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NEW ZEALAND HOUSE CONDITION SURVEY 1994

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HOUSING CONDITION SURVEY

BRANZ STUDY REPORT SR 62

PREFACE

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

REFERENCE

Page I. C., Sharman W. R., and Bennett A. F. 1995. New Zealand House Condition Survey 1994. Building Research Association of New Zealand Study Report SR62, Judgeford.

KEYWORDS

Surveys, House Condition, Maintenance, Costs, Durability, Repairs.

ABSTRACT

This report summarises the results of on-site inspections of the physical condition of over 400 houses in 1993/94. The houses were chosen at random in the three main centres and the inspections were carried out by BRANZ staff. A total of 26 components in each house were assessed on a five point condition scale. The nature of any defect and the material types were recorded. A further 14 attributes were recorded including sub-floor moisture content, types of space heating devices, and types of thermal insulation, etc.

Analyses included the ranking of defects, costs of repairing the defects, defects by house age group, and comparisons with the English House Condition Survey. The study concludes that the worst defects relate to inadequate sub-floor vents, non-restraint of header tanks against earthquakes, foundations, claddings, linings, and windows. The average costs of outstanding maintenance, requiring attention within three months, is calculated to be approximately $3,200. In recent years the actual expenditure on maintenance by households is approximately $900 per annum and is insufficient to adequately repair the housing stock.

CONTENTS

1 SUMMARY

A survey was carried out on the physical condition of over 400 houses in the Auckland, Wellington and Christchurch regions. The main defects discovered were in the sub-floor vents, roof space, claddings, foundations, hot water cylinder, spouting, and windows. In general the condition of components showed a deterioration with increasing age of the house. The cost required to repair the more serious defects is estimated at an average of $3,200 per house. Current maintenance expenditure is estimated at $900 per house so that at present insufficient maintenance is being undertaken to maintain the housing stock in a satisfactory state.

Data compiled includes:

- A complete survey of 402 houses plus the exterior of a further 165 houses from Auckland, Wellington and Canterbury in late 1993/ early 1994 - Table 2.
- The physical condition, material type and frequency of defect for 26 components - Table 5.
- Attributes for another 14 components recorded in lesser detail for each house.

The analyses carried out include:

- Ranking of components by average condition - Section 5.4.
- Ranking of a composite house condition by age cohort - Figure 2.
- Component condition by material type - Table 6.
- Calculation of costs of repair by component and age cohort - Figures 5 and 6 and Appendix 6.
- Calculation of costs of delay in maintenance - Figure 7 and Appendix 6.
- Comparisons of the survey results with the Valuation NZ condition recording, - Appendix 7, and with the general results from the English House Condition Survey 1991, - Table 7.

2 INTRODUCTION

The New Zealand dwelling stock consists of approximately 1.3 million dwellings valued at over $90B, but little is known about the physical condition of this vital national asset. What, for example, is the state of maintenance of the stock? What is the incidence of serious physical defects in housing? Are there measurable trends in these defects? There has been little work in the past to answer these questions in any detail.

In the UK the Department of the Environment carries out a survey of the English dwelling stock every five years. These surveys started in 1966 and the latest was completed in 1991 (1). Main results and trends arising from the latest UK survey are:

- The cost of disrepair has fallen by approximately 24% in the last 5 years from £1,480 to £1,130 per average dwelling (unadjusted for inflation).
- Most of the improvement has occurred in the pre-1919 stock.
- Repair costs rise with age of the dwelling, up to about 60 years old, then level off.
- 55% of the stock has been built since 1945.
- The median year of construction of an English dwelling is approximately 1947.

There are many differences between the English and New Zealand housing stock including age composition, service conditions and types of construction. However it would be of interest to carry out some comparisions.

In New Zealand research has been done on the mortality of the housing stock by Johnstone (2). This work suggests that some quite recent housing cohorts have an unexpectedly high rate of obsolescence or demolition. It was hoped that a survey might throw light on this finding.

The first nationwide New Zealand study was one carried out by the National Housing Commission in the early 1980's (3), using Valuation New Zealand (VNZ) data. The study presented data on age of dwellings, floor areas, condition of cladding, and section area. VNZ revalues every dwelling triennially and, as part of the valuation process, they may update their records on the condition of the wall and roof cladding, although this is not done as a matter of course every three years. There is no recording of other components and the findings of the NHC study are limited as far as the physical condition of the stock is concerned.

What was required was a detailed inspection involving a large number of building components. BRANZ decided to undertake such a study, which would be limited to privately owned houses in the main centres. The aim of the study was to shed light on the following areas:

- What is the physical condition of typical NZ housing, expressed in terms of a set of objective criteria?
- What are the common maintenance problems?
- Is the housing stock being adequately maintained?
- What are the outstanding maintenance workloads?
- What data can be obtained for lifecycle cost studies?
- Is BRANZ research being directed in the right areas in the housing sector or are there unidentified problems of which BRANZ is unaware?
- To obtain useful information on the incidence and performance of different components, materials and products.

3 PILOT SURVEY.

To investigate the feasibility of carrying out a full scale survey, a pilot survey was undertaken on approximately 40 privately owned houses in the Wellington area in 1992/93. The sample was a random selection of privately owned houses, (flats i.e. adjacent dwellings with common walls or ceilings/floors, were excluded), and approximately 20 components were assessed for condition on a 10 point condition rating scale (4).

As a guide to designing the survey the English House Condition Survey was investigated and some of its procedures were adopted. In general though the English survey was undertaken in considerably more detail than what was proposed locally, as well as being carried out on a larger percentage of the stock than local resources would allow.

In New Zealand, Housing New Zealand, the major housing portfolio owner, with 70,000 homes, surveyed its own stock in 1992/93. Although the detailed results have never been published, BRANZ was allowed access to the survey methodology to assist in designing its own national survey.

The following aspects were tested in the pilot:

- The survey form design.
- Bias in the sample.
- Problems in gaining access for inspection.
- The method of analysis of data.
- The time required for the inspection.
- The extent of serious defects in the physical condition of housing.
- The usefulness of the results.

Self-selection bias was checked by carrying out a quick inspection of the outside of non-responding households and comparing the results with the households which allowed a full inspection. This potential bias relates to the possibility that home owners with a high standard of maintenance may be more likely to invite inspection than other owners (see Section 5.3 for more details).

The main results of the pilot survey were:

- About 12% of the sample had problems rated as serious and this figure alone indicated that a full scale survey would be worthwhile.
- The survey forms needed to include more defect types and to provide a clear indication of the condition rating of each type of defect.
- A five point condition scale (i.e. excellent to serious) is more realistic than a 10 point condition scale in order to facilitate consistency between inspectors.
- Some self-selection bias was evident in the houses made available for inspection and every attempt must be made to get access to all the selected houses to minimise sample bias.
- Follow up phone calls to the initial letter requesting access are worthwhile in obtaining a better response, and flexible hours of inspection, including at night and weekends, improves the response rate significantly.
- Each inspection took a minimum of 1.5 hours and although every attempt was made to arrange sequential inspections in a given locality this proved difficult and significant time was spent in travelling.
- Incentives are effective in gaining approvals of homeowners for inspection access. They included a free BRANZ publication or an individual written report on the results of the specific house survey. The latter proved to be costly to provide and was not recommended for the main survey.

4 SURVEY DESIGN

The design of the full scale survey incorporated the findings from the pilot survey. The main aspects were:

4.1 Sample Size

It was decided to aim for a sample size of 500 houses. This represented the maximum resources available in terms of time of the inspection staff. Information was required for the different 10 year age cohorts and a sample size of 400 to 500 would ensure that most cohorts would have at least 25 houses within them. The pilot had shown that the standard deviation for individual components was about 1.2 on the five point condition scale. Thus the 95% confidence level of condition, for any particular component, is given by $\pm t^*S/\sqrt{N}$,

where S =standard deviation of the sample condition,

N = sample size

t = Students t statistic = 2.1 approximately for N=25.

For a sample size of around 400 to 500 the margin of error is about 0.5, which was considered to be acceptable. That is, we can be 95% confident that the average condition rating for a particular defect in a given cohort was within 0.5 condition points of the overall population average condition. Only 402 houses were actually fully inspected due to resource constraints and another 165 were inspected on the outside only.

4.2 Regional Sample

The survey was limited to the three main centres in which the BRANZ staff carrying out the survey were based so that costs were minimised. Within these centres a mix of city, surburban and rural areas were chosen, and were:

Auckland
- Auckland City
- Manukau City
- Papakura District

Wellington
- Wellington City
- Upper Hutt City
- Kapiti Coast District

Canterbury
- Christchurch City
- Waimakariri District

Media reports suggest that some of the worst housing problems occur in areas not covered by the sample, such as parts of Northland, the East Coast of the North Island and the South Island's West Coast. Unfortunately resources did not permit including these areas and the housing numbers in these areas are small, at less than 4% of the national housing stock.

To check how representative the selected regions are of the national housing stock, an analysis was carried out on the NHC 1981 study. This analysis, reported in Appendix 1, indicates that the sampled regions are closely representative of New Zealand as a whole, and that the survey results can be meaningfully scaled up for the whole population.

4.3 Sample Selection

A random selection of owners' names and addresses of privately owned houses was obtained from VNZ. A letter requesting access was sent to these owners including information on BRANZ, a reply paid form, and a list of the incentives on offer. The latter were a choice of a BRANZ book, or $20 of Lotto tickets/grocery/petrol vouchers. The mailout enclosures are in Appendix 2. Follow-up phone calls were made to non-responding households. A door knock visit was also made to some non-responding households, as discussed in Section 5.1.

Housing New Zealand offered to provide access to a random sample from its stock and a total of 29 of its houses were included in the survey.

4.4 Survey Forms

The survey forms are attached as Appendix 3. A total of 26 components had their condition recorded and assessed on a five point scale, as shown in Table 1. In the pilot survey a 10 point scale was used based on the method used in a Dutch House Condition Survey (5). In practice the inspectors found it difficult to distinguish between adjacent points on the scale and a coarser scale was adopted in the main survey to enable more consistency in condition rating between inspectors.

As well as the defect severity, the material type and the extent of the defect were also recorded so that the cost implications could be more readily estimated.

TABLE 1 CONDITION SCALE

CONDITION	SCALE	DESCRIPTION
SERIOUS	4	Health and safety implications, needs immediate replacement.
POOR	3	Needs replacement in the next 3 months.
MODERATE	2	Needs replacement within 18 months.
GOOD	1	Near new condition.
EXCELLENT	0	As new condition.

Apart from the 26 components recorded on the five point condition scale another 14 components and/or attributes were recorded, e.g. type of plumbing materials, type of insulation and where situated, sub-floor moisture levels, roof type and slope, electrical wiring materials, floor coverings, fire safety devices, etc.

A photographic record of each house was taken, usually a front elevation, and any defects of an unusual severity or with some other interest were also recorded.

4.5 Inspector Training

The three BRANZ staff involved in the inspections were brought together for a one-day training session involving familiarisation with the survey manual and a trial inspection of two houses. The manual consisted of the survey forms with photographic examples of various defects and their condition rating. The main aim was to achieve standardisation of condition assessment.

5 RESULTS

5.1 Survey Response

A response rate of just under 1 in 2 was achieved for full inspection. The numbers inspected in each area are shown in Table 2. Where there was no response to the initial letter at least one phone call was made and if there was still no response a door knock visit was undertaken for a random sample. During the door knock visit a quick exterior survey was undertaken or, if approval was given, the full inspection was carried out. The door knock visits provided an opportunity to check for sample bias, as discussed in Section 5.3.

The incentives proved to be quite successful in obtaining access, particularly in the middle-lower income areas. The take-up of the incentives was approximately in the ratio of 2 to1 for lotto/grocery/petrol vouchers compared to the BRANZ books. While a written report was not provided to the owners in many cases the results were discussed with them.

5.2 Regional Distribution and Age Group Distribution

The sample was randomly chosen from the territorial authority areas shown in Table 2. It was expected that these areas would approximately represent the total housing stock both in terms of condition and in the age profile of the stock. The evidence that the areas chosen are representative of the national condition is explained in Appendix 1.

Figure 1 and Table 3 indicate that the sample is also fairly representive of the age profile of the New Zealand-wide stock. The 1920's and 1930's cohorts are over-represented and the 1970's and 1980's cohorts are under-represented in the sample but most other cohorts have fairly good matches. The sample was a random selection of all houses within each authority with no controls on age of house. The numbers in the table include the 29 Housing New Zealand houses.

