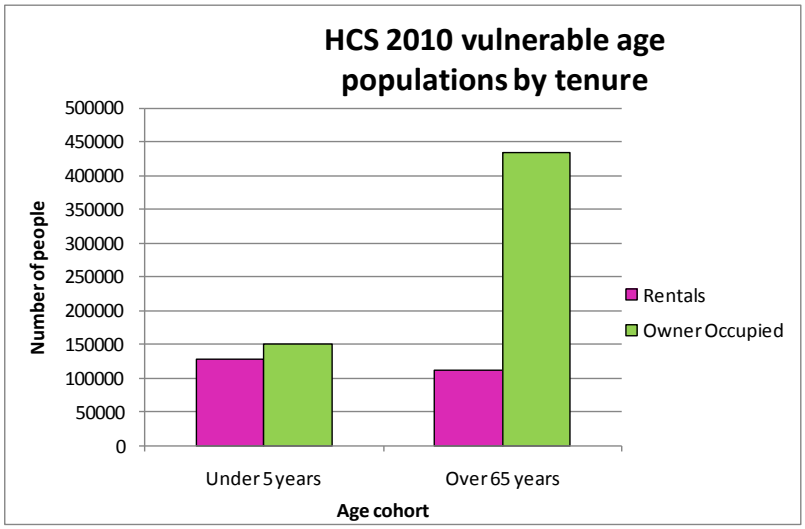

Figure 6: Vulnerable age cohorts by tenure status scaled to population

Renting households also tended to have lower incomes than owner occupiers, with more than a quarter with household incomes of $20,000 or less per year, compared to 7% of owner occupiers, as shown in Figure 7. Nearly three quarters of renting households received less than $50,000 income per year, compared to less than half of owner occupiers. Owner occupiers tended to have higher incomes, with over half having household incomes over $50,000 per year.

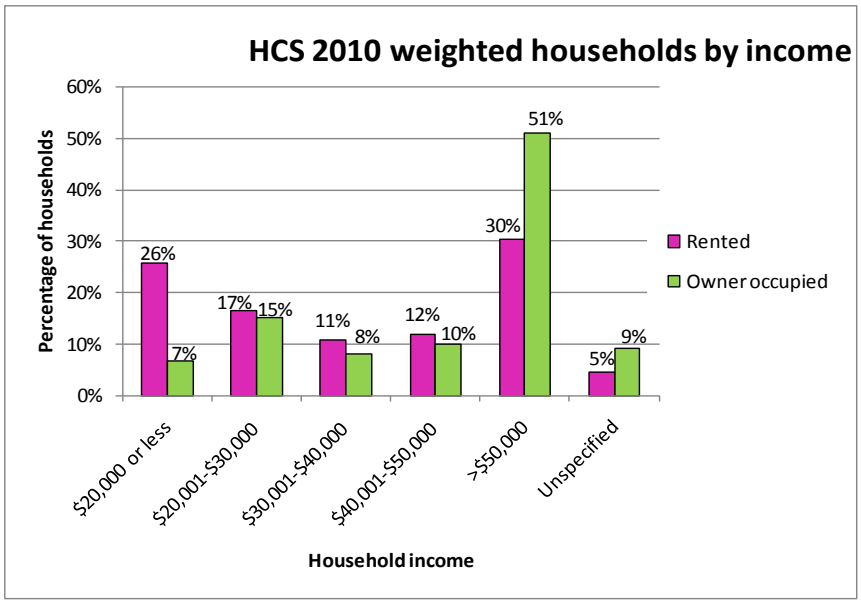

Figure 7: Income brackets of households by tenure

Renting households: comprised more single households; fewer two-person households; more large households with four or more members, and a higher average household size. The average household size for renters was 3 people, compared to 2.7 for owner occupiers.

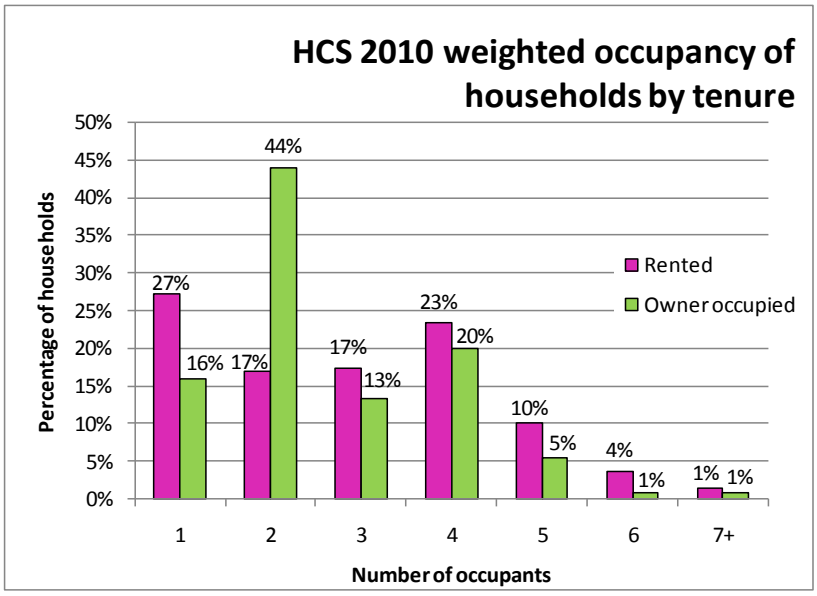

Figure 8: Number of occupants by tenure

The higher household numbers for renters does not mean their houses are larger – on the contrary, as shown in Figure 9, rented houses tended to be far smaller. Approximately 46% of rented houses were below 100 m² in size, compared to 17% of owner occupied houses. Rented houses also had fewer bedrooms, with an average of 2.9 compared to 3.3 for owner occupied houses. Rented houses also had fewer rooms, with an average of 7.9 rooms compared to 9.5 rooms in owner occupied houses.

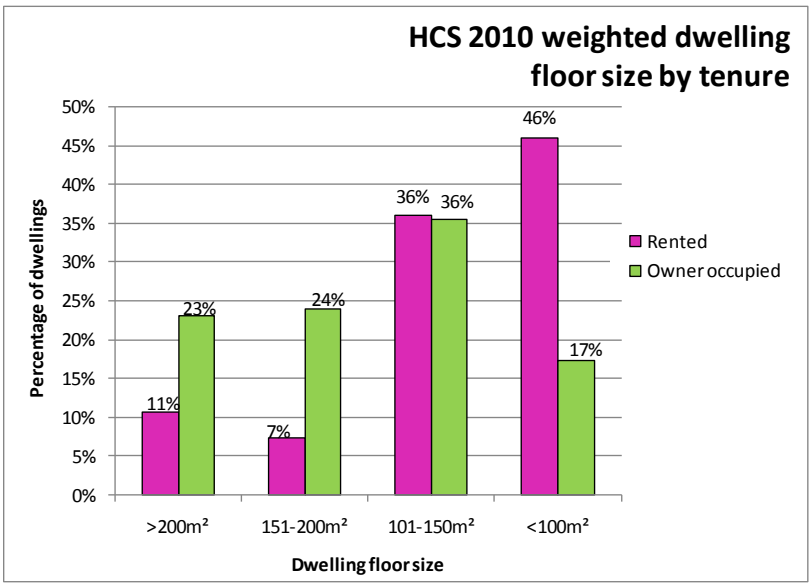

Figure 9: Floor area by dwelling tenure

Crowding is defined by Statistics New Zealand as “situations where the number of people residing in a household exceeds the capacity of the household to provide adequate shelter and services to its members” (Statistics NZ, 2011). Crowding affects not only the health of households, but may also lead to greater wear, tear and moisture loadings, potentially resulting in mould, on the dwelling. Overcrowding typically occurs within low income households. While overcrowding is associated with large households, one-parent families are also particularly vulnerable (Saville-Smith and Amey, 1999). While analysis of crowding was not undertaken for this report, sufficient data exists for it to be analysed in the future.

4.3 Stability

Renting households appear to move more frequently than owner occupiers, with 17% having been in the dwelling for less than a year, compared to 3% of owner occupiers. 39% had been in the house for more than seven years, compared to 59% of owner occupiers. The overall results are shown below in Figure 10.

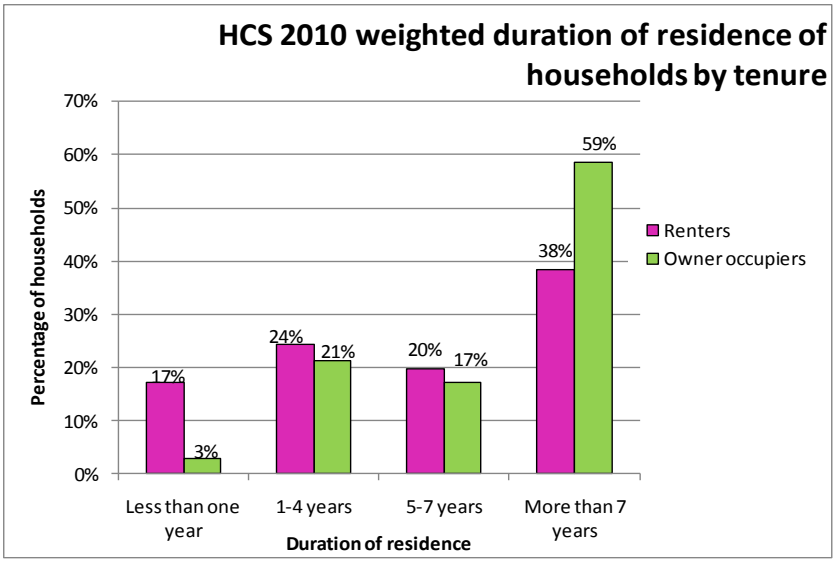

Figure 10: Duration of residence by household tenure

This increased frequency of moving is reinforced with information on intentions surrounding moving within the next 12 months. 19% of renting households planned to move within the next 12 months, compared to 6% of owner occupiers, as shown in Figure 11.