TABLE 2 HOUSES SURVEYED	FULL SURVEY	OUTSIDE ONLY
AUCKLAND		
Auckland City	67	36
Manukau City	38	19
Papakura District	16	5
WELLINGTON		
Wellington City	89	4
Upper Hutt City	50	2
Kapiti Coast District	15	0
CANTERBURY		
Christchurch City	77	72
Waimakariri District	50	27
TOTAL	402	165

DWELLING STOCK DISTRIBUTION FIGURE 1

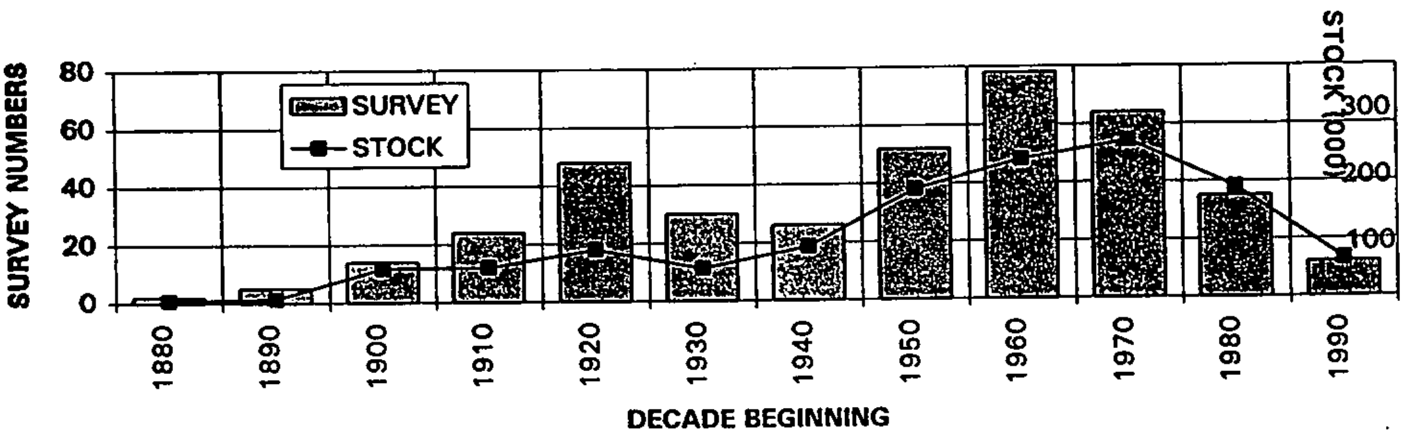


TABLE 3 AGE DISTRIBUTION OF THE SAMPLE		
DECADE BEGINNING	PERCENTAGE IN SURVEY	PERCENTAGE (1) OF HOUSING STOCK
PRE 1880	0.0	0.4
1880	0.5	0.3
1890	1.3	0.5
1900	3.6	4.4
1910	6.2	4.5
1920	12.3	6.7
1930	7.7	4.3
1940	6.7	7.0
1950	13.3	14.2
1960	20.0	18.0
1970	16.4	20.4
1980	9.0	14.3
1990 (2)	3.1	4.9
ALL	100.0	100.0

NOTES: (1) Based on Johnstone 1993 (2).
(2) 1990 Decade is to March 1993.

5.3 Sample Bias

The pilot survey showed some self-selection bias had occurred (see reference 4). It appeared that owners with houses in poor condition were less likely to offer their houses for inspection whereas owners with good condition houses more readily offered their houses for inspection. This factor was checked in the main survey and the results are shown in Table 4. Non-respondent households had a slightly better condition for most components than for the fully inspected houses. This suggests that the survey slightly over-estimates the extent of the deterioration in the housing stock.

A possible reason for the switch in bias is that the incentives used (lotto tickets, etc) in the full survey are more popular in the lower socio-economic groups than the books or a report used in the pilot survey. Thus the responses from the lower income groups, with the poorer quality houses, was better in the full survey and they may have been over represented.

Another aspect of potential bias is the slightly non-representative age distribution of the sample as discussed in the previous section. The effect of this is to slightly over-estimate the deterioration of the stock, as in general, condition deteriorates with age, as discussed later in Section 5.4.6.

TABLE 4 COMPARISON OF CONDITION OF FULLY INSPECTED HOUSES AND THE NON-RESPONDENT HOUSES						
	AVERAGE CONDITION					
	AUCKLAND			CANTERBURY		
COMPONENT	NON-RESPONSE	FULL INSPECTN	DIFFERENCE	NON-RESPONSE	FULL INSPECTN	DIFFERENCE
FOUNDATIONS	2.3	3.0	-0.7	0.7	1.1	-0.4
FASTENERS	1.0	1.7	-0.7	3.3	1.8	1.5
GROUND CLEAR	1.3	1.3	0.0	0.5	0.9	-0.4
JOISTS/BEARERS	1.3	1.2	0.1	1.1	1.3	-0.2
FLOOR	1.1	1.2	-0.1	1.1	1.3	-0.2
SUB-FLOOR VENTS	2.8	2.8	0.0	1.6	2.2	-0.6
WALL CLADDING	1.7	2.0	-0.3	1.0	1.2	-0.3
WINDOWS	1.8	2.1	-0.3	0.9	1.2	-0.2
CHIMNEY	2.3	1.4	0.8	1.8	1.7	0.1
ROOF CLADDING	1.7	2.1	-0.4	1.0	1.4	-0.4
SPOUTING	1.4	1.8	-0.4	1.4	1.8	-0.4

5.4 Defect Ranking

The average condition of components is shown in Table 5.

The ranking of these defects, in descending order of severity, is listed below. The defects have been classified into three categories:

- C Code requirement, with the applicable New Zealand Building Code (NZBC) clause E2, C3, etc as in the New Zealand Building Code Approved Documents (9).
- M Poor maintenance/ house management.
- P Poor building practice.

Descriptions of typical defects are as follows, with defect category and NZBC clause reference in brackets:

5.4.1 Exterior Defects

Sub-floor Ventilation:

Severely inadequate or blocked vents. Includes insufficient vents in the original construction (C:E2), vents not spaced at the required centres (C:E2), vents blocked by subsequent additions such as paths, patios and new rooms (C:E2, P), vents blocked by vegetation, soil, and firewood (M).

Roof Space:

The main defects were no, or poor, earthquake restraint of the header tank (C:B1), inadequate or nil roofing underlay, and venting from bathrooms and kitchens into the roof space instead of to the exterior (C:B2:C3, P). The latter often caused deterioration of the underlay and dampness in the insulation. In a few cases rodent and bird nests were evident, creating health hazards (M).

Roof Cladding:

Rust in steel tiles and sheets and in the interior gutters, partial to complete loss of the chip coating from metal tiles, cracked concrete tiles and missing mortar, poor fixing of roofing material (C:E2, M).

Wall Cladding:
Missing boards, decay in timber, severe checking in timber, poor fixing of boards and sheets, cracks in bricks particularly at lintels, dents, cracks and holes in fibre cement sheet, missing plaster in stucco (M). Cracks and crazing of stucco, and drummy surface (P).

Foundations:
Unsafe basement excavations, usually carried out by the owner (C:B1, P), ground subsidence (P), cracks in perimeter walls (P), missing perimeter baseboards allowing rodent access (M), decay in native timber piles, missing piles, non vertical piles and jack studs, inadequate bracing causing earthquake hazards, native timber piles and jack studs in ground contact and suffering decay (C:E2), water ponding or damp on the ground under the house, usually due to inflow through sub-floor vents or non-connection of waste pipes (C:E2, P, M).

Spouting:
Rust holes in galvanised spouting and cracked PVC spouting (M), missing spouting and downpipes, missing supports and sags in spouting, inadequate discharge into the sump (M).

Windows:
Decay in timber frames, paint deterioration to bare timber, corroded flashings and hinges, broken and missing glass (C:E2, M), poor flashing details (P).

Exterior doors:
Paint deterioration to bare timber, broken panels and panes, poor hardware causing security hazards (M).

Chimneys:
Cracks in concrete and brick chimneys and mortar loss (M), fire hazard due to unsafe construction including inadequate clearances to, and protection of, adjacent flammable surfaces (P), earthquake hazard due to inadequate structural strength (C:B1).

Fasteners:
Corroded (M), and inadequate fixing (C:B1, P). Includes all sub-floor structural steel connectors including nails, nail plates, wire, strip, and bolts.

Insulation:
Inadequate thermal insulation in the ceilings, mainly in older houses (M). The rating scale in Table 5 was used. A uniform rating was adopted for all locations so that while nil insulation is less serious, in terms of energy losses, in Auckland than in Christchurch the rating in both locations is the same. The occurrence of insulation in the walls was not recorded but it was recorded for the floor.

Roof Rafters/ Joists:
Extensive borer in older houses with native timbers, a few examples of two-tooth borer infestation (M). In one case rafters and ceiling joists had been cut to accommodate flues from gas water and space heating installations (C:B1, P).

Floor and Floor Joists/ Bearers:
Extensive borer in native timbers, including two tooth borer. Mould and fungus growth on bearers and joists due to a damp sub-floor area. Decay in joists and bearers at the perimeter due to the failure of the cladding. Bearers in contact with the ground causing decay (C:E2, M).

Ground Clearance:
Insufficient clearance to cladding, usually in older houses caused by inadequate pile height and /or subsequent earthworks and installation of concrete paths, patios, etc in contact with the cladding. Some modern houses on concrete slabs also have the latter problems in which the initial clearance to bare ground may have been adequate, but after topsoil, lawn and/or paths are placed the clearance is inadequate (C:E2, P).

A range of photographs illustrating many of these defects is given in Appendix 4.

5.4.2 Interior Defects
Hot Water Cylinder:
Inadequate earthquake restraint, corroded connections and leaks at connections (M).

Bathroom linings:
Decay of linings due to moisture penetration especially in showers, severe mould on walls and ceilings, extensive paint peeling (C:E3, M).

Bathroom whiteware/ joinery:
Excessive wear of joinery, poor seals around the bath causing unhygienic surfaces and decay in the mouldings, chips, cracks, and severe staining of whiteware. Leaking waste connections. Poor tapware. Cracked and insecure WC cistern and fixings (M).

Laundry linings:
Decay, mould, and excessive wear of linings (M).

Laundry joinery/ tub:
Excessive wear, and paint deterioration to joinery. Poor seals around the tub. Poor condition of the tub included pitted concrete tubs. Leaking waste connections (M). Poor tapware.

Living area linings:
Excessive wear including torn wallpaper, dirty surfaces, dents and holes in linings (M).

Kitchen linings:
Decay, mould, staining and fat deposits on linings (M).

Kitchen joinery/ bench:
Excessive wear, paint deterioration, poor hardware. Leaking waste connections. Poor tapware (M).

Interior doors/ hardware:
Holes and dents in doors. Poor or missing handles and hinges. (M).

Fireplace:
Missing mortar (M).

5.4.3 Incidence of Serious and Poor Condition Defects

Defects with a condition number of 3 and 4 are categorised as poor and serious conditions respectively. As shown in Table 5 the incidence of these conditions is similar to the ranking of components by average condition. (The Spearman rank coefficient was 0.73 indicating a reasonable amount of correlation). In other words those components with the worst average condition across all houses also generally have the highest percentages of condition 3 and 4 defects. The main exception is ground clearance to claddings where on average, the clearance is good but there is a significant number of houses with serious clearance problems.

5.4.4 Composite Condition versus Age Group

Figure 2 shows the composite condition of houses by the age group of original construction. The composite condition is the average condition across all 26 components of a house and then the average of the composite for all houses in that age group. Composite condition rating rises with age in a fairly steady fashion. There is a dip for the 1890's cohort but the margin of error is high due to the small number (5 houses) in this cohort. Details of the spread in composite condition by cohort and region are given in Appendix 5. This shows that the error at the 95% confidence level for the composite condition shown in Figure 2 is about ±0.2 for most cohorts but for the 1880 to 1900 cohorts the error is ±1.1 due to the small sample sizes.