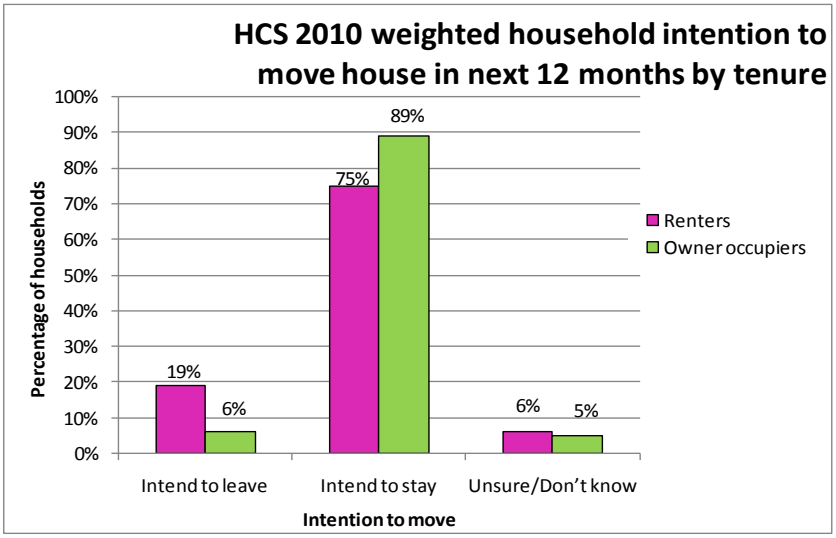

Figure 11: Intentions to move by tenure

5. CONDITION RATINGS

This condition ratings section is based on ratings for components, rather than the broad dwelling assessment made for the ratings in section 3. These ratings are based on a five point scale, as shown below in Table 1.

Table 1: HCS condition rating scale

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

5.1 Overall average condition

The overall average condition of each dwelling is an average of every component assessed by the survey, each component is regarded as of equal importance.

The average condition of houses varied depending on when they were built, and the type of tenure. Rentals as a whole have lower average condition ratings than owner occupied houses.

Rental houses built between 1930 and 1950 tended to be in slightly better condition than the owner-occupied houses. This may reflect a high percentage of public housing stock built in this time period, and resulting maintenance and upgrade programmes.

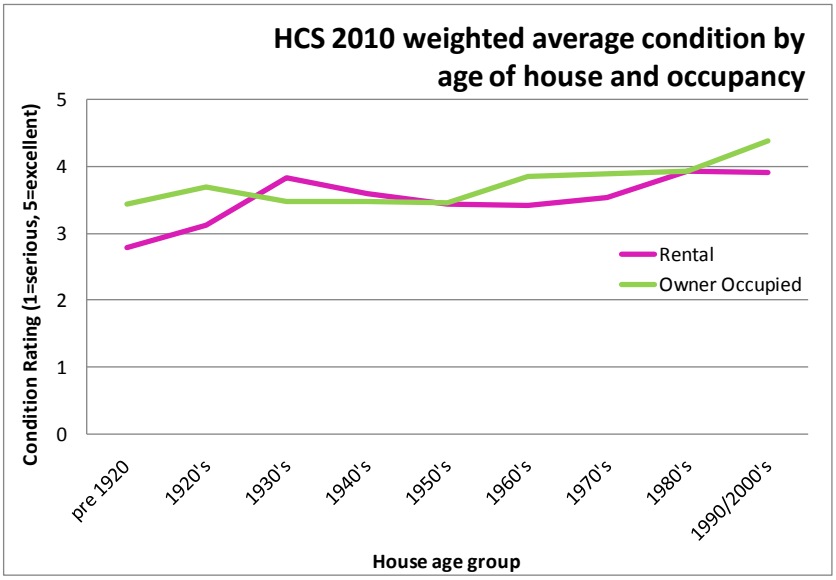

Figure 12: Average house condition by house age and occupancy

5.2 Exterior and Envelope Components

More rentals had exterior and envelope components in poor or serious condition than owner occupied houses. Windows and roof claddings were far more likely to be in poor or serious condition in rentals than in owner occupied houses. Rentals were nearly twice as likely to have foundations in poor to serious condition as owner occupied houses.

However, owner occupied houses were more than twice as likely to have blocked subfloor vents than rentals (see section 5.2.1), and nearly twice as likely to have decks in poor or serious condition, partly due to rentals having fewer decks. Roof framing was also far more likely to be in poor to serious condition for owner-occupied houses, however the reasons for this are unclear at this stage. Particular issues included inadequate bracing, joists and/or rafters, borer and splitting of timber. It was noted that these issues affected houses of all ages.

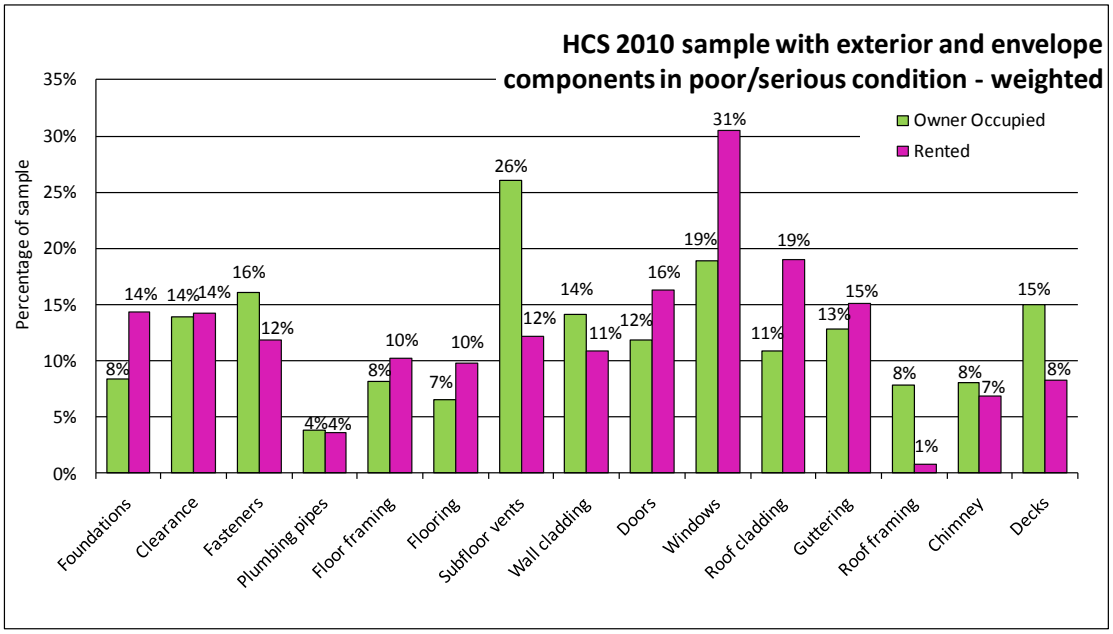

Figure 13: Exterior and envelope components in poor or serious condition.

5.2.1 Decks

Figure 14 shows the proportion of decks on rental and owner-occupied houses (of the sample with decks) with defects. While fewer rentals had decks than owner occupied houses (see section 5.2), decks on rentals were over-represented with the percentage of deck defects, and had more defects in every category except for slippery surfaces, inadequate structure and corroded fasteners.

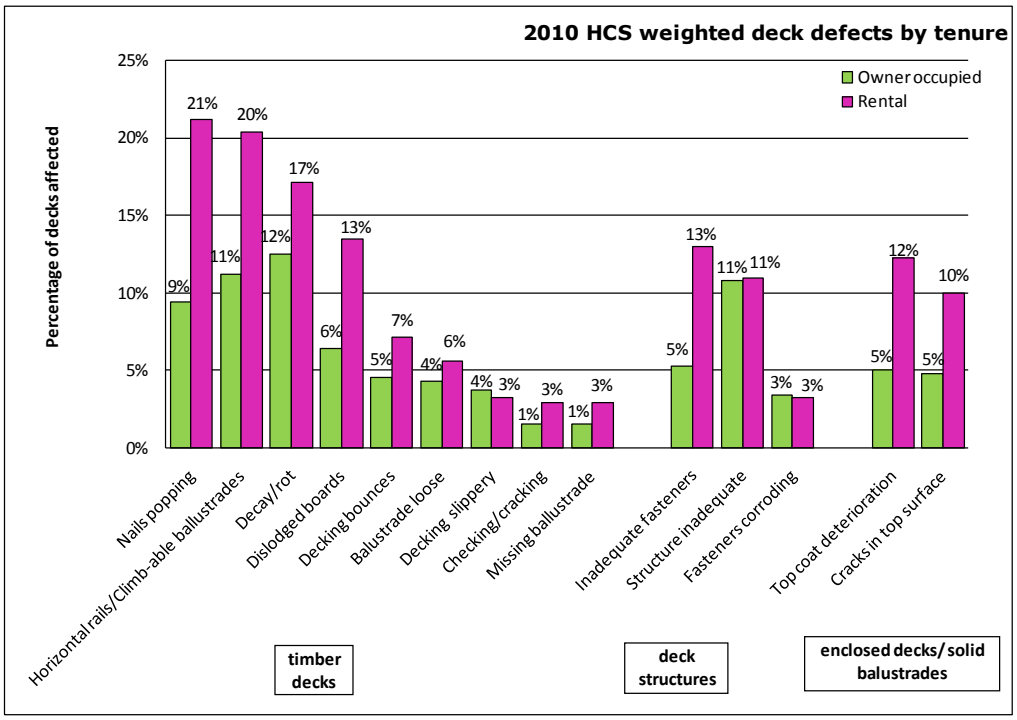

Figure 14: Deck defect prevalence by tenure

The majority of the defects were related to age and lack of maintenance, rather than new-build defects. The findings suggest that owner-occupied decks receive more frequent maintenance than rentals.

5.3 Subfloor

Subfloor moisture-related defects were an area which did not appear to be related to occupancy type, as shown in Figure 15. Rentals tended to be more likely to have inadequate subfloor ventilation, borer in flooring, and inadequate clearance between the structure/cladding and the ground.

Inadequate ventilation in rentals is likely to be a direct result of the materials used at the time of construction. Concrete vents, commonly used from around the 1940s to around the 1970s, when most of the rentals were built, have only 50% clear space, and therefore permit little air through, which was often not anticipated when first installed. The higher amount of borer in rentals is likely to be due to the higher percentage in older age cohorts compared to owner-occupied houses. Borer is more likely to attack sapwood on older strip flooring than particle board flooring in newer homes.

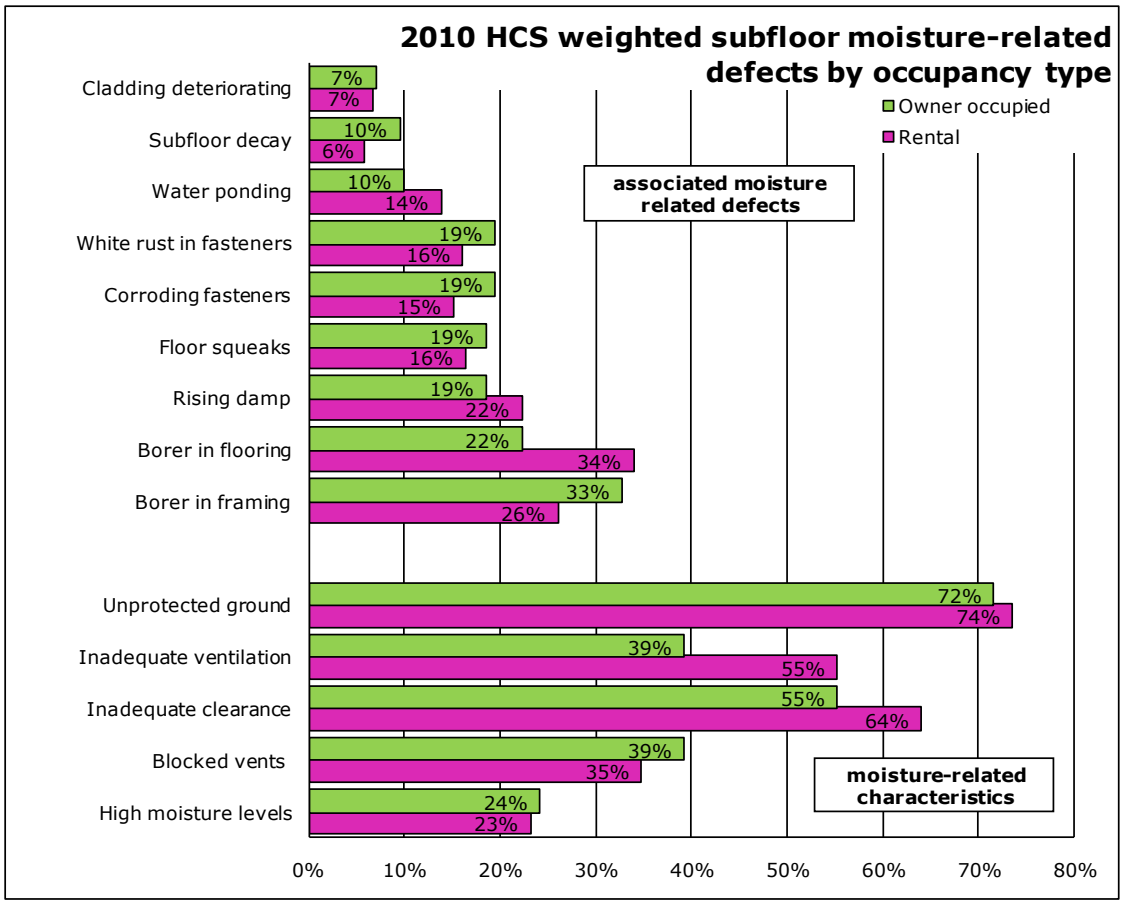

Figure 15: Subfloor moisture-related defects by tenure

The higher percentage of blocked vents in owner-occupied houses, as mentioned in section 5.2, is often due to 'improvements' to the property, such as landscaping, shrubs and raised garden beds blocking vents, and the addition of decks at a level which covers adjacent vents.

Higher subfloor moisture levels increase the risk of borer, and also contribute to the internal moisture load of the dwelling. Dampness and mould is covered in more detail in Section 7.3.

5.4 Interior Components

Interior components in poor to serious condition were more common in rentals than they were in owner-occupied houses in each measured category.

Wet area linings and fittings in wet areas had the biggest disparity in condition between owner occupied and rented houses (see Figure 16). Around twice as many rentals as owner occupied houses had wet area linings and fittings in poor or serious condition. There was a clear disparity in all cases, with the largest being bathroom fittings where rental houses were nearly three times more likely to have them in poor to serious condition, compared to owner occupied houses. There was a slightly lower level of disparity evident for all other components in this category.

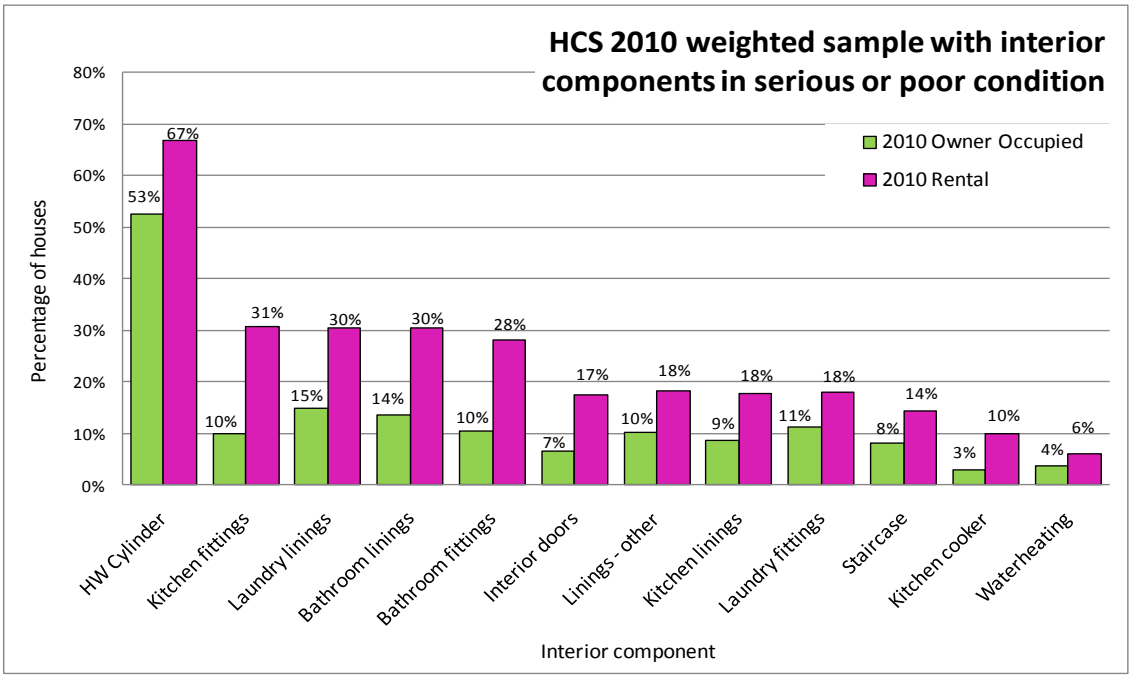

Figure 16: Interior components in poor to serious condition

Also shown in Figure 16, the most common interior component to be in poor or serious condition is the hot water cylinder (HWC), at 67% of rentals, and 53% of owner-occupied houses. If a hot water cylinder was deemed to not have sufficient seismic restraints, a lower rating was applied to bring the cylinder into the poor condition category. This is due to the threat to occupant safety and damage to houses should a sufficiently large seismic event take place. Damage in Christchurch from the earthquakes has reiterated the need for adequate seismic restraints.

The most common hot water cylinder defect was inadequate seismic restraint, affecting 65% of all the rentals and 48% of all the owner occupied houses. Before the downgrade for inadequate seismic restraints was applied, 6% of rentals and 4% of owner occupied houses had hot water cylinders (including header tank) in poor or serious condition. Other defects, such as leaks or corrosion, brought 2% of rental and 5% of owner occupied house hot water cylinders into the poor or serious condition rating despite adequate seismic strapping.

5.5 Insulation

Insulation became mandatory for new homes in New Zealand in April 1978 with the NZS 4218P:1977 coming into force. Housing built before this period has been a target for insulation subsidy schemes in the past. The most recent nationwide insulation

retrofit scheme is the Warm Up New Zealand Scheme from EECA, which also covers homes built before 2000.