AVERAGE COMPOSITE CONDITION ALL REGIONS

FIGURE 2

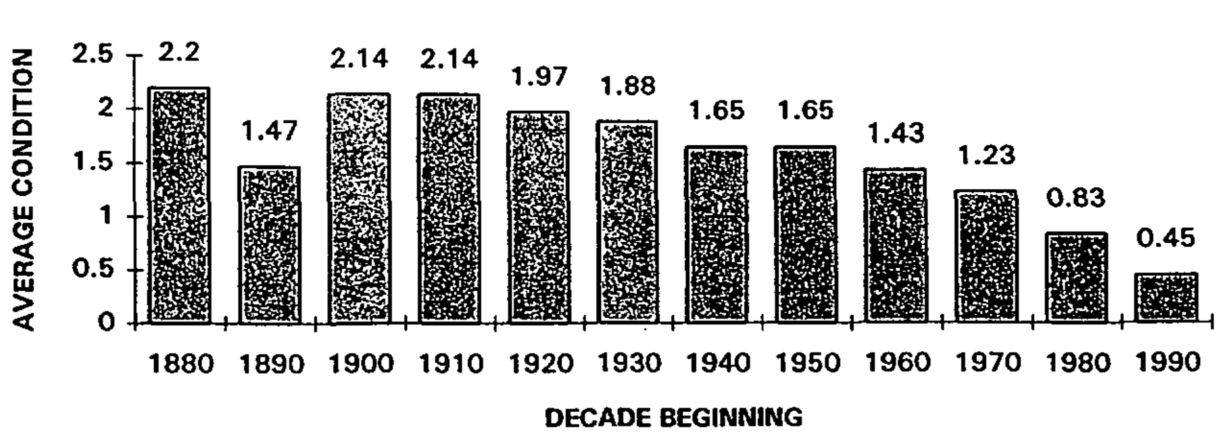


TABLE 5 AVERAGE CONDITION OF COMPONENTS

	FOUNDATIONS			SUB FLOOR			WALL CLADDING		WINDOWS	CHIMNEY	ROOF CLADDING		ROOF SPACE		
	FDNS	FASTNRS	GROUND CLEARANCE	JOIST/ BEARER	FLOOR	VENTS	CLADDING	EXTERIOR DOORS			CLADDING	SPOUTING	RAFTER/ JOISTS	OTHER	INSULATN
AUCKLAND	3.0	1.8	1.3	1.2	1.2	2.8	2.0	1.9	2.1	1.4	2.1	1.8	1.6	2.0	1.9
WELLINGTON	1.6	1.3	1.4	1.3	1.1	2.5	2.0	1.4	1.9	1.6	2.1	1.7	1.3	2.3	1.8
CHRISTCHURCH	1.1	1.8	0.9	1.3	1.3	2.2	1.2	1.6	1.2	1.7	1.4	1.8	1.1	1.9	0.8
ALL	1.8	1.5	1.2	1.3	1.2	2.5	1.8	1.6	1.7	1.6	1.9	1.8	1.3	2.1	1.5
% CONDITION 3 OR 4	39.7	22.5	28.9	12.7	9.4	59.7	28.0	21.9	26.6	10.9	28.2	13.7	17.2	56.4	29.6

	BATHROOM		KITCHEN			LAUNDRY			INTERIOR LININGS ETC		
	WHITE/ WEAR	LININGS	JOINERY/ BENCH	RANGE	LININGS	JOINERY/ TUB	HWC	LININGS	DOORS/ HARDWR	FIREPL	LININGS
AUCKLAND	1.7	1.9	1.5	1.3	1.6	1.7	2.6	1.7	1.3	0.9	1.7
WELLINGTON	1.7	1.6	1.5	0.8	1.5	1.6	1.8	1.6	1.3	1.0	1.5
CHRISTCHURCH	1.1	1.1	0.9	0.6	0.8	1.0	0.7	1.1	1.0	0.6	1.0
ALL	1.5	1.5	1.3	0.9	1.3	1.4	1.8	1.5	1.2	0.9	1.4
% CONDITION 3 OR 4	27.7	27.5	22.0	8.4	24.2	24.1	50.2	21.8	6.6	3.7	16.8

ROOF INSULATION CONDITION SCALE

CONDITION RATING	THICKNESS AND % COVER
0	100MM 100%
1	75MM 100%, 100MM > 90%
2	50MM 100%, 75MM >90%
3	50MM > 90%, OTHER SIZES 70 - 89%.
4	LESS THAN 70% ANY SIZE.

GROUND CLEARANCE CONDITION SCALE

CONDITION RATING	DISTANCE FROM CLADDING TO PROTECTED GROUND	UNPROTECTED GROUND
3	0-50MM	0-100MM
2	51-150MM	101-200MM
0	> 150MM	> 200MM

CONDITION SCALE ALL OTHER COMPONENTS

CONDITION RATING		
4	SERIOUS	HEALTH & SAFETY IMPLICATIONS
3	POOR	NEEDS ATTENTION NEXT 3 MONTHS
2	MODERATE	NEEDS ATTENTION IN NEXT 18 MONTHS
1	GOOD	NEAR NEW CONDITION
0	EXCELLENT	NEW CONDITION

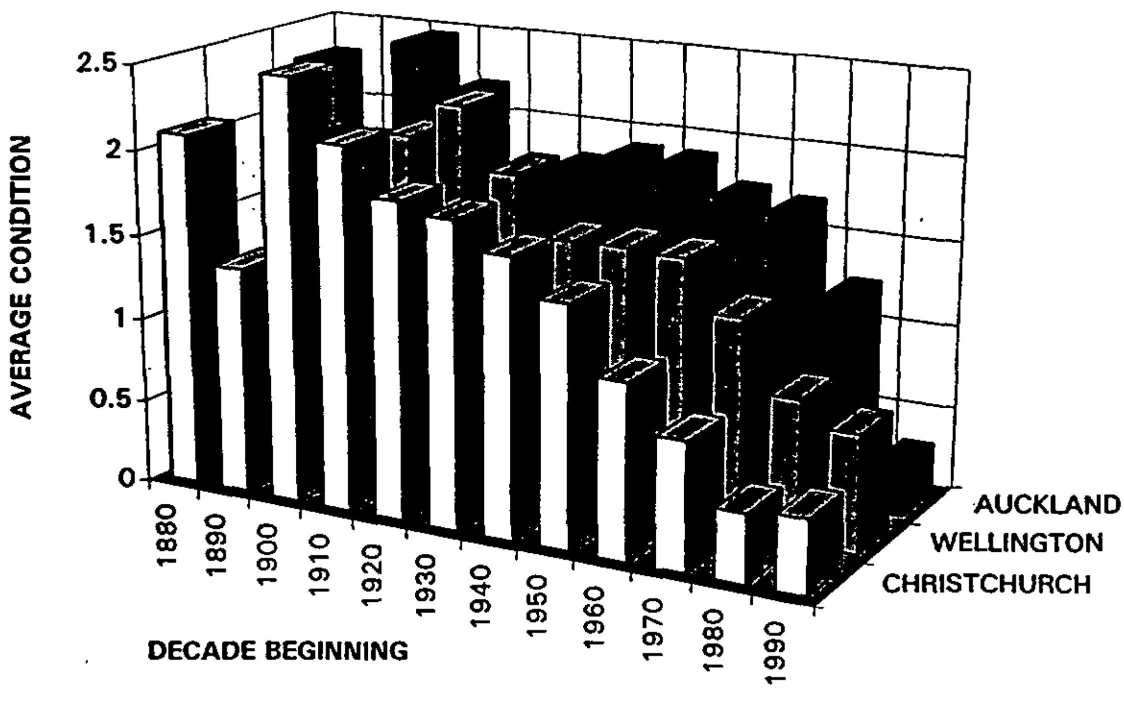
The work by Johnstone (2) indicates that dwellings in the 1950's and 1960's cohorts have quite high removals from the dwelling stock. The survey did not show any particular problem with the survivors from these cohorts that might indicate early obsolescence or demolition.

5.4.5 Component Condition by Region

The regional variation in condition of the components is shown in Table 5 and the composite condition by region is in Figure 3. Between 1900 and 1939 the composite condition is similar in all regions on average. Since 1939 the trend is for the composite condition to deteriorate from south to north., i.e. Auckland houses have, on average, the worst condition, while Canterbury houses have the best condition, after 1939.

It is likely that variability between the inspectors will explain some of the regional differences though this influence is considered to be minor. It is obviously important to achieve consistency between inspectors and to this end the training procedures discussed in Section 4.5 were undertaken. In addition, during the survey the forms were monitored for apparent inconsistencies in assessment and discussions took place between the inspectors on condition rating for a variety of components.

AVERAGE COMPOSITE CONDITION FIGURE 3



Obtaining inspector consistency has been a major problem in overseas surveys particularly when the number of inspectors is large, as in the English survey. With the BRANZ survey consistency has been less of a problem due to the smaller scale of the survey and it is considered that the regional difference as recorded in the tables and figure do reflect, in the main, real differences in physical condition.

5.4.6 Component Condition versus Age Group

The average component condition for all houses in a cohort are shown in Figure 4. In general the condition deteriorates with age in a similar manner to the composite condition curve (Figure 2). The exceptions are ground clearance and sub-floor ventilation, where recent construction has indicated shortcomings in these aspects.

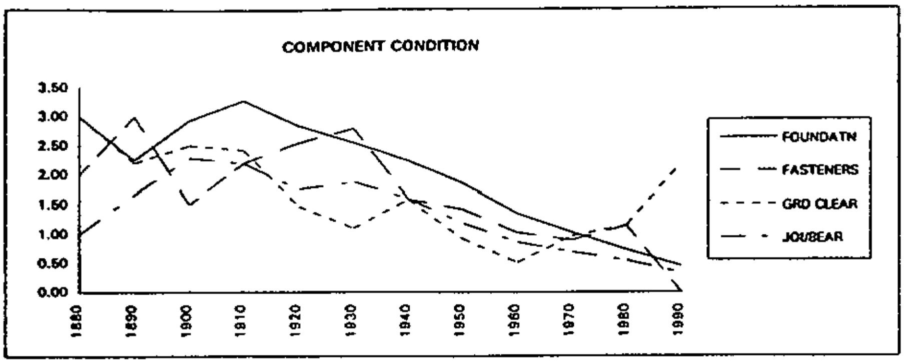
5.4.7 Condition by Material

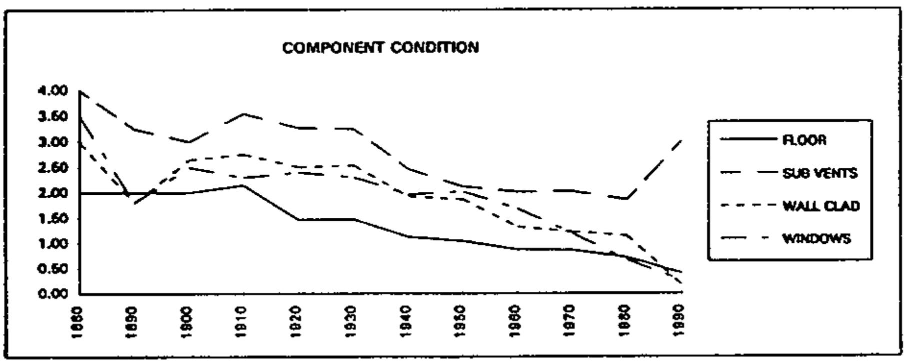
Table 6 shows the analysis of cladding and window materials. In wall claddings the worst average condition occurred in stucco, native weatherboard and radiata weatherboard. For roofs the worst performers were asbestos cement, galvanised corrugated steel and clay tiles. For windows, timber was on average in the worst condition. All of these are traditional materials, i.e . they have been used in buildings for a long time. Given the trend of a worsening condition with time it is not surprising that the traditional materials score worst. Likewise as could be expected 'permanent' materials such as brick claddings are outperforming timber weatherboards.

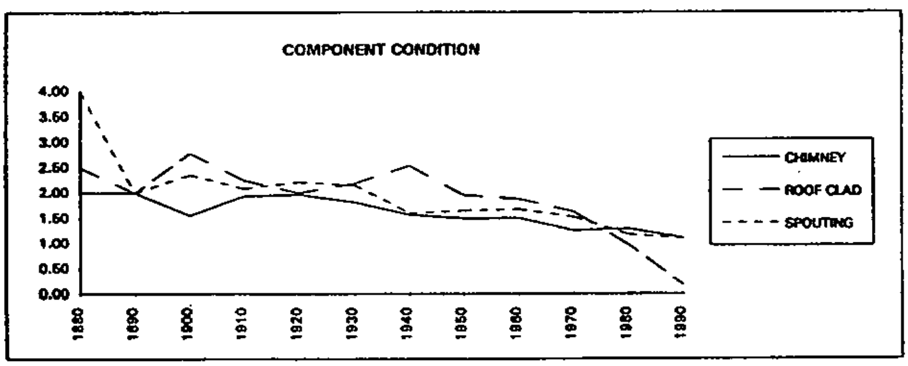
5.4.8 Housing New Zealand Houses

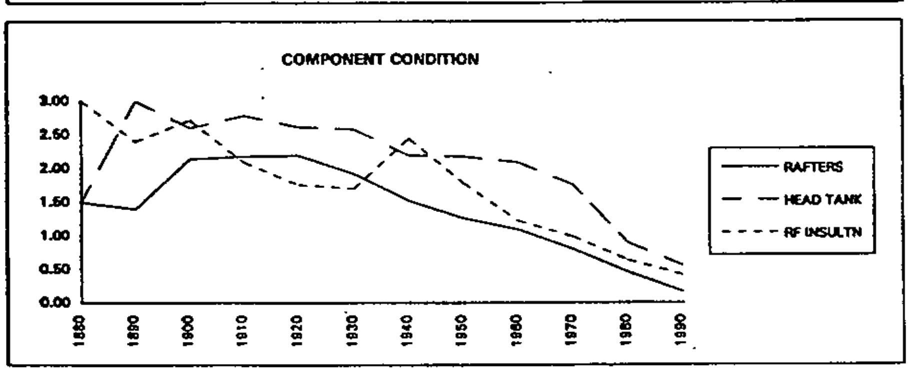
The 29 Housing NZ houses in the survey on average had a slightly worse composite condition than the total stock in all cohorts apart from the 1970's where their average condition was better. However, because of the small sample size the difference is not significantly different, at the 95% confidence level, except for Auckland 1950, 1960 and 1980 HNZ houses. Further details are in Appendix 5.