The data on insulation appears counterintuitive in some cases – for example, rental houses were more likely to have no insulation, however they were also more likely to have higher levels of insulation than owner occupied houses.

Figure 17 shows insulation coverage in rentals compared to owner-occupied houses. Most houses have some insulation. Twice as many rentals had no ceiling insulation compared to owner occupied houses. Around a third more rentals than owner occupied houses had no subfloor insulation. Full ceiling and underfloor insulation coverage was present in a slightly higher proportion of rental houses than owner-occupied.

The presence of insulation of the walls was harder to assess. If a house was built before 1979, the occupants did not know of any having been installed, and there was no evidence to the contrary, a wall was presumed to be uninsulated. Some houses were only partially insulated, for example those with more modern additions.

It appeared that rentals were twice as likely to have uninsulated walls as owner occupied houses. A contributor to this is age, as discussed in section 4.1, and shown in Figure 4, owner occupied houses are more likely to have been built after insulation became mandatory, in the age groups from 1980 onwards. However, with owner occupied houses twice as likely to have full wall insulation, and more likely to have partial wall insulation, this age effect does not fully explain this. This may also indicate a lack of knowledge of retrofitted wall insulation by tenants given that they tend to move more often (see section 4.3).

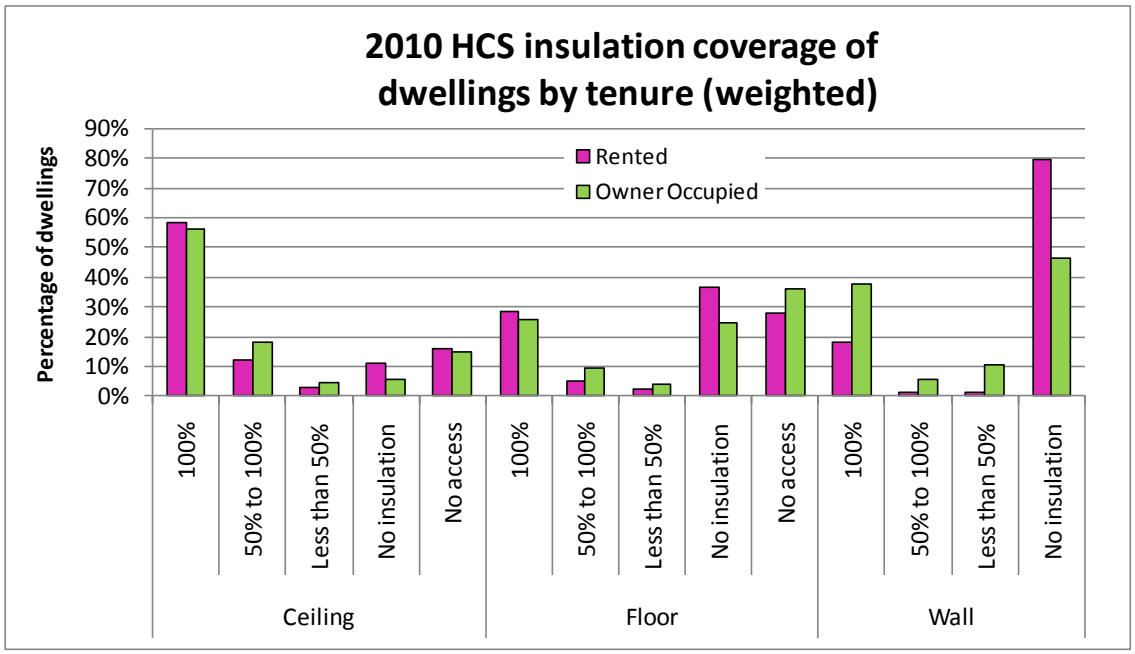

Figure 17: Ceiling, underfloor and wall insulation coverage by occupancy

Incomplete insulation coverage may be related to house age and typology. For example, houses from the 1930s to 1950s, when many rentals were built, commonly had accessible roof spaces, making them easier to insulate, as compared to 1970s houses with enclosed skillion roofs. Another factor may be a higher likelihood that these have been professionally installed rather than DIY.

Full coverage of ceiling insulation does not necessarily mean the insulation is of fair (≥100 mm) thickness. A quarter of rentals had ceiling insulation 50 mm thick or less (see Figure 18), yet they were also more likely to have ceiling insulation over 100 mm thick (23%) than owner-occupied houses (18%). Again, this may be influenced by

professional installation, and may indicate uptake of insulation schemes around the country, such as EECA's Warm Up New Zealand scheme. EECA reported that around 114,000 houses had been insulated under the scheme between July 2009 and June 2011 (EECA, 2011C). The proportion of rental houses that had been insulated by the scheme was lower than owner occupied houses, at around 15% of uptake (EECA, 2011B).

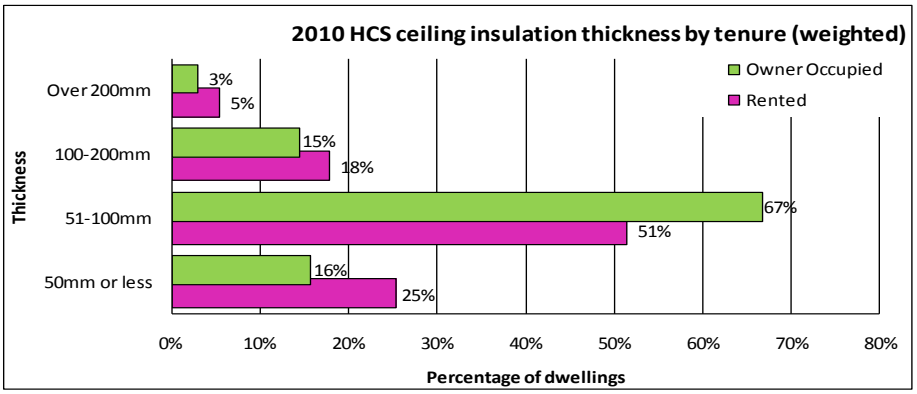

Figure 18: Tenure and ceiling insulation thickness

5.5.1 Ceiling insulation defects

As shown in Figure 19, post-installation displacement was more likely in rental properties, while installation defects, aside from coverage, were more likely in owner-occupied houses. The latter supports the premise that insulation in rentals is more likely to be professionally installed.

Insulation damage and displacement may be due to uninformed DIY installation and/or subsequent work by trades in the area. It is unclear why there are differences between rentals and owner occupied houses.

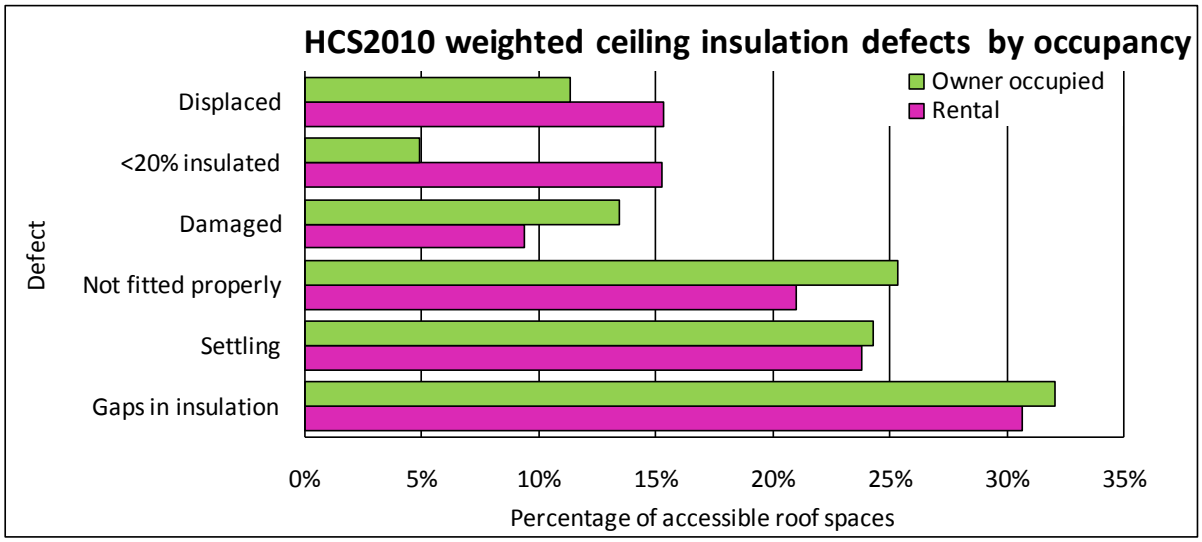

Figure 19: Ceiling insulation defects by occupancy

Defects associated with poor installation quality were more common in owner-occupied homes. This suggests that DIY is popular for insulation retrofits in New Zealand, but an understanding of the importance of and techniques for doing it properly are not.

6. HOUSEHOLD HEATING

The figures presented in this section cover all heaters found in houses during the survey.

As shown in Figure 20, rented houses are more likely to have portable types of heaters, and twice as likely to contain portable LPG heaters (also see section 6.1.1). Aside from standard fixed electric heaters, which are equally as likely in owner-occupied or rental houses, all other types of fixed heaters are more likely in owner-occupied houses.

The Household Energy End-use Project (HEEP) found that houses with fixed heater types, with the exception of open fires, tended to have higher winter evening living room temperatures than those using portable heating (Isaacs et al, 2010).

Higher capital investment fixed heaters, such as solid fuel burners, heat pumps, and flued fixed gas/LPG, are far more likely in owner occupied houses than rentals. There may be reluctance on behalf of landlords to install fixed heating types into rentals when tenants can use or purchase their own portable heaters.

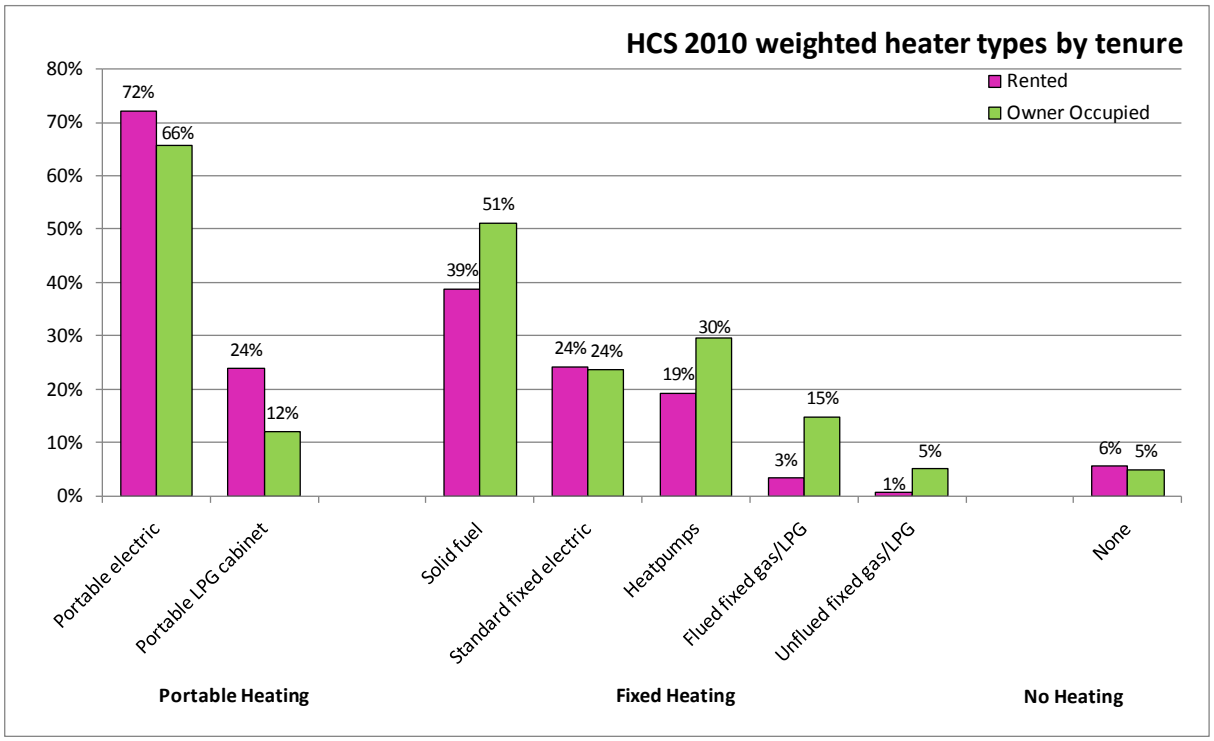

Figure 20: Percentage of houses with heater types by tenure

6.1.1 Unflued gas heaters

Unflued gas heaters (fixed, and LPG portable cabinet heaters) are present in many New Zealand houses. Figure 21 shows that a quarter of rentals have unflued gas heaters as compared to 17% of owner occupied houses. With moisture being a by-product of the combustion of gas, the use of unflued heaters results in increased moisture loads in the rooms being heated, and in turn higher likelihood of exposure to of mould and dust mites. Children and older people are more vulnerable to health effects from indoor environmental factors. The higher presence of unflued gas heaters in rental houses suggests people in rentals are more vulnerable to possible follow on effects of high indoor moisture such as respiratory disease (eg asthma) and allergies. Approximately half of New Zealand's children under five years of age live in rentals, which leaves them particularly vulnerable.

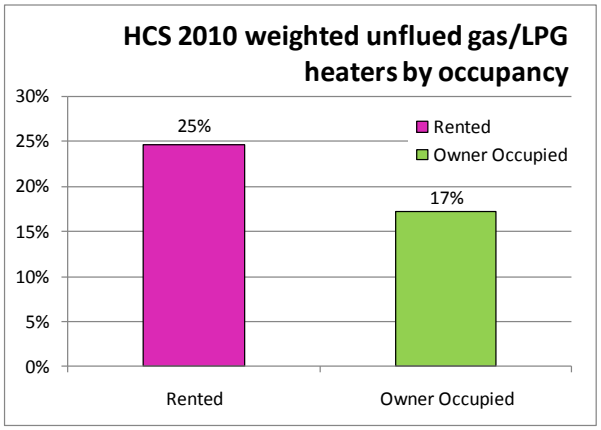

Figure 21: Unflued gas heaters by occupancy

7. HEALTH AND SAFETY

7.1 Fire safety

The most common type of fire 'protection' in the House Condition Survey were smoke alarms, with the majority of houses of both tenures containing at least one. Of the rental houses with at least one smoke alarm, 7% contained at least one alarm that was not operational at the time of the survey, as compared to 9% of owner occupied houses.

Other fire protection features or equipment were less common, and showed a significant difference between the tenures. Fire extinguishers were present in 27% of rentals, as compared to 46% of owner occupied houses. Rental houses were also more susceptible than owner occupied houses when it came to vulnerability to combustion, with more hollow core doors, synthetic carpets, and dangerously sited cookers. Tenants were also more likely to have combustible clutter in rooms within the houses inspected.

7.2 Deck barrier height

As shown in Figure 22, well over half of decks over a metre off the ground have barriers which are below a metre in height, the current standard to prevent falls and subsequent injuries[2].

Rental houses are slightly more likely to fall into this category, which may reflect the age of decks and the standards at the time of construction.

[2] *Note that at the time of publication it was not a legal requirement to bring older (pre-legislation) decks to modern levels*.

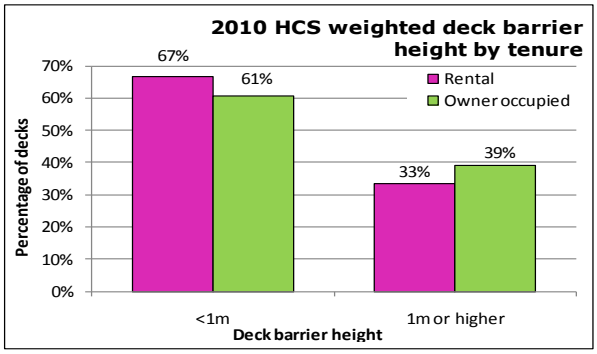

Figure 22: Deck barrier height by tenure for decks over 1 m in height

7.3 Dampness and Mould

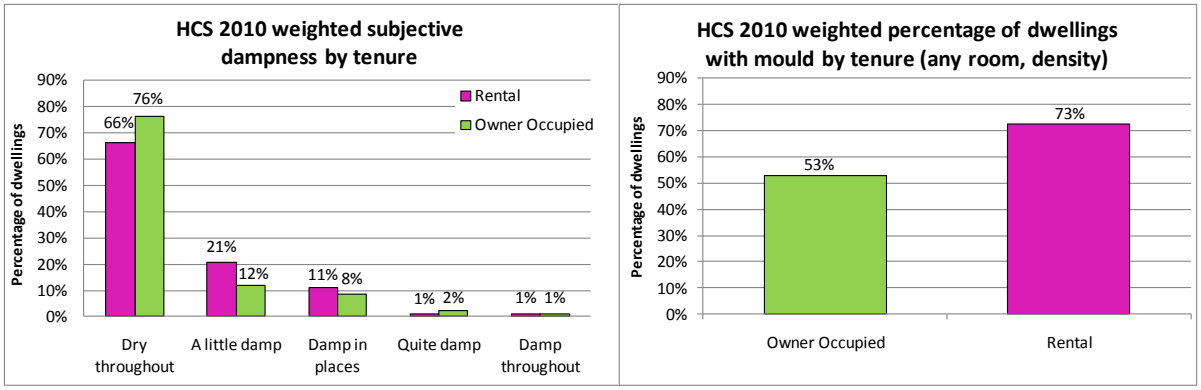

Figure 23: Assessor dampness assessments by tenure paired with presence of mould by tenure

As shown in Figure 23, 34% of rentals were assessed as having some level of subjective dampness by the assessors, without taking into account the effect of dehumidifiers, compared to 24% of owner-occupied houses. Despite the mitigating effect of dehumidifiers, most of the houses had mould present.

According to this survey, nearly three quarters of rentals and more than half owner-occupied houses have mould. There are numerous contributing factors to this, including:

- Poor or no insulation (see section 5.5)
- Lack of extraction fans at moisture sources
- Lack of ventilation
- Lack of moisture barrier over ground in subfloors
- Excessive subfloor moisture
- Unflued gas heating releasing moisture as a by-product of combustion
- Prior infestation of mould not adequately destroyed before refinishing
- Damaged wall/floor linings trapping moisture
- Leaks

Figure 24 shows the highest density of mould found in houses broken down by tenure. While rentals were more likely to have mould, they were also more likely to have moderate to high levels of mould (43%) than low levels (30%), in contrast to owner-occupied houses (25% moderate to high; 28% low).