FIGURE 4 COMPONENT CONDITION









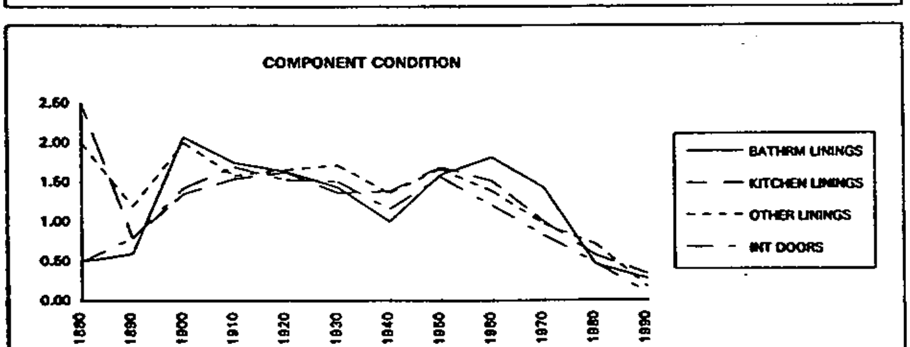


TABLE 6 AVERAGE CONDITION OF MATERIALS							
	AUCKLAND		WELLINGTON		CANTERBURY		ALL
WALL CLADDING		NUM		NUM		NUM	
WB TREATED RADIATA	2.2		2.0		2.1		2.1
WB NATIVE	2.1		2.4		2.6		2.3
WB CEDAR	1.9		1.8		0.2	(5)	1.6
CLAY BRICK	1.4		1.0	(6)	0.7		1.0
CONCRETE BRICK			0.7	(3)	0.3		0.3
CONCRETE BLOCK	1.0	(1)	0.7	(3)	0.8	(8)	0.8
FIBRE CEMENT SHEET	2.0	(6)	1.6	(7)	2	(1)	1.8
FIBRE CEMENT PLANK	2.6	(5)	1.3		1.3	(3)	1.7
CORRUGATED STEEL					0	(1)	0.0
STUCCO	2.0	(1)	4.0	(1)	2.4	(7)	2.6
OTHER	1.7	(3)	2.0	(2)	1.2	(6)	1.5
ROOF CLADDING							
METAL TILES	2.4		1.6		1.0		1.6
GALV CORRU STEEL	2.2		2.4		2.0		2.2
COIL COATED STEEL	1.3	(6)	1.1	(9)	0.4		0.8
CONCRETE TILE	2.0		2.0		1.2		1.7
CLAY TILES	2.0	(6)	2.0	(2)			2.0
ASBESTOS			3.0	(4)	2.5	(2)	2.8
MEMBRANE							
OTHER	1.8	(4)	2.2		0.5	(2)	2.0
WINDOWS							
TIMBER	2.5		2.3		1.7		2.1
ANODISED ALUMINIUM	1.6		1.1		0.4		0.9
POWDER COATED ALUMINUM	1.0	(6)	0.0	(5)	0.1	(12)	0.3
OTHER	0.7	(4)	2.0	(4)	0.0	(3)	1.0
NUM = Number in the sample. If not shown the number is over 12.							

6 ANALYSIS

6.1 Comparison of Survey Condition Rating with the English House Condition Survey and the VNZ Condition Rating

6.1.1. Comparison with the English House Condition Survey (EHCS)

Some comparisons are shown in Table 7. The percentage cost of repair by component shows marked differences between the two surveys. Repairs to the exterior account for 64% of the total in the EHCS compared to 41% in NZ. Conversely the interior repairs share is 20% and 33% respectively, and amentities and services repairs are 10% and 20% respectively.

The costs of all repairs is £1,130 (approximately $3,400NZ) for an average owner-occupied dwelling in the English survey. This average is inclusive for houses, flats

TABLE 7 COMPARISION OF THE ENGLISH SURVEY AND THE BRANZ SURVEY RESULTS	EHCS		BRANZ
DWELLING STOCK			
NUMBER	19.7M		1.4M
MEDIAN AGE	1948		1964
% PRE 1900	18%		1.5%
AVERAGE AREA (1)	87		110
TYPE OF CONSTRUCTION			
WALL FRAME (MATERIAL %) (2)			
MASONRY CAVITY	61.6	)	
MASONRY SOLID <9"	1.2	)	5.0
MASONRY SOLID > 9"	31.1	)	
INSITU CONCRETE	1.4	)	0.5
CONCRETE PANEL	1.4	)	
TIMBER FRAME	1.4		94.4
METAL FRAME	0.3		0.1
MIXTURE	1.6		
	100.0		100.0
WALL CLADDING (MATERIAL %) (2)			
MASONRY	69.5		18.0
STONE/CONCRETE	1.1		8.0
STUCCO	20.1		8.0
WEATHERBOARD	0.6		53.0
TILES/ METAL	0.9		0.0
PLASTIC	0.5		0.0
MIXTURE/ OTHER	7.3		6.0
FIBRE CEMENT BD	0.0		7.0
	100.0		100.0
DEFECT REPAIRS PERCENTAGES (3)			
EXTERIOR			
WINDOWS/ DOORS	15.2		5.3
ROOF CLADDING	14.8		7.1
CHIMNEYS	11.4		7.0
WALL STRUCTURE (4)	8.5		0.0
WALL CLADDING	7.5		5.4
ROOF STRUCTURE	4.6		0.7
DPC/ VENTS (5)	1.9		15.3
TOTAL EXTERIOR	63.9		40.8
INTERIOR			
CEILINGS	7.3		9.2
FLOOR	4.5		2.4
WALL	3.9		18.5
OTHER INTERIOR (6)	4.7		2.7
TOTAL INTERIOR	20.4		32.8
ADDITIONAL STRUCTURAL (7)	6.2		6.5
AMENITIES/ SERVICES (8)	9.5		19.9
ALL WORK	100.0		100.0

NOTES:

(1) Average area is for all dwellings, includes houses, flats apartments, etc. NZ data is estimated.

(2) Wall structure and cladding % are estimated for NZ using the 1981 National Housing Commission study.

(3) Defect repair % are for all defect conditions. The EHCS data is for all types of dwellings. NZ data is derived from Table A5.

(4) Wall structure includes settlement, differential movement, lintels and corrosion.

(5) DPC= Damp proof course in the EHCS. Vents = subfloor vents in the BRANZ survey.

(6) Other interior includes doors and hardware.

(7) Additional structural includes interior walls and foundations.

(8) Amenities/ services includes bathrooms, kitchen, and WC fittings, HWC gas and electricity.

and apartments. In comparision the average cost of all repairs for the houses in the NZ survey was $4,400 (see Table A7).

In making comparisions the following factors need to be considered:

- The average NZ dwelling is larger than the English dwelling. Furthermore, the NZ survey was for houses only (average floor area of 139 sqm), compared to the ECHS results for all dwelling types (87 sqm all dwellings, owner-occupier only).
- The age structure of the stocks are quite different, with the English median age approximately 16 years greater. In England 18% of dwellings were built before 1900 compared to approximately 2% in New Zealand.
- The method of construction is quite different. English houses tend to be permanent materials, with brick or block exterior and interior walls, versus "non-permanent" materials in New Zealand.
- Other differences include the greater proportion of multi-storey and tenement type dwellings in England, the greater demands made on the building fabric due to the colder and wetter climate in the UK, and the slightly different definitions of repair between the two surveys.

The difference in size of dwelling can be allowed for by expressing the repair costs in $NZ/sqm, giving values of $32/sqm for NZ houses and $39/sqm for English dwellings. The cost of outstanding maintenance is similar in both countries but in the English situation the effect of the older stock and harsher environment outweighs the longer maintenance cycles of their more permanent materials, resulting in higher maintenance costs. Exact comparisons by age cohort are difficult due to the way the EHCS data is presented, but approximate comparisons between the two surveys suggest that within each cohort maintenance costs are the same or lower in the English survey when compared to the BRANZ survey.

6.1.2 Comparison with Valuation New Zealand Data.

Valuation New Zealand records the condition of the wall and roof cladding of dwellings whenever it carries out an on-site inspection. All dwellings are revaluated on a three year cycle but this valuation does not necessarily involve an on-site inspection of the property. This section investigates the correlation between VNZ's cladding condition rating and the BRANZ survey results.

The detailed analysis is provided in Appendix 6 and uses the latest available VNZ data. The conclusion is that the VNZ condition data does not give a good correlation with the BRANZ survey results. Even poor and serious defects from the survey were not readily identified in the VNZ data. Reasons for the poor correlation are:

- Due to resource constraints the triennial VNZ revaluation is unlikely to involve an on-site inspection unless a building consent has been issued within the three year period for alterations or additions. The condition rating remains unchanged until an inspection occurs.
- Even if inspections occurred every three years there would be an inspection time difference of 1.5 years, on average, between the BRANZ and VNZ data. Repairs and, to a lesser extent, deterioration will have occurred in the interim, so that the two datasets record different conditions.

The VNZ inspection, when carried out, is quick and cursory and may not pick up all the defects that the BRANZ survey is designed to catch.

6.2 Costs of Repairs

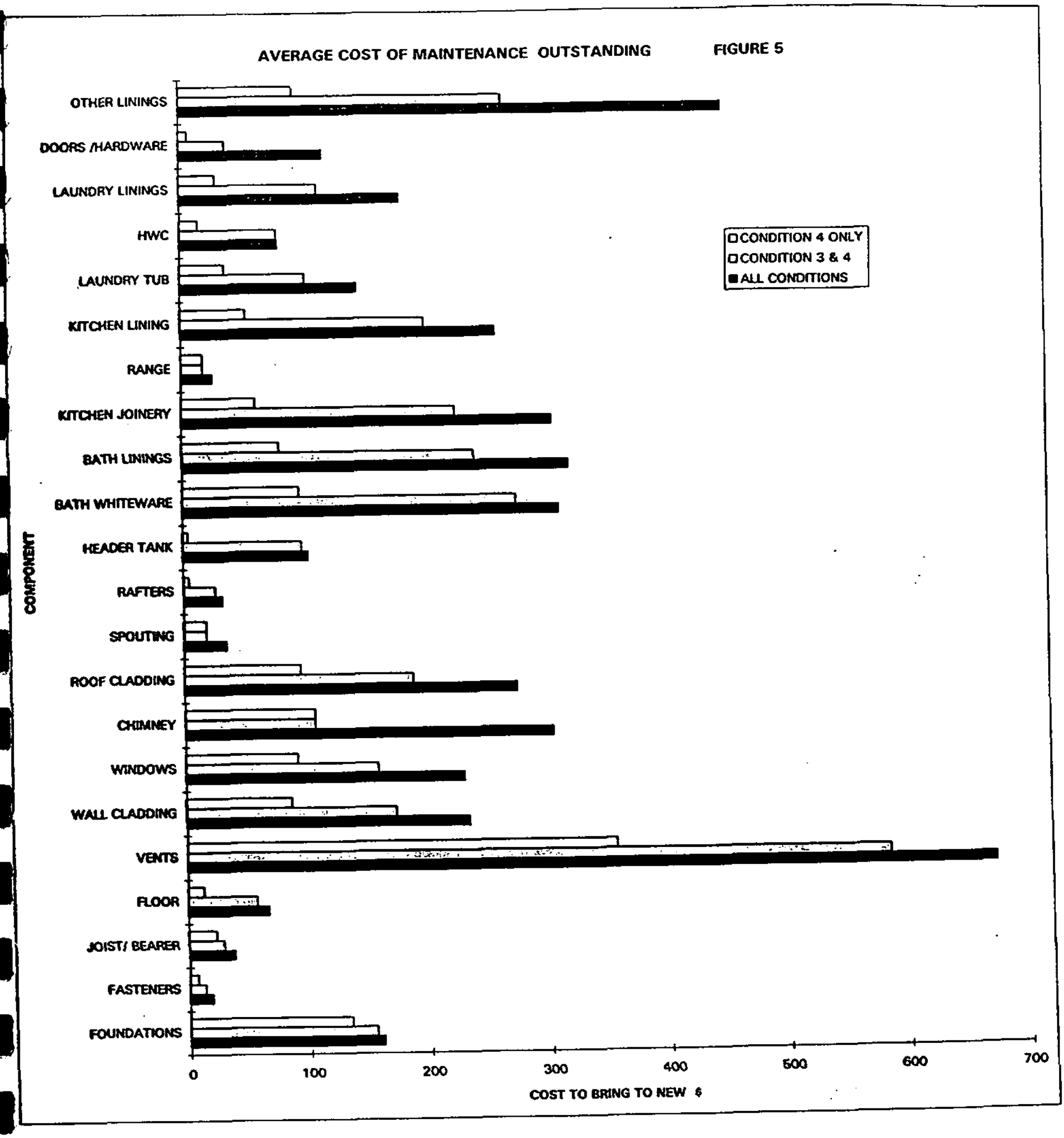
The cost of repairs of the defects was calculated by BRANZ from the information collected in the survey. Instead of asking the inspector to estimate the cost of the repairs this was derived using unit repair costs for the different condition ratings and materials. The unit costs were estimated by BRANZ technical advisors and scientists, as outlined in Appendix 7. This information was applied to each house in the survey, including the frequency of defect information and the floor area, to calculate the cost of repairs.

The results are shown in Figures 5 and 6. An average house requires approximately $4,400 to bring it to as new condition. A more realistic aim is to attend to the most urgent maintenance needs, namely condition 3 and 4 defects. This costs approximately $3,200 per house on average. A significant share of the cost occurs in modifying the sub-floor vents to conform to code requirements. It should be noted that 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 interior linings but, as discussed later (see Section 7.2), there are good reasons for requiring adequate venting in all houses.

Other components requiring significant expenditure are living area and bedroom linings, bathroom whiteware and linings, kitchen joinery, wall and roof cladding and windows. The detailed data are given in Appendix 7. Figure 6 shows the average cost of repair by cohort. Costs rise with age of the cohort and peak at around the 1920's era at approximately $5,000 for condition 3 and 4 repairs.

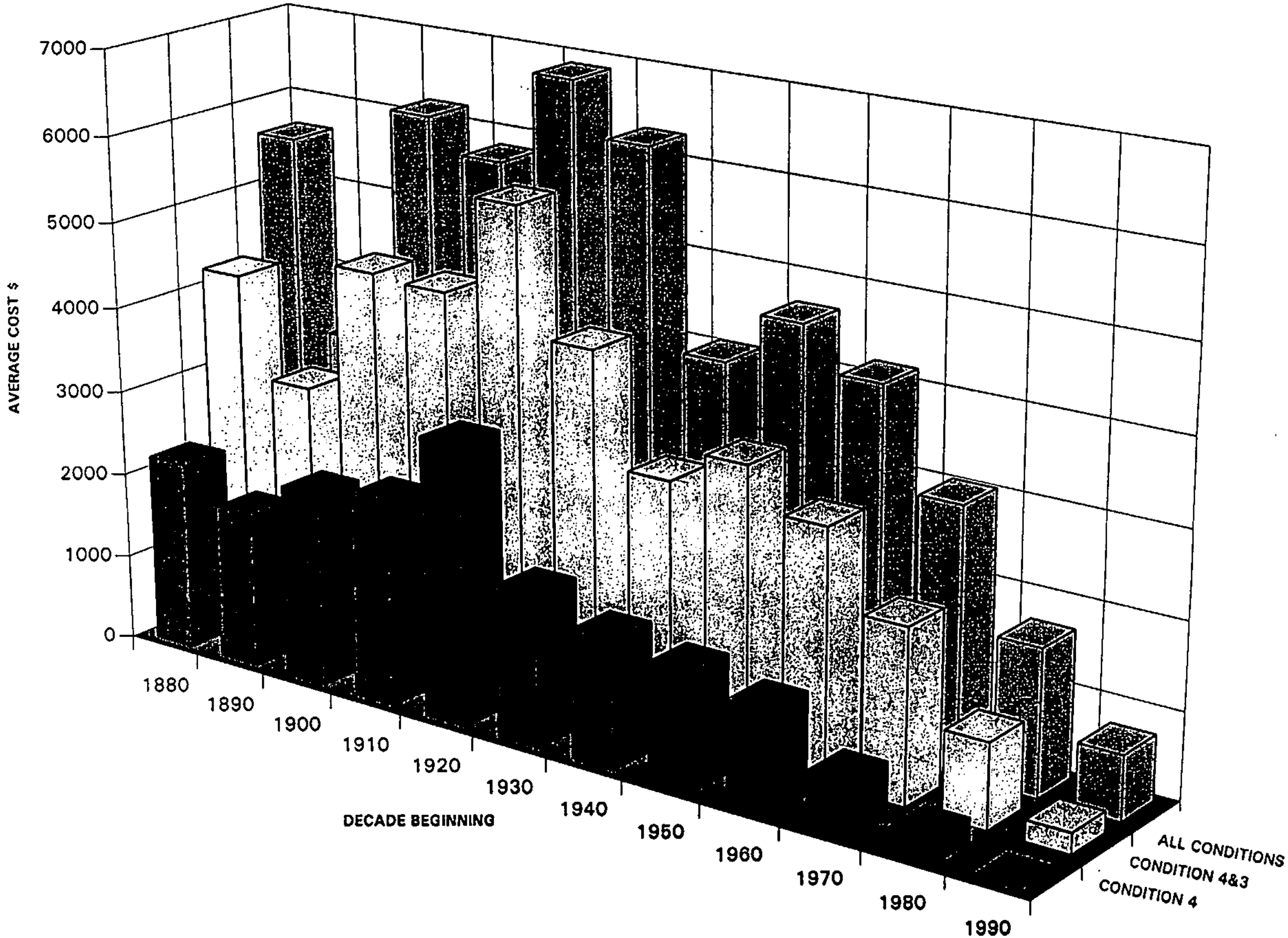
6.3 Cost of Delays in Maintenance

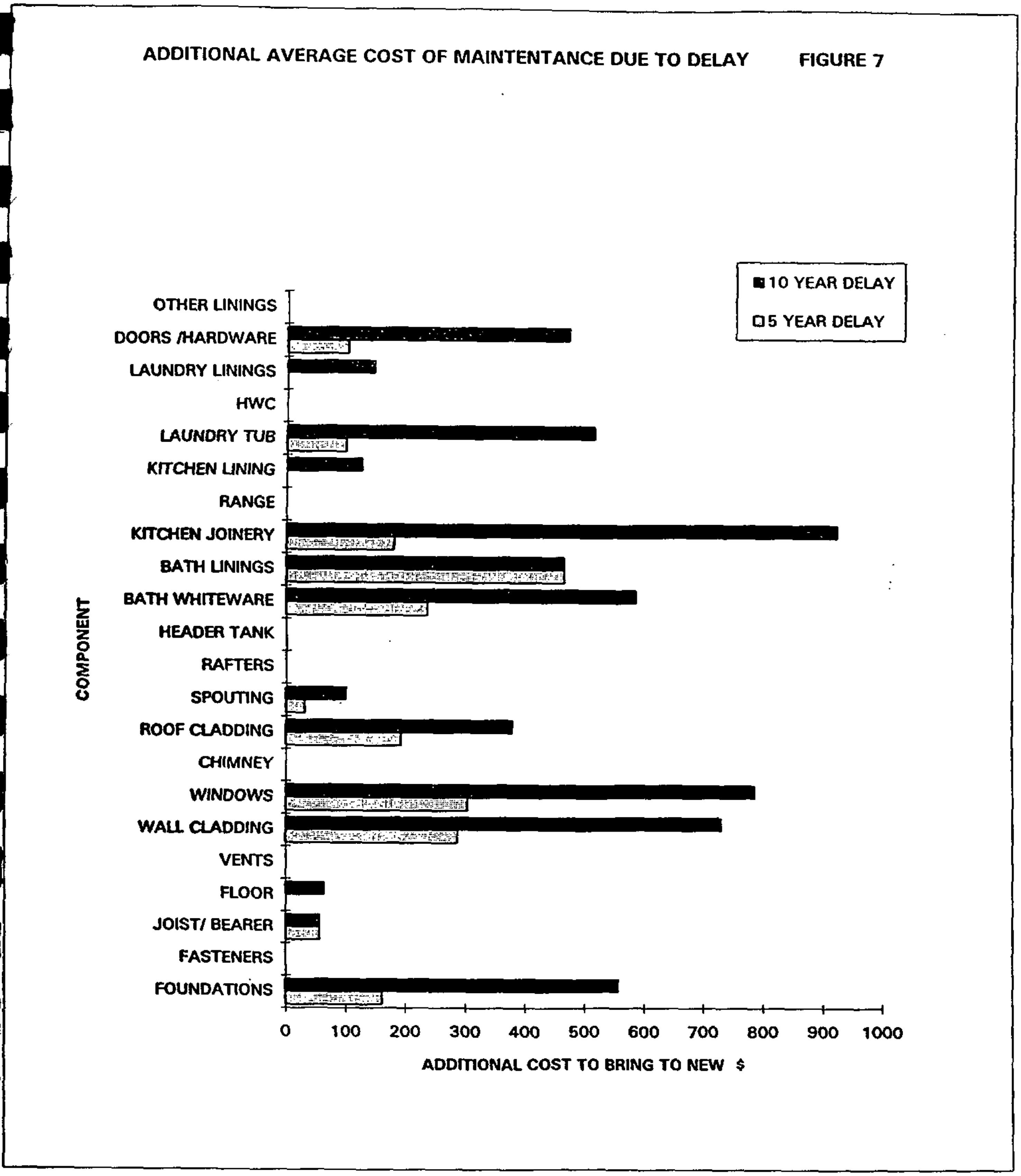
For each component, material type and and defect condition, an estimate was made of the time in years until the next condition level was reached, assuming no maintenance was carried out. These assumptions are contained in Appendix 7. It is then possible to estimate the costs of delayed maintenance given the number of years of delay. For those components that were already in a serious or poor condition the effect of maintenance delay is damage to other components and spreading of the defect within the component itself. For example delay in repairing serious cladding defects will cause damage to the linings as well as a likely spreading of the defective cladding to cover a wider area. An estimate was made of these cost effects of delay in condition 4 defects and with the other defect levels the total cost of delay was estimated, as shown in Figure 7 and Appendix 7. These additional costs average out at around $2,100 for a five-year delay, and $5,900 for a ten-year delay in repairing condition 3 and 4.



AVERAGE COST OF MAINTENANCE OUTSTANDING
FIGURE 5
OTHER LININGS
DOORS /HARDWARE
LAUNDRY LININGS
HWC
LAUNDRY TUB
KITCHEN LINING
RANGE
KITCHEN JOINERY
BATH LININGS
BATH WHITEWARE
HEADER TANK
RAFTERS
SPOUTING
ROOF CLADDING
CHIMNEY
WINDOWS
WALL CLADDING
VENTS
FLOOR
JOIST/ BEARER
FASTENERS
FOUNDATIONS
COMPONENT
CONDITION 4 ONLY
CONDITION 3 & 4
ALL CONDITIONS
0
100
200
300
400
500
600
700
COST TO BRING TO NEW $

AVERAGE COST TO BRING TO NEW CONDITION FIGURE 6




ADDITIONAL AVERAGE COST OF MAINTENTANCE DUE TO DELAY
FIGURE 7
10 YEAR DELAY
5 YEAR DELAY
OTHER LININGS
DOORS /HARDWARE
LAUNDRY LININGS
HWC
LAUNDRY TUB
KITCHEN LINING
RANGE
KITCHEN JOINERY
BATH LININGS
BATH WHITEWARE
HEADER TANK
RAFTERS
SPOUTING
ROOF CLADDING
CHIMNEY
WINDOWS
WALL CLADDING
VENTS
FLOOR
JOIST/ BEARER
FASTENERS
FOUNDATIONS
COMPONENT
0 100 200 300 400 500 600 700 800 900 1000
ADDITIONAL COST TO BRING TO NEW $

7 DISCUSSION

7.1 Average Condition

The average composite condition, as shown in Figure 2, ranges from 0.5, i.e. between good and excellent, for the 1990's cohort to 2.1, i.e. just below moderate, for the 1900's cohort. The average condition for the stock is 1.42, i.e. midway between good to moderate. These parameters suggest that the condition of the housing stock is satisfactory.

However a more important aspect to consider is the incidence of defect by component. Table 5 indicates that for some components the average condition rating is over 2 and, more importantly, the incidence of poor or serious defects incidence is quite high for a number of components. The latter include sub-floor ventilation, header tanks, hot water cylinders (HWC), foundations, roof and wall claddings and windows, with over 25% of houses having one or more of these components in the poor or serious rating category, as defined in the survey.

It is a little surprising to find a high incidence of sub-floor ventilation defects since the current code requirement for ventilation has been in existence since the 1924 NZ State Forest Service Building Conference Recommendations (6), subsequently adopted by the NZ Institute of Standards in 1944 in its Model Building By-law (7). It would appear that not all local authorities were using or enforcing the vent requirements in the earlier days. As well, additions and upgrades carried out by owners, such as terraces, porches, patios, paths, gardens, etc have often resulted in the blocking of the original vents. Despite non-code compliance, older houses will not necessarily have problems in other components caused by poor vents because factors such as shelter, ground conditions, wind zone, and alternative air leakage paths will affect the impact.

The incidence of header tank and HWC restraint defects is high because these were not mandatory for new dwellings until the introduction of the NZ Building Code in 1993, so that unless the builder or owner had an interest in disaster preparedness it is likely these components will be unrestrained. However in many cases the HWC is restrained as a by-product of tight fitting shelving in hot-water cylinder cupboards.

Foundation problems were mainly ground subsidence, unsafe excavations (too close to existing foundations), non-vertical or missing piles, and inadequate bracing, especially in basement additions work. Some of the problems were owner-builder related but in some instances the work was carried out by builders.