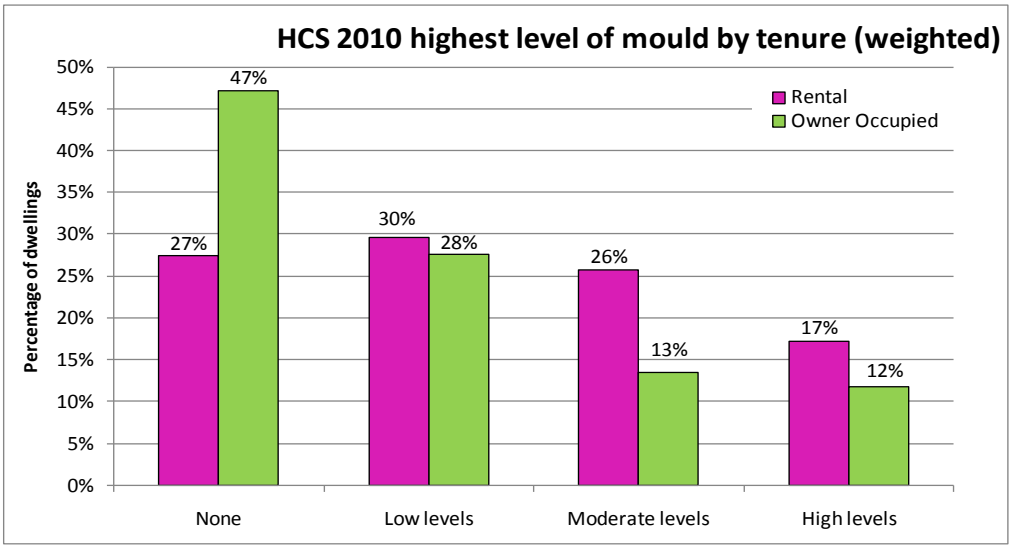

Figure 24: Dwelling mould levels by tenure

8. MAINTENANCE AND REPAIR COSTS

For each of the previous House Condition Surveys, the repairs and maintenance costs have been assessed to bring houses up to “excellent” or “as new” standard. The costs for the 2010 survey are based on 2010 prices, rounded to the nearest $100, and have been weighted in accordance with the rest of the survey.

The costs vary dependent upon component – some components cost more to repair or replace than others. For example, a kitchen in serious condition requiring replacement would cost more than replacing a pair of taps in the bathroom.

There was a statistically significant relationship between tenure and cost of repairs and maintenance to bring up to standard. Approximately 56% of owner occupied houses and 60% of rentals require over $6000 of repairs and maintenance, as shown in Figure 25. Over 35% of rentals required over $12,000 of repairs and maintenance, compared to 32% of owner occupied houses.

The average cost of repairs and maintenance required to address only components in poor to serious condition was $9,700 for rentals, and $8,000 for owner occupied houses. When considering all components in less than “excellent” condition, the average value of repairs and maintenance requirements for rented houses went up to $13,600, compared to $12,000 for owner occupied houses.

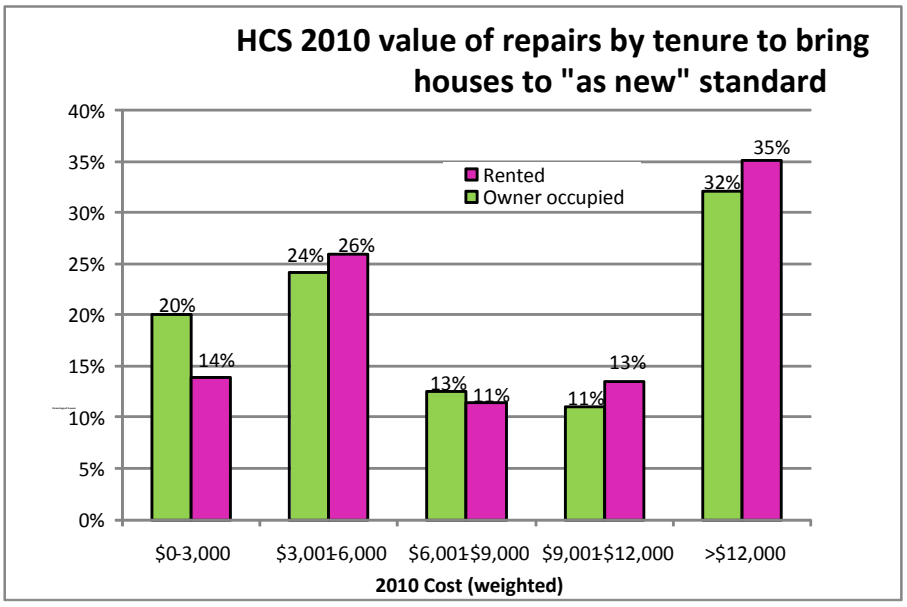

Figure 25: Costs to bring houses up to "as new" standard split into dwelling tenure.

Due to the smaller average floor area of rentals, as shown in Figure 9, the repairs and maintenance costs are higher per square metre for rentals, compared to owner occupied houses. The average cost required to address only the components in poor or serious condition per square metre of floor space is $78 for rentals, compared to $50 for owner occupied houses.

Broadened across all components in less than "excellent" condition, the costs per square metre of floor area increase to $86 for rentals, and $74 for owner occupied houses.

9. COMBINED REFERENCES

Buckett N.R. [Ed], Marston N.J [Ed], Saville-Smith, K. Jowett J.H. and Jones M.S. 2011. '*Preliminary BRANZ 2010 House Condition Survey Report'* BRANZ Study Report 240. BRANZ Ltd, Wellington, New Zealand

Building Industry Authority (BIA). 1992. *NZBC Approved Documents:* B1 Structure; B2 Durability; C3 Spread of Fire; E2 External Moisture; E3 Internal Moisture; F4 Safety from Falling; *H1 Energy Efficiency*. BIA, Wellington, New Zealand.

Clark SJ, Page IC, Bennett AF and Bishop S. 2000. *'New Zealand House Condition Survey 1999'*. BRANZ Study Report 91. BRANZ Ltd, Judgeford, New Zealand.

Clark SJ, Jones MS and Page IC. 2005. *'New Zealand House Condition Survey 2005'*. BRANZ Study Report 142. BRANZ Ltd, Wellington, New Zealand.

Department of Building and Housing (DBH), 31 October 2007. *'Compliance Document for New Zealand Building Code; Clause H1- Energy Efficiency – Third Edition'*. Department of Building and Housing, Wellington, New Zealand.

Energy Efficiency and Conservation Authority (EECA, 2011A). *'EnergyWise™; Insulation – how much insulation?'* (http://www.energywise.govt.nz/how-to-be-energy-efficient/your-house/insulation, accessed 14 September 2011).

Energy Efficiency and Conservation Authority (EECA, 2011B). *'EnergyWise™; About the Warm Up New Zealand: Heat Smart programme'* http://www.energywise.govt.nz/funding-available/insulation-and-clean-heating/about, accessed 14 September 2011).

Energy Efficiency and Conservation Authority (EECA, 2011C). *'EnergyWise™; About the Warm Up New Zealand: Heat Smart programme'* (http://www.energywise.govt.nz/node/18453 , accessed 17 August 2011).

Isaacs, N, et.al. 2006. *'Energy Use in New Zealand Households: Report on the Year 10 Analysis for the Household Energy End-use Project (HEEP)'*. Study Report 155, BRANZ Ltd, Judgeford, Porirua.

Jowett, JH. 2011. *'Assessment for Sample of House Condition Survey as at 30 March'.* Report prepared for BRANZ Ltd, Wellington, New Zealand.

Page IC, Sharman WR and Bennett AF. 1995. *'New Zealand House Condition Survey 1994'.* BRANZ Study Report 62. BRANZ Ltd, Judgeford, New Zealand.

Rawlinsons. 2010. *New Zealand Construction Handbook*. Rawlinsons Ltd, Auckland, New Zealand.

Saville-Smith, K, and Amey, B. 1999. *'Overcrowded Families in New Zealand: Regional Patterns'.* CRESA Ltd, Wellington, New Zealand.

Saville-Smith, K, Fraser, R (CRESA), and Jowett, J. 2011. *'House Condition and Repairs and Maintenance Survey 2010: A Report on Rented Houses'.* Report prepared by CRESA for BRANZ Ltd, Wellington, New Zealand.

Standards New Zealand, NZS 4218P:1977. *'Minimum Thermal Insulation Requirements for Residential Buildings'.* SNZ, Wellington, New Zealand.

Statistics New Zealand, 2009. *'Review of Housing Statistics Report 2009 - Topic 4 Housing Habitability'*. Statistics New Zealand, Wellington, New Zealand.

Statistics New Zealand, 2011. *'Number of Rooms/Bedrooms – Definition'* (http://www.stats.govt.nz/surveys_and_methods/methods/classifications-and-standards/classification-related-stats-standards/number-of-rooms-bedrooms/definition.aspx, accessed 14/09/2011*).*

Appendix A SAMPLE CONSTRUCTION

A.1 Design

The statistical design for the 2010 House Condition Survey (HCS) was modified from previous surveys. The sample was constructed to be representative of New Zealand houses, including rural and rental properties.

The result is a robust national dataset on both the physical attributes of New Zealand houses and the homeowners'/occupiers' perceptions of the quality of their homes.

This work aligns with the review of Statistics New Zealand's *Review of Housing Statistics Report, 2009*, which presents recommendations from a review of housing statistics carried out under section 7 of the Statistics Act 1975. This identified the need for national information on the physical attributes of the housing stock. The recommendation from this review was for the Department of Building and Housing, Statistics New Zealand and BRANZ to work together to improve existing survey and administrative data sources on the physical quality of the national housing stock, including rural and rental. It is also expected that the survey will also provide further information on substandard housing within the country.

The original sample design of over 550 houses was divided into two groups in an approximate 50:50 split:

- cities and suburbs of the five main centres (Auckland, Hamilton, Wellington, Christchurch, and Dunedin)
- a series of 69 area unit clusters randomly selected across the remainder of the country, with a target of four properties to be inspected in each.