Roof and wall cladding and window defects were also quite common and although few cases were found of moisture penetration through these components the maintenance level was generally quite poor.

7.2 Costs of Repairs

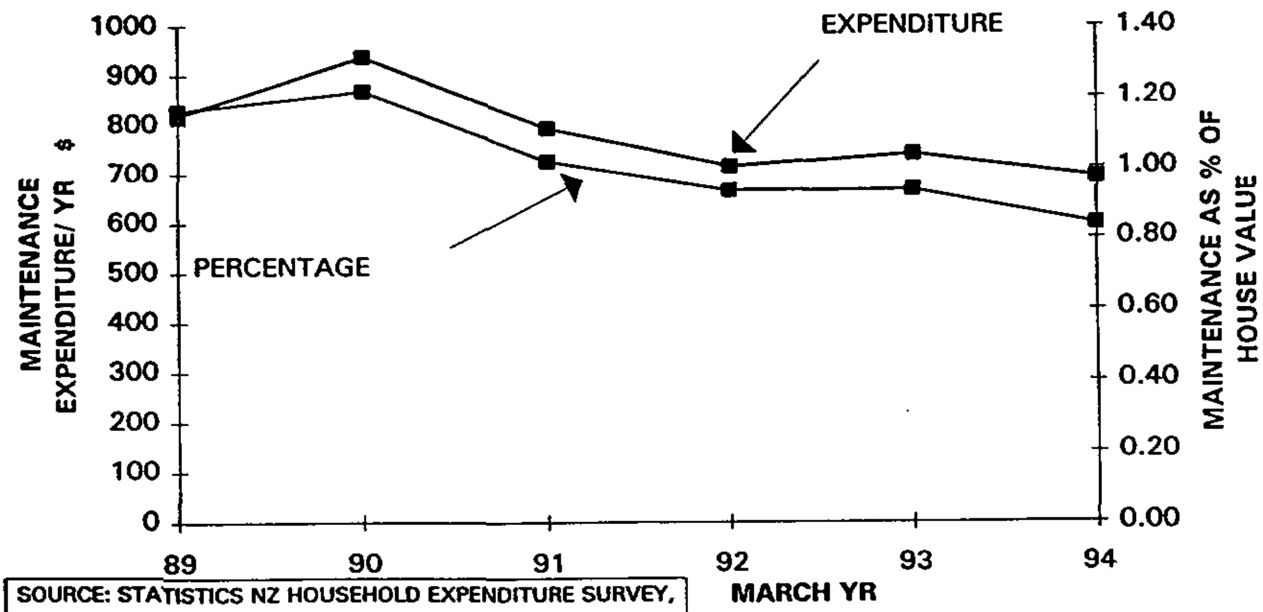
The estimated costs of repairs of condition 3 and 4 defects averages out at $3,200 per house. These are the defects which need immediate, or within three months, repair for health and safety reasons and to maintain material integrity. This represents approximately 4% of the average house value, excluding land, ($83,000 in March 1994 based on VNZ data).

Surveys of household expenditure carried out by Statistics New Zealand (SNZ) indicate an average expenditure of $690 on dwelling maintenance for the March 1994 year, or 0.8% of average house value, which is substantially lower than the amount required from the survey. The expenditure survey covers both owner-occupiers and renters so that it will tend to understate the amount of expenditure by the former. Since approximately 75% of households are owner-occupiers the adjusted amount of maintenance being done by them is $690/0.75= $920 or 1.1% of average house value.

Data from SNZ's annual Household Expenditure and Income Survey (8) shows that maintenance expenditure, in dollars of the day and as a percentage of house value, has been on a downward trend in recent years (see Figure 8). The implication is that the housing stock is not being adequately maintained and that its physical condition is deteriorating.

The costs of repair of the various components is shown in Figure 5. The most expensive component is the sub floor vents at an average of approximately $580 per house. The question arises as to whether it is necessary to retro-fit additional vents in existing houses with vent areas below current code requirements. As discussed above the potential hazard from under capacity depends greatly on the particular circumstances. The survey found only a weak relationship between vent area and incidence of defects in sub-floor timbers or connectors and no relationship with moisture related problems internally, e.g. mildew growth, (although in the latter the survey timing, being carried out in summer, may have precluded the identification of such a relationship). The correlation analysis is shown in Appendix 8.

AVERAGE MAINTENANCE EXPENDITURE FIGURE 8



SOURCE: STATISTICS NZ HOUSEHOLD EXPENDITURE SURVEY, AND VALUATION NEW ZEALAND.

In short, it appears unreasonable to include the full amount of vent installation in the outstanding maintenance costings. But despite not being able to exactly quantify the effects of poor sub-floor ventilation it cannot be dismissed as a problem. Local research indicates an average 100sqm house has an evaporation of 40 litres per day of water vapour from under the house. If not vented this moisture will be absorbed by floor timbers causing eventual decay, or make its way into living spaces causing mould problems. As discussed, the actual damage depends greatly on particular circumstances.

Assume that only 20% of houses with sub-standard vents will develop moisture related problems and that the additional vents, to current code requirements, should be installed in these houses. The average cost per house of vent installation then falls to $116 and the average cost for all condition 3 and 4 defect repairs falls to approximately $2,700 per house. The amount still remains well above current maintenance expenditure by households.

7.3 Cost Implications of Delay

The cost implications of a delay in maintenance are set out in Figure 7. A five year delay adds approximately another $2,100 (present day dollars) per house on average to the eventual repair cost, additional to the existing outstanding maintenance requirement. This does not include the adverse impact that inadequate sub-floor vents will have in some cases. The reason for this omission is that it is difficult to assess the incidence and amount of damage from this defect, as discussed above, and it is not suggested that there will be no damage.

The most crucial components in terms of repair are windows, bathroom whiteware, kitchen joinery, and wall and roof claddings because they can deteriorate quickly after reaching a condition rating of 2 and often cause damage to other components if not repaired quickly.

8 CONCLUSIONS

In terms of the questions in the introductory section the conclusions and results of this study are:

What is the average physical condition? The average condition across the 26 components (composite condition) inspected for the whole stock was 1.4 on the condition scale, or between good to moderate. The composite condition deteriorated with the age of the house from just below excellent for 1990's houses to just below moderate for 1900's houses. In terms of the three metropolitian areas, houses in Auckland were general in the worst condition followed by Wellington, with Canterbury houses on average in the best condition.

What are the common maintenance problems? The components with the main problems, in order of average defect severity were: for the exterior and roof space, inadequate sub-floor vents or blocked existing vents; non-restrained header tanks against earthquakes, and venting from bathrooms and kitchens into the roof space causing moisture related problems; and roof and wall cladding deterioration. Foundation defects included inadequate bracing, missing piles, and unsafe excavations. Other exterior defects included missing or leaking spouting; and windows defects including poor maintenance and flashing deterioration.

In the interior the main problems were non-restrained hot water cylinders; bathroom linings and whiteware in poor condition causing health hazards; worn laundry joinery; and worn living area linings.

Is the housing stock being adequately maintained? Current household expenditure is around $900 per dwelling. The estimated cost of maintenance required now for serious and poor defect conditions is $3,200 per house, or $2,700 per house if most sub-floor vent defects are considered to have no flow-on effects. At current rates of expenditure this will take three to four years to repair and in the meantime damage will have been accumulating amounting to another $2,100. On these figures the *housing stock is not being adequately maintained.*

Data obtained for lifecycle cost studies. This survey provides a base point for housing condition. Re-inspection of some of the houses from the survey in five or 10 years time would provide valuable information on performance of materials and household maintenance practices which would be useful in lifecycle cost studies. At this time there is no commitment to carry out a re-inspection or undertake a new survey in future years.

Is BRANZ research in the right areas? No *unidentified problems in component* deterioration or building performance were uncovered. All can be resolved by the use of existing building and repair techniques. Some problems of householder use were revealed, including the blocking of sub-floor vents by vegetation, earthworks and paths, unsafe excavations in foundations, and ignorance of the benefits of restraining water tanks. An education programme to households would address these issues.

A database on the performance of materials and components. The survey information is maintained in a computer database which will provide a valuable resource for analysing component performance, and as a yardstick against which to measure future developments.

The survey was well worth carrying out to obtain better information on the typical condition of New Zealand housing. Vital data has been obtained on the incidence of defects by component and the amount of outstanding maintenance. While some of the reputed worst regions for housing condition, such as Northland, the East Cape, and the South Island West Coast, were not covered it is believed that the survey was representative of the average New Zealand house. The cost of outstanding maintenance, which is high compared to current average expenditures, is of concern and will need monitoring to assess its effect on the stock over the next decade.

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(8) Statistics New Zealand. 1989. Household Expenditure and Income Survey 1988-1989. (Volumes for earlier years are available. Subsequent to 1989 data is available on a fee paying basis.)

(9) Building Industry Authority. 1993. Wellington. NZBC Approved Document

B1 Structure.
B2 Durability.
C3 Spread of Fire.
E2 External Moisture.
E3 Internal Moisture.

APPENDIX 1 VNZ Regional Cladding Condition Data

This appendix considers whether Valuation New Zealand (VNZ) data indicates if the survey territorial areas used in the BRANZ survey are representative of the country as a whole.

In a 1981 study the National Housing Commission (NHC) used the complete records of VNZ, who, among other data, record the condition of the roof and wall cladding for every house on a 4 point scale. This information was used to assess whether the BRANZ sample was representative of the whole country. Table A1 shows the analysis in which the VNZ condition ratings are taken for each area used in the BRANZ sample and weighted according to the survey size. The weighted total is compared to the actual condition ratings obtained in the NHC study using every house in NZ. As the Table indicates the two distributions are similar indicating that the BRANZ regional samples are representative for cladding defects (claddings are the only component defect recorded by VNZ).

TABLE A1 NHC STUDY - VNZ CLADDING DATA

VNZ CLADDING RATING	CENTRAL AUCKLAND UA	SOUTH AUCKLAND UA	MANUKAU CITY	WELLINGTON UA	UPPER HUTT UA	CHRISTCHURCH CITY	CANTERBURY SA	WEIGHTED RATING (1)	ACTUAL FOR ALL NZ (2)
	PERCENTAGE IN RATING CATEGORY.								
GOOD	27.2	33.9	54.5	45.1	40.7	38.8	41.4	40.2	38.5
AVERAGE	65.0	60.4	41.5	46.0	52.8	53.5	48.1	52.1	53.0
FAIR	6.4	4.4	3.1	7.0	4.2	5.8	7.6	5.9	6.5
POOR	1.1	0.9	0.4	1.3	0.9	1.5	2.3	1.3	1.5
MIXED	0.2	0.2	0.3	0.5	1.2	0.1	0.3	0.4	0.3
NOT KNOWN	0.2	0.1	0.2	0.1	0.1	0.4	0.4	0.2	0.2
								100.0	100.0
PROPORTION OF SURVEY (3)	0.167	0.040	0.095	0.221	0.124	0.192	0.124		
						TOTAL =	0.963		

NOTES: UA = Urban Area, SA = Statistical Area.
(1) The weighted rating percentages are derived by weighting each region by the proportion of the BRANZ survey from that region.
(2) The percentage in each category for all New Zealand from the VNZ database.
(3) Proportion of the BRANZ survey from the region.
The final two columns have similiar percentages in each rating group indicating that the BRANZ sample is representative of the cladding condition for all New Zealand.

There may appear to be an inconsistency between using the VNZ data to justify the BRANZ regional sample selection and the results in Section 5.3.2 which show low correlation for the physical condition scores in the VNZ and BRANZ surveys. But the justification is that while the correlation between surveys for individual houses is low there is consistency of condition rating within each survey. The average period between physical inspection in the VNZ data is likely to be similar for the different areas so that the weighted rating, in Table A1, is valid.

APPENDIX 2 Mail Out Enclosures

The mail out consisted of an explanatory letter, reply paid form, and information on the BRANZ books which were offered as gifts for those taking part in the survey. The first two enclosures are shown in the following pages.

25 February 1994

«Name»
«Address»
«CITY»

Dear Householder

BRANZ (Building Research Association of New Zealand) is undertaking a survey of 500 houses in New Zealand. BRANZ is a non-profit organisation set up to assist the NZ building industry and NZ as a whole by improving the performance of buildings.

Currently there are about 1.3 million houses in New Zealand with a value of about 130 billion dollars. Ensuring that these houses are maintained effectively and economically is an important consideration. BRANZ intends to gather data on the condition of typical houses and has obtained randomly selected residential addresses from Valuation New Zealand. We would like to survey your house looking at items such as; cladding materials, foundations, roof spaces, wall linings and heating. All results are confidential and only published in an anonymous format. The information BRANZ gathers will be used to get an overall picture of NZ's housing condition, and allow us to provide information on the best ways to maintain houses.

The survey only takes about 1-2 hours and is carried out by 1 or 2 BRANZ Technical Advisers. To compensate for any inconvenience, a free book or four Lotto lucky dips is offered to participating households. Details of the choice of books are attached along with information on BRANZ.

If you are willing to assist us in this survey please fill out the enclosed form and return it in the prepaid envelope. Please feel free to ring BRANZ if you need further information before making up your mind. The following name and numbers is provided for contacts:

Bill Irvine Phone (03) 366 3435

Yours faithfully

I C PAGE
Building Economist

HOUSING CONDITION SURVEY

REPLY FORM

Yes my house is available for the survey

Name ....

Address..

Contact phone number Day...........................

Night..........................

INSPECTION TIME

BRANZ will phone to set a convenient time and date for the inspection, either during a weekday, early evening (5pm to 7pm), or on Saturday.

MY PREFERRED GIFT CHOICE IS (Circle One):

$20 of Lotto Lucky Dips.

Home Owners Manual

BRANZ Building Guide

$20 grocery voucher

$20 petrol voucher.

Please fill in the above form and return to BRANZ in the enclosed reply paid envelope.

APPENDIX 3 Survey Forms

The forms used by the BRANZ inspectors are attached, consisting of 12 sheets.
Note: These survey forms are subject to BRANZ copyright.

ID NO =

SUB FLOOR/ FLOOR

MATERIAL TYPE		%
CONCRETE SLAB		
JOISTS/BEARER	TREATED RADIATA	
	UNTREATED RADIATA	
	NATIVE	
	OTHER (STATE)	
FLOOR	T&G	
	PARTICLE BOARD	
	OTHER FLOOR (STATE)	

PLUMB WASTES	TICK	LEAKS ?
COPPER		
PVC		
OTHER (STATE)		
WATER RETIC	TICK	
COPPER		
POLYBUTYLENE		
GALV STEEL		
OTHER (STATE)		

JOISTS/BEARERS	COND	FREQ	FLOOR	COND	FREQ
SERIOUS	4	0-10%	SERIOUS	4	0-10%
Severe timber decay.		10-25%	Severe timber decay		10-25%
Structural cracks.		25-50%	Structural cracks.		25-50%
		50-100	Major holes.		50-100%
POOR	3	0-10%	POOR	3	0-10%
Insufficient joists/bearers.		10-25%	Cupped boards.		10-25%
Severe borer.		25-50%	Severe borer.		25-50%
Two toothed borer.		50-100	Two toothed borer.		50-100%
			Minor holes.		
MODERATE	2	0-10%	MODERATE	2	0-10%
Moderate/minor borer.		10-25%	Moderate/minor borer.		10-25%
Moderate/ minor decay.		25-50%	Moderate/ minor decay.		25-50%
		50-100	Major floor squeaks.		50-100%
			Minor gaps between part bd sheets.		
GOOD	1		GOOD	1	
Minor cracks/ checking.			Minor floor squeaks.		
			Moderate/ minor decay.		
EXCELLENT	0		EXCELLENT	0	
No defects.			No defects.		

FLOOR INSULATION	
Y/N	
FOIL	
OTHER (STATE)	

SUB FLOOR MOISTURE	CORRECTED READING	NO 1	NO 2
Readings on 2 joists at least 5m apart, record both.			
Readings on the floor at two locations at least 5m apart, record both.			

GENERAL COMMENTS:

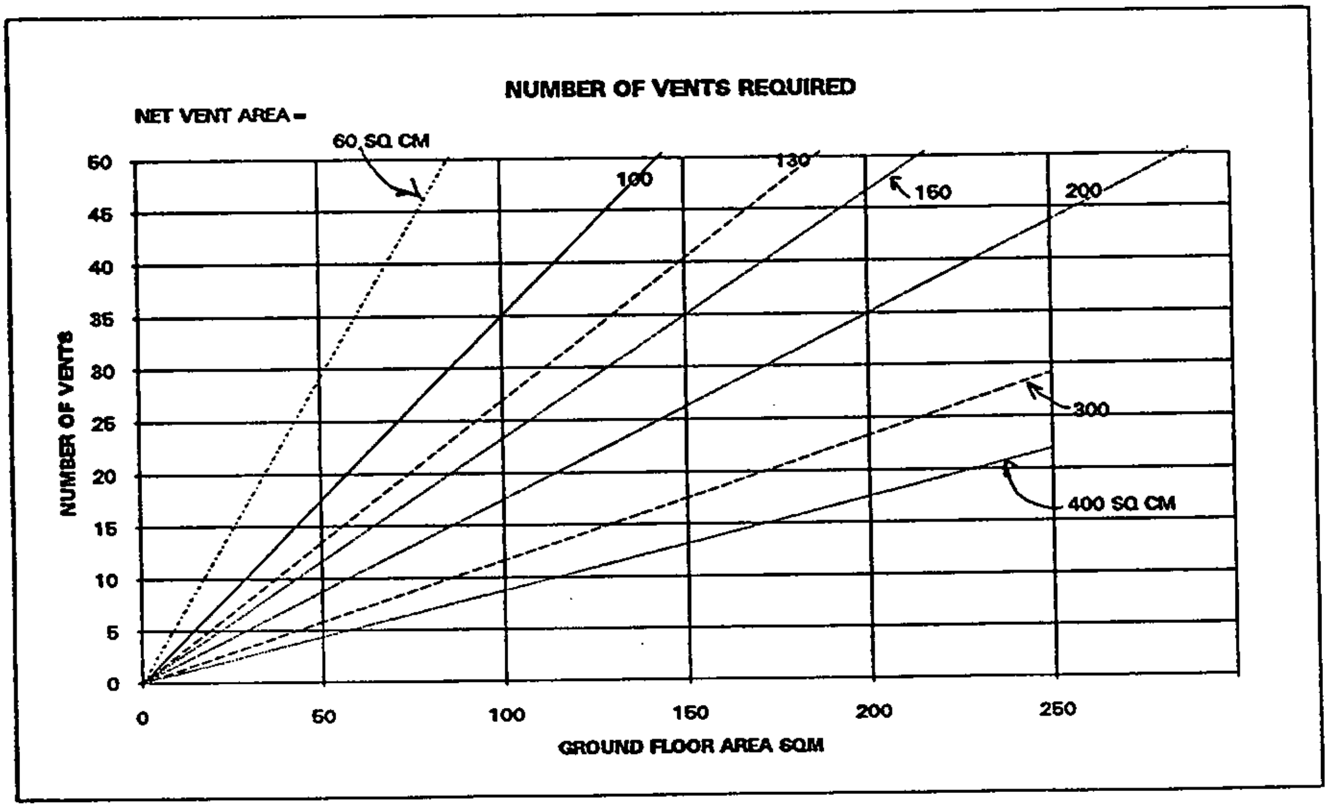
ID NO=

VENTS (SUB FLOOR)

TYPE	TICK
BASE BOARDS	
CONCRETE	
PRESSED METAL	
WIRE	
OTHER (STATE)	

CONDITION (Circle one or more defects)		COND
SERIOUS		4
0-25%of code requirement		
No vents or 75% blocked.		
POOR		3
25-60% of code requirement.	Vents not on all sides.	
Dense vegetation blocking most vents.		
MODERATE		2
60-80% of code requirement.	Vents greater than 1.8m spacing.	
Minor vegetation blockage.	Vents not within 0.75m of corners.	
GOOD		1
80-100% of code requirement.		
EXCELLENT		0
100% of code requirement.		
No vegetation, vents within 0.75M of corners, vents evenly spread on all sides.		

NOTE: A TIMBER PERIMETER WALL REQUIRES A CONTINOUS 20MM VENTILATION GAP.
NET VENT AREA IS TYPICALLY 80% OF THE BLOCKOUT SIZE FOR CONCRETE, 50% FOR METAL/ PLASTIC AND 85% FOR WIRE.



GENERAL COMMENTS:

ID NO =

WALL CLADDING

MATERIAL TYPE		% AREA	PAINTED (TICK)
WEATHERBOARD	TREATED		
	NATIVE		
	CEDAR		
CLAY BRICK			
CONCRETE BRICK			
CONCRETE BLOCK			
FIBRE CEMENT SHEET			
FIBRE CEMENT PLANK			
CORRUGATED STEEL			
STUCCO			
SOLID TIMBER			
OTHER (STATE)			

EXTERNAL DOORS	NUMBER
SOLID TIMBER	
TIMBER/ PART GLASS	
FRENCH	
SLIDING ALUMINIUM	
OTHER (STATE)	

CONDITION	(Circle one or more defects).				COND	FREQ
SERIOUS (Health, Safety Implications)					4	
ALL	Missing cladding.	Full depth holes.	Full depth cracks.			0-10%
TIMBER	Dislodged boards.	Severe decay.				10-25%
MASONRY	Broken blocks.	Corrosion of reinf.				25-50%
STUCCO	Missing plaster.	Drummy surface.				50-100%
EXTERIOR DOORS	Missing glass	Missing/ inoperative hardware.	Holes.			
POOR (Needs attention next 3 mths.)					3	
ALL	Insecure cladding.	Paint deterioration to bare material.				0-10%
TIMBER	Extensive checking.	Severe borer.				10-25%
MASONRY	Missing mortar.	Serious efflorescence.				25-50%
STUCCO	Major crazing.					50-100%
OTHER CLADDING	Rusty metal clad.					
EXTERIOR DOORS	Sticking door.	Poor hardware.	Severe paint deterioration.			
MODERATE (Needs attention within 18 months)					2	
ALL	Top coat deterioration.		Minor cracks.	Nail popping.		0-10%
TIMBER	Minor checking.	Nail rust.	Mod /minor borer.	Putty replacement.		10-25%
MASONRY	Mod/ minor efflorscence.					25-50%
EXTERIOR DOORS	Top coat deterioration.		Minor cracks.			50-100%
GOOD (Near new condition)					1	
ALL	Minor paint blemishes.					
EXCELLENT (New condition)					0	

GENERAL COMMENTS:

ID NO =

WINDOWS (EXTERIOR)

MATERIAL TYPE	TICK
TICK ONE OR MORE	
TIMBER	
ANODISED ALUMINIUM	
POWDER COATED ALUMINUM	
OTHER (STATE)	

CONDITION	(Circle one or more defects).			COND	FREQ
SERIOUS (Health , Safety Implications)				4	
TIMBER	Severe decay.	Stressed joints.			0-10%
	Leaking flashing.	Badly corroded hinges.			10-25%
ALUMIMUM	Significant pitting.	Missing glazing mouldings.			25-50%
	Leaking flashing.	Broken hinges.			50-100%
POOR (Needs attention next 3 mths.)				3	
TIMBER	Windows sticking.	Dislodged/ missing	Paint deterioration		0-10%
	Broken/cracked panes	putty.	to bare timber.		10-25%
ALUMIMUM	Glazing mouldings in	Broken/cracked panes.			25-50%
	poor condition.				50-100%
MODERATE (Needs attention within 18 months)				2	
TIMBER	Checking in timber.	Nail rust staining.	Minor joint cracks.		0-10%
	Putty cracks.	Moderate/ minor hinge/ flashing corrosion.			10-25%
ALUMIMUM	Moderate/ minor hinge/ flashing corrosion.				25-50%
	Moderate/ minor anodising/ powder coat failure.				50-100%
GOOD (Near new condition)				1	
TIMBER	Minor paint blemishes.				
ALUMIMUM	Minor coating/ anodising failures.				
EXCELLENT (New condition)				0	

CHIMNEY		CONDITION			COND
TYPE	TICK	SERIOUS			4
CLAY BRICK			Broken/ missing bricks.	Obvious EQ risk.	
CONCRETE		MODERATE			2
STEEL			Cracked concrete/ bricks.	Missing mortar.	
OTHER (STATE)		GOOD			1

GENERAL COMMENTS:

ID NO =

ROOF CLADDING

MATERIAL TYPE	TICK	PAINTED (TICK)
METAL TILES		
GALV CORRU STEEL		
COIL COATED STEEL		
CONCRETE TILE		
CLAY TILES		
ASBESTOS		
MEMBRANE		
OTHER (STATE)		

INSPECT 2 SIDES OF ROOF WHERE POSSIBLE FROM LADDER.