This was carried out in order to give a representative spread across the sample. In order to incorporate a representative sample of rental homes within the survey, approximately 20-25% of the sample (100-130 houses) needed to be rentals.

Difficulty in maintaining the statistical integrity of the sample after the Christchurch earthquakes led to the removal of Christchurch houses. Surveyors were working in Christchurch on 4th September, and moved onto other areas in the South Island. The second, more destructive earthquake on 22nd February meant it would not be possible to collect data from the required number of houses. The data from the 15 houses surveyed prior to the earthquakes was not used in the analysis. The sample was adjusted to enable a similar accuracy to the original design to be achieved (Jowett, 2011).

Four hundred and ninety one houses were inspected and occupant interviews were completed concerning their family circumstances and maintenance practices. This 'matched' sample, where the property had been inspected and the occupants interviewed, included one hundred and eight rented houses. All properties in the House Condition survey were standalone houses or units. For the purposes of the survey, the term 'house', includes townhouses and terrace houses, and excludes apartments and flats. As such, 'houses' had a maximum of two common walls, allowing the inclusion of terrace housing, but in the most part exclude flats and apartments. It was required that each property had no units above or below it, and that there were no more than two common walls. It was required that there was fire separation from other units if adjoined, thereby constituting an independent dwelling.

Further details on the sampling methods and final sample are outlined below.

A.1.1 Owner-occupied samples – property selection protocol

The owner occupied properties were sourced from two groups. The five main centres (Auckland, Wellington, Christchurch, Hamilton and Dunedin) were the first group, stratified by city, and could be surveyed with a simple random sample in each stratum. The rest of the country was put into another group, to be surveyed using a cluster sample based on area unit.

A.1.2 Cities

For the cities, properties were randomly selected, for example 35 properties were to be in Manukau City. Required sample numbers for the cities is given below in Table 2. The area unit, physical/postal address, owner name and age of each property were obtained from Terralink for each property in each city. Then for each of the chosen properties, six more properties within the same area unit and property age were selected to be available as substitutes in case of refusals.

Table 2: Number of properties surveyed in each city

District	No. of Properties
Auckland City	54
Dunedin City	16
Hamilton City	17
Lower Hutt City	13
Manukau City	27
North Shore City	24
Porirua City	7
Upper Hutt City	6
Waitakere City	16
Wellington City	28
Total	208

A.1.3 Clusters

Sixty-nine area units were randomly selected. Table 3 outlines an extract from the full list. Four properties within each area unit were then randomly selected. Again six substitute properties for each property were also sourced.

Table 3: Extract from area unit list

District	Unit No	Unit Name
Far North District	500900	Kerikeri
Far North District	501614	Kapiro
Whangarei District	501819	Bream Head
Kaipara District	504501	Kaipara Coastal
Rodney District	505802	Red Beach
Rodney District	505803	Waiwera
Rodney District	505805	Orewa

The locations of the clusters are shown in Figure 26.

Figure 26: Intended survey locations – selected cities in orange, clusters in yellow

A.1.4 Owner occupied sample – property selection

After the clusters were randomly selected, the required area units and cities were then sent to Terralink. They was asked to randomly select an age bracket (e.g. 1980-1989) for each property required for the sample, and provide seven names and addresses, one candidate and six substitutes for properties within the candidate's area unit.

The owners of each property on the Terralink data list were sent a letter requesting their cooperation with the *HCS* study. Local papers were also given a press release to coincide with the mail-out.

Due to privacy laws, Terralink was only able to provide owners' names and addresses. To find phone numbers for the telephone surveyors tele-matching was carried out on the Terralink results by Veda Advantage. The process was repeated to obtain sufficient numbers of properties.

A.1.5 Rental sample – property selection

A modification to the sampling method was necessary for rentals, as approximately 2% of the houses recruited under the initial methods were rentals – far lower than could be expected. With the discovery of the bias toward owner occupation, analysis was

performed to find out what was required to rebalance the sample. Subsequent analysis has shown that, that the one hundred and eight rented houses surveyed is an adequate number to incorporate rentals within a 95% confidence interval.

Rented households were recruited by telephone survey through the random selection of phone numbers in required area units and stratums. This was for a number of reasons including statistical integrity and simplicity of recruitment. Due to the random selection and cold-calling, there was no longer a requirement for landlords and property agents to be involved. However, tenants were not provided with any information on the condition of the houses, and where a serious problem was found, a call was made directly to the landlord.

Had landlords or property agents been involved in the recruitment process, a bias may have been created due to:

- landlords/property agents not wanting to inconvenience their tenants
- landlords/property agents not wanting their properties surveyed due to perceived condition
- landlords/property agents not wanting tenants to demand repairs that they otherwise may not have demanded
- the need to get agreement from both landlords and their tenants, meaning duplication or triplication of recruitment effort.

The randomised rental selection method had the potential for bias from tenants seeking surveys of houses perceived to be in poor condition, potentially to encourage their landlords to improve the property. However, the policy of not discussing the condition of the property with the tenant avoided this issue.

Using a telephone list also biases the sample, excluding houses without telephones or who have unlisted numbers.

The phone survey company was asked to obtain required rental sample sizes for the applicable area unit strata.

The rental sample includes both privately and publically owned rentals.

A.1.6 Telephone surveying

As for past *House Condition Surveys,* potential participants were called by a telephone research company, and asked to answer a short questionnaire on the maintenance of their home and if they would allow BRANZ to complete a physical inspection of their property. The survey was altered slightly for the rental houses to acknowledge the responsibility of the landlord rather than the tenant for the maintenance of the house.

From the samples returned from telephone surveying, approximately 540 householders agreed at the time to both participate in the telephone survey and allow the physical inspection of their house.

A.1.7 Training

This was the first HCS where a standardised training programme was undertaken by all surveyors involved in the physical surveying of the recruited houses. In previous surveys qualified assessors were contracted to do the inspections and fill out the standardised form according to their own experience and knowledge. By training assessors as a group, the programme aimed to achieve higher consistency between the surveyors.

The experienced surveyors were responsible for implementing a training programme for additional surveyors. This initially involved six surveyors, and three of the six were

selected to proceed with the surveys. Along with physical inspection techniques, surveyors were trained to use digital pen technology, which allowed forms to be sent back in digital format while surveyors were still in the field. Surveyors were also trained in the use of geotagging digital cameras, which tagged photos to the location where they were taken.

Appendix B EXCERPT ON DATA AND STATISTICS FROM THE HOUSE CONDITION AND REPAIRS AND MAINTENANCE SURVEY 2010: A REPORT ON RENTED HOUSES

K. Saville-Smith, Ruth Fraser (CRESA Ltd), and J.H. Jowett.
Prepared by CRESA Ltd for BRANZ.

B.1 The Data and Its Collection

The House Condition Survey approach combines data from on-site assessments of houses and data from a preceding telephone survey of householders around their houses condition, amenities and repairs and maintenance. Both those surveys were undertaken in 2010 and 2011.

The onsite assessment was undertaken by BRANZ and consisted of a systematic house condition assessment of the interior, exterior and structural elements of participant houses. Key components of the houses were rated by BRANZ assessors and a subsequent assessment of those component rates allows BRANZ to assess the overall condition of the dwelling.

The overall house condition and the components are rated according to the following scale:

- Excellent – average component HCScore 4.5-5.0
- Very good – average component HCScore 4.0-4.4
- Good – average component HCScore 3.5-3.9
- Moderate – average component HCScore 3.0-3.4
- Poor – average component HCScore 2.5-2.9
- Serious – average component HCScore <2.5

Components or houses in serious condition not only require immediate attention they can present health and/or safety risks and are likely to deteriorate rapidly.

The cost of bringing a dwelling to acceptable condition has also been calculated by BRANZ. This has, for the purpose of this report, been undertaken using the same building requirements and pricing extant in 2005 when the last analysis of repair and maintenance requirements was undertaken.

The telephone surveying, consisted of a telephone interview with homeowners and renters using a structured close-end questionnaire. Participants reported on their: duration of residence, tenure, and intentions to move; perceptions of house conditions; maintenance practice and expenditure in the past twelve months; and, intended expenditure for the next twelve months on repairs and maintenance.

The questionnaire largely replicated the 2004 Home Repairs and Maintenance Survey. However, some adjustments were made in relation to scope, but more importantly, to take account of the inclusion of rental houses in the sample.

Different sample selection processes were used in the recruitment process targeting owner-occupied houses and rented houses respectively. The renter sample was generated using a list of area units corresponding to the sample developed for the

owner-occupied houses. A set of phone numbers for houses in the sample areas was randomly selected. A screening question was then used to identify rented houses and occupiers of those rented dwelling who were invited to participate in the survey. The design and its revision is detailed in Section 1.2, Section 1.3 and Section 1.4.

620 participant householders completed the Home Repairs and Maintenance Survey and agreed to be approached for an on-site condition survey of their dwelling. Of those, 491 were retained through to dwelling assessment.

B.2 Original Sample Design and Estimation Procedures

For the original sample New Zealand was divided into 13 parts, or strata. 11 of these strata corresponded to major cities (including the four Auckland Cities existing at that time.) The two remaining strata were the rest of the North Island and the rest of the South Island. 500 samples were divided among these strata in proportion to the number of houses recorded in the 2006 Census of Population and Houses.

The 11 strata corresponding to the major cities were to be sampled using simple random sampling. The two remaining strata were sampled in clusters, each cluster being a census area unit as defined at the 2006 Census. 69 clusters were selected at random. The clusters were selected with replacement (several were in fact selected twice) and with probability proportional to the number of houses in the 2006 Census. Within each selected cluster four houses were to be selected by simple random sampling.

The sample as described above was to be self-weighting: that is, for any variable the average value from the sample would be an unbiased estimate of the average value for the population being sampled. Thus almost all estimates could be made by tabulating and averaging the sample responses without regard to the underlying survey design. However, estimates of the precision of these estimates, and tests of statistical significance based on them would involve taking account of the survey design, to recognise gains in precision due to stratification and losses of precision due to clustering. The necessary adjustment to allow for the latter is to estimate precision within the clustered strata from variation between cluster means rather than variation between individual responses. This having been done, the precisions of estimation within the separate strata could be combined in the usual way for stratified samples.

B.3 Revised Sample Design

A fault in the selection method for the population from which the original sample was to be drawn, meant that very few rental properties were selected. This was due to a lack of correspondence between the owner's address and the property address supplied for the telephone surveying and expected to be used as a basis for on-site assessment. The problem was noted part way through the sample selection process. To remedy this defect, an additional sample of rental properties had to be selected using a different method. This resulted in a cross stratification, with owner occupied and rental properties being treated, for sampling purposes, as separate strata within each geographic stratum.

Houses owned by family trusts operated by one or more of the residents were treated as owner occupied irrespectively of whether or not rent was paid.) As more than a fair share of owner occupied houses had all ready been surveyed, the selection of further owner/occupied properties was halted except in the clustered strata, and rental properties were then accumulated. However, these had to be sampled at a reduced rate to prevent serious escalation in the costs of the survey.

The additional rental houses were selected from the various geographic strata in numbers proportional to the numbers of rental houses in those strata according to the

2006 Census, with one rental dwelling being added to each of the clusters for most of the clusters in the clustered strata. This course was taken because taking a dwelling from every sampled cluster would have lead to an over-representation of the clustered strata in respect of rental houses. The under-representation of rental houses, provided that due allowance is made in the estimation procedures, was calculated to have little effect on the precision of overall estimates (owner occupied and rental houses combined). However, it does affect the precision of estimates made purely for rental properties, or comparisons between rental and owner-occupies houses.

Due to the earthquake in Christchurch City, surveying of this stratum had to be abandoned (with no rental properties surveyed.) The estimates from the survey are thus for the houses in New Zealand excluding Christchurch City.

B.4 Revised Estimation Procedures

The resulting sample from the revisions set out in Section 1.3 could no longer be treated as self weighting. This was partly due to unevenness of response at the points where surveying of additional owner-occupied houses was halted and partly due to the fact the relative stratum populations changed when restricted to owner-occupied properties. The most important issue was the significant under-representation of rental properties in the total sample.

Nevertheless, it is possible to calculate, for each surveyed unit *j*, a weight W_j which can be interpreted as the number of houses "represented by" that unit. Estimates of population totals and means for a variable (say *x*) can then be calculated as $\sum W_j x_j$ and $\frac{\sum W_j x_j}{\sum W_j}$ respectively. Totals and means for subpopulations can be made by confining the summations to those subpopulations.

The ultimate justification of this procedure does not lie, however, in any intuitive interpretation that a property "represents" a certain number of others, but in the fact that the procedure yields exactly the same answers as the estimation procedure described below, which in any case is necessary to estimating the precision of the estimates obtained where this is required.

The calculation of the estimates and their standard errors (and correlations where necessary) is done as follows.

- Define PSUs (primary sampling units.) These are individual houses in the non-clustered strata, and clusters in the clustered strata. Note that owner-occupied and rental properties in an area unit are considered for this purpose to belong to separate clusters, since they fall within separate strata.
- Calculate the means of the variables concerned for the various PSUs (in the unclustered strata these means will just be the individual responses.)
- Within each stratum (*i*), calculate the mean m_i, and standard deviation s_i of the PSU means. Where the correlation is required for two variable (as in, for example, estimates of ratios) calculate the covariance c_i of the corresponding PSU means.
- To combine results from the various strata, we use stratum weights w_i equal to the stratum populations.

The overall total is then estimated as: $m = \sum_i w_i m_i$ and its standard error as: $\text{sem} = \sqrt{\sum_i \frac{w_i^2 s_i^2}{n_i}}$. The covariance of two estimates is $\sum_i \frac{w_i^2 c_i}{n_i}$. In these formulae n_i is the number of PSUs in stratum *i*. The corresponding estimates of the population mean and its standard errors are then obtained by division by $\sum w_i$ (the total size of the population.). For the covariances, the division is by $\left(\sum w_i\right)^2$.

It should be noted that this method is appropriate when and only when cluster have been selected with probability proportional to size.

B.4.1 Calculation of the weights

For unit *j*, the weight W_j discussed in the "Quick Method" described above is calculated by dividing the number of houses in the relevant stratum by the number of PSUs sampled in that stratum, and then by the number of houses sampled in the relevant PSU. (This last quantity is always 1 for units outside the clustered strata, and normally 4 or 3 for owner occupied properties and 1 for rental properties in the clustered strata.)

B.5 Further Technical Notes on Analysis

It is useful to note the way in which various aspects of the data and analysis have been handled. They are as follows:

B.5.1 Percentages:

Percentages of the population falling into various categories were dealt with by defining an indicator variable for each category, which has the value 1 if a unit falls within that category, 0 if it does not. The number of units in the population falling in that category is then the population total for the indicator variable, the percentage is its mean (x 100%), For an overall significance test analogous to a chi-squared test the covariances of the various indicator variables need to be calculated and used.

B.5.2 Treatment of missing values

There were in fact very few missing values in the survey: for many variables there were no missing values, for most others only one or two. For such variables, the treatment of missing values is not critical, although it creates considerable nuisance value in the calculations. Apart from the question on Household Income (in which refusal was not in fact treated as a missing value) the highest rates of missing values (18 out of 491) occurred in response to question 8 (how often had smoke alarms been checked in the last 6 months.

Missing values can "dealt with" using the weighting coefficients W_j by estimating the population mean by: $m = \frac{\sum W_j x_j}{\sum Wj}$, where both sums are taken only over the units *j* for which x_j is not missing.

This is in fact a ratio estimate: if an indicator variable e_j is defined as 0 when the variable x_j is missing, 1 when it is not, the mean of variable *x* is estimated as the ratio of the mean of the variable *ex* to the mean of the variable *e*. A standard error can be calculated using the usual methods for ratio estimation.

This method is similar to assigning to each missing value the corresponding estimate of the population mean. However, it gives slightly different estimates from the method used. Rather estimates were formed by including missing values separately for the owner occupied and rental houses and then combining them. This is similar to replacing missing values in the owner-occupied units by the mean for owner-occupied houses, those for rental houses by the mean for rental houses.

B.5.3 "Not Applicable"

Missing values should be distinguished from the valid answer "not applicable." Survey estimates in the form of averages over applicable cases are again derived as ratio estimates using indicator variables, and can again be calculated from the formula: $m = \frac{\sum W_j x_j}{\sum Wj}$. The rate of "not applicable" answers was quite high for some questions, (for example those relating to the condition of a carport of second bathroom.) However, in this case (unlike the case for missing values) there is no "makeshift" element involved, and there is no doubt of the validity of the estimates thus formed.

B.5.4 Chi-squared tests

"Chi-squared" tests to test difference owner-occupied and rental properties, in respect of their distribution among categorical values, were conducted by computing the statistic $(\bar{x}_1 - \bar{x}_2)G(\bar{x}_1 - \bar{x}_2)'$ where $\bar{x}_1$ and $\bar{x}_2$ are vectors of the estimated means of indicator functions for the owner-occupied and rental categories respectively and G is a generalized inverse of the sum of the estimated covariance matrices of the estimates $\bar{x}_1$ and $\bar{x}_2$ respectively.

Appendix C REPAIR COSTING METHOD FOR THE 2010 HCS

I.C. Page, BRANZ

Costs were calculated using the 2010 Rawlinsons New Zealand Construction Handbook for total replacement of each of 25 components in a "standard" 140 square metre house on timber piles. The components are: foundations, fasteners, steps, joists/ bearers, floor, wall cladding, exterior doors, windows, carport, roofing, spouting, chimney, roof framing, ceiling insulation, kitchen lining, kitchen fittings, stove, laundry linings, laundry fittings, bathroom1 linings, bathroom1 fittings, bathroom2 linings, bathroom2 fittings, other room linings, interior doors.

For a component scored as a "Serious" condition total replacement is assumed. For the next condition "Poor" the repair/replacement cost is assumed to be 70% of total replacement, except for windows, stove and bathroom fittings where it is assumed to be 50% of total replacement. A "Moderate" condition repair cost is assumed to be 10% of total replacement for all components. A "Good" condition repair costs is assumed to be 1% of total replacement. "Excellent" condition has no repair cost.

The above costs are then proportioned for each house according to the floor area of that house. For example a 200 square metre house will have its component repair costs proportioned upward by 200/140 = 1.43. The 140 in the denominator is the floor area of the "standard" house.

The above approach is similar to that used in earlier surveys. However some component costs have escalated more than others, namely joists/ bearers, windows (double glazing assumed), roof framing, ceiling insulation (thickness upgrade), bathroom fittings (higher specs), and other linings (previously under-estimated the areas involved). Insulation levels (including glazing) increased with the 2007 New Zealand Building Code H1 changes. The extra for double glazing (compared to like-with-like single glazing replacement) in the "standard" house is about $2,300 assuming total replacement.