ROOF TYPE

	TICK
GABLE	
HIP	
DUTCH GABLE	
FLAT	
MANSARD	
OTHER (STATE)	

SPOUTING AND DOWNPIPES

MATERIAL TYPE	TICK
PVC	
GALV STEEL	
COPPER	
OTHER (STATE)	

CONDITION (Circle one or more defects).				COND	FREQ
SERIOUS (Health,Safety Implications)				4	
ALL	Missing sheets/tiles.	Internal gutters leaking.			0-10%
METAL TILES	>75% chip coat missing	Rust penetration of base metal.			10-25%
GALV/COIL COAT	Rust penetration of base metal.				25-50%
CONCRETE /CLAY	Cracked/ dislodged tiles.				50-100%
OTHER	Holes/ cracks.				
POOR (Needs attention next 3 mths.)				3	
ALL	Moderate rust in internal gutters.				0-10%
METAL TILES	40-75% chip coat missing.	Some rust.			10-25%
GALV/COIL COAT	Rust appearing thru galv coating.	Major paint flaking.	Refixing required.		25-50%
CONCRETE /CLAY	Severe moss growth.	Dislodged pointing.			50-100%
OTHER	Refixing required.				
MODERATE (Needs attention within 18 months)				2	
ALL	Minor rust in internal gutters.				0-10%
METAL TILES	10-40% chip coat missing.				10-25%
GALV/COIL COAT	Minor deterioration of fixings.	Some paint flaking.			25-50%
CONCRETE /CLAY	Moderate moss growth.				50-100%
OTHER	Top coat deterioration.	Slight deformation/ dents.			
GOOD (Near new condition)				1	
ALL	Minor paint blemishes.	0-10% chip coating missing.			
EXCELLENT (New condition)				0	

SPOUTING AND DOWNPIPES

			COND	FREQ
SERIOUS (Health,Safety Implications)			4	0-10% 10-25%
ALL	Missing spouting/downpipes.			25-50%
	Major holes.	Inadequate drains.		50-100%
MODERATE (Needs attention next 18 mths.)			2	0-10% 10-25%
ALL	Uneven fall.	Missing supports.		25-50%
	Minor holes.			50-100%
GOOD (Near new condition)			1	

GENERAL COMMENTS:

ID NO =

ROOF SPACE

ROOF SPACE	NONE	
MATERIAL TYPE		TICK
TRUSS		
RAFTERS/PURLINS & CEILING JOISTS		
	TREATED RADIATA	
	UNTREATED RADIATA	
	NATIVE	
	OTHER (STATE)	
ROOF SLOPE	0-15 DEGREES	
	15-30	
	> 30	
ROOF SARKING		
CEILING SARKING		

CEILING INSULATION

TYPE		% COVER
FIBREGLASS		
MACERATED PAPER		
ROCWOOL		
OTHER (STATE)		
NONE		
THICKNESS (TICK)	50MM	
	75	
	100	
	150	

WIRING

TYPE	TICK
TOUGH PLASTIC SHEATH.	
TOUGH RUBBER SHEATH	
VULCANISED INDIAN RUBBER	
CONDITION NUMBER	

RAFTER/PURLIN/JOISTS	COND	FREQ	HEAD TANK/ UNDERLAY/TIES	COND	FREQ
SERIOUS	4	0-10%	SERIOUS	4	0-10%
Severe timber decay.		10-25%			10-25%
Structural cracks.		25-50%			25-50%
		50-100%			50-100%
POOR	3	0-10%	POOR	3	0-10%
Insufficient joists/bearers.		10-25%	Header tank unrestrained.		10-25%
Severe borer.		25-50%	Insufficient ties to conc tiles.		25-50%
Two toothed borer.		50-100%	No underlay (metal roof).		50-100%
MODERATE	2	0-10%	MODERATE	2	0-10%
Moderate/minor borer.		10-25%	Underlay deterioration.		10-25%
Moderate/ minor decay.		25-50%			25-50%
		50-100%			50-100%
GOOD	1		GOOD	1	
Minor cracks/ checking.					
EXCELLENT	0		EXCELLENT	0	
No defects.			No defects.		

GENERAL COMMENTS:

ID NO =

BATHROOM NUMBER =	NO 1	NO 2
	TICK	TICK
BATH		
SHOWER OVER BATH		
SEPERATE SHOWER CUBICLE		
TOILET IN BATHROOM		
SEPERATE TOILET CUBICLE		
HEATER (RADIANT,FAN, ETC)		
HEATED RAIL		
POSITIVE VENTILATION EG EXPELAIR.		
WALL LININGS		
PLASTERBOARD		
HARDBOARD		
FORMICA		
OTHER (STATE)		

CEILING	TICK
PLASTERBOARD	
HARDBOARD	
PINEX	
OTHER (STATE)	
FLOOR COVERING	
VINYL	
CERAMIC TILES	
BARE	
OTHER (STATE)	

BASIN/BATH/TOILET/SHOWER	COND	LININGS/VENTS/FLOOR COVER	COND
SERIOUS	4	**SERIOUS**	4
Badly cracked/chipped enamel.		Severe mould growth/dirt.	
Severe staining of surfaces.		Holes in linings.	
Leaking outlets.		Holes in floor.	
Broken seat or cistern.		Damaged wiring/ outlets/ switches.	
POOR	3	**POOR**	3
Minor cracks/chips to enamel.		Moderate mould growth/dirt.	
Moderate staining of surfaces.		Paint deterioration to bare timber.	
Rotten shower linings.		Worn timber edges.	
Shower tray pitted.		Venting into roof space.	
		Unsafe floor covering.	
MODERATE	2	**MODERATE**	2
Uneven shower spray.		Minor mould growth/dirt.	
Tap deterioration.		Discoloured/ chipped/ peeling paint/ paper.	
Mould shower lining.		Reveals/ sills cracked, water stains.	
GOOD	1	**GOOD**	1
Minor staining/ mould.		Minor coating/lining floor blemishes.	
EXCELLENT	0	**EXCELLENT**	0
No defects.		No defects.	

GENERAL COMMENTS:

ID NO =

KITCHEN

BENCH TOP	TICK
STAINLESS STEEL	
FORMICA	
OTHER (STATE)	
RANGE ELECTRIC	
GAS	
COAL/WOOD.	
OTHER RANGEHOOD	
POSITIVE VENT	
EG EXPELAIR.	
WALL LININGS	
PLASTERBOARD	
HARDBOARD	
FORMICA	
OTHER (STATE)	

CEILING	TICK
PLASTERBOARD	
HARDBOARD	
PINEX	
OTHER (STATE)	
FLOOR COVERING	
VINYL	
CERAMIC TILES	
BARE	
OTHER (STATE)	

JOINERY/BENCH	COND	RANGE	COND	LININGS/ VENTS/ FLOOR	COND
SERIOUS	4	SERIOUS	4	SERIOUS	4
Badly cracked/ dented.		Damaged elements.		Severe mould growth/ dirt.	
Insantitary surfaces.		Fire risk.		Holes in linings.	
Leaking outlets.				Holes in floor.	
				Damaged wiring/ outlets/ switches.	
				Fat build up inrangehood/ fans.	
POOR	3	POOR	3	POOR	3
Some cracks.		Damaged seals.		Moderate mould growth/dirt.	
Worn joinery edges.				Paint deterioration to bare timber.	
Poor seals at bench top.				Worn timber edges.	
				Venting into roof space.	
				Unsafe floor cover.	
MODERATE	2	MODERATE	2	MODERATE	2
Minor cracks/ wear.		Minor damge.		Minor mould growth/dirt.	
Taps deterioration.				Discoloured/ chipped/ peeling paint/ paper.	
				Reveals/ sills cracked, water stains.	
GOOD	1	GOOD	1	GOOD	1
Minor blemishes.		Minor blemishes.		Minor coating, flooring lining blemishes.	
EXCELLENT	0	EXCELLENT	0	EXCELLENT	0
No defects.		No defects.		No defects.	

GENERAL COMMENTS:

ID NO =

LAUNDRY

	TICK
TUB, STAINLESS STEEL	
TUB, CONCRETE.	
WASHING MACHINE	
DRYER	
POSITIVE VENTILATION EG EXPELAIR.	

HOT WATER CYLINDER

	TICK	AGE
ELECTRIC		
GAS		

BASEMENT/GARAGE

(ONE OR MORE WALLS BELOW GROUND)

WALL TYPE	TICK
CONCRETE BLOCK	
CONCRETE	
NOT KNOWN	
LEAKS Y/N/DN	

BASEMENT ROOM USE	TICK
GARAGE	
LAUNDRY	
BATHROOM	
LIVING/ BEDROOM	
OTHER (STATE)	

JOINERY/TUB	COND	HWC	COND	LININGS/ VENTS/ FLOOR	COND
SERIOUS	4	SERIOUS	4	SERIOUS	4
Badly cracked/ dented.		Leaking at connectns.		Severe mould growth/ dirt.	
Insantitary surfaces.		Gas flue damage.		Holes in linings.	
Leaking outlets.		Wiring damage.		Holes in floor.	
				Damaged wiring/ outlets/ switches.	
POOR	3	POOR	3	POOR	3
Some cracks.		No effective EQ		Moderate mould growth/dirt.	
Worn joinery edges.		restraint.		Paint deterioration to bare timber.	
Poor seals at sink top.		Deterioration at		Worn timber edges.	
		connections.		Venting into roof space.	
				Unsafe floor cover.	
MODERATE	2	MODERATE	2	MODERATE	2
Minor cracks/ wear.		Minor damge.		Minor mould growth/dirt.	
Taps deterioration.				Discoloured/ chipped/ peeling paint/ paper.	
				Reveals/ sills cracked, water stains.	
GOOD	1	GOOD	1	GOOD	1
Minor blemishes.		Minor blemishes.		Minor coating, flooring lining blemishes.	
EXCELLENT	0	EXCELLENT	0	EXCELLENT	0
No defects.		No defects.		No defects.	

GENERAL COMMENTS:

ID NO =

INTERIOR LININGS/ DECORATION
(EXCL KITCHEN/ BATHROOM/ LAUNDRY)

TYPE	TICK
TICK ONE OR MORE	
WALL LININGS	
PLASTERBOARD	
HARDBOARD	
FORMICA	
OTHER (STATE)	
CEILING	
PLASTERBOARD	
HARDBOARD	
PINEX	
OTHER (STATE)	

FLOOR COVERING	%
BARE	
CARPET	
VINYL	
CERAMIC TILES	
OTHER (STATE)	

WALL INSULATION	TICK
FIBREGLASS	
MACERATED PAPER	
ROCWOOL	
FOIL	
NONE	
OTHER (STATE)	
THICKNESS 50MM	
75	
100	

INSPECT BY REMOVING LIGHT SWITCH AT ONE LOCATION.

INTERNAL DOORS	TICK
HOLLOW CORE	
SOLID TIMBER	
TIMBER AND GLASS	
OTHER (STATE)	
SPACE HEATERS (FIXED)	**NUMBER**
ELECTRIC	
GAS (VENTED)	
GAS (UNVENTED)	
CONTROLLED COMB	
OPEN FIRE	
OTHER (STATE)	
MDF REVEALS Y/N	
CONDITION NUMBER =	

FIRE SAFETY	Y/N
SMOKE DETECTOR ?	
FIRE EXTINGUISHER ?	

INT DOORS/ HARDWARE	COND	FIREPLACE	COND	LININGS/ FINISHES/ SILLS.	COND
SERIOUS	4	**SERIOUS**	4	**SERIOUS**	4
Holes in door.		Missing bricks.		Severe mould growth/ dirt.	
				Holes in linings.	
				Holes in floor.	
				Damaged wiring/ outlets/ switches.	
POOR	3	**POOR**	3	**POOR**	3
Moderate cracks.		Missing mortar.		Moderate mould growth/dirt.	
Severe borer.				Paint deterioration to bare timber.	
Missing/ broken hardware.				Worn timber edges.	
				Severe borer in sills/ mouldings.	
				Unsafe floor cover.	
MODERATE	2	**MODERATE**	2	**MODERATE**	2
Minor cracks/ wear.				Minor mould growth/dirt.	
Moderate/ minor borer.				Discoloured/ chipped/ peeling paint/ paper.	
Worn hardware.				Reveals/ sills cracked, water stains.	
				Moderate/ minor borer in sills/ mouldings.	
GOOD	1	**GOOD**	1	**GOOD**	1
Minor blemishes.		Minor blemishes.		Minor coating, flooring lining blemishes.	
EXCELLENT	0	**EXCELLENT**	0	**EXCELLENT**	0
No defects.		No defects.		No defects.	

GENERAL COMMENTS:

ID NO =

FOUNDATIONS

MATERIAL TYPE	
TICK ONE OR MORE	
CONCRETE SLAB	
CONTINUOUS CONCRETE PERIMETER WALLS	
CORNER CONCRETE PERIMETER WALLS	
CONCRETE PILE	
CONCRETE BLOCK	
BRICK	
TIMBER PILE	
JACK STUD	
OTHER (STATE)	

MINIMUM GROUND CLEARANCE	
MINIMUM CLEARANCE TO:	MM
CLADDING .	
BEARERS.	
PAVED OR UNPROTECTED GRD ?	
ANY DETERIORATION IN	
CLADDING NEAR GRD Y/N	

CONDITION	(Circle one or more defects).			COND	FREQ
SERIOUS (Health,Safety Implications)				4	
ALL	Subsidence.	Structural cracks.	Water ponding under house.		0-10%
	Unsafe excavation.	Non vertical piles.	Missing pile.		10-25%
CONCRETE WALL	Deep spalling or holes.	Rising damp.			25-50%
CONC/CLAY BRICK	Broken blocks.	Rising damp.			50-100%
TIMBER PILE	Severe timber decay.				
JACK STUDS	Severe timber decay.	Non-vertical jacks.			
POOR (Needs attention next 3 mths.)				3	
ALL	Inadequate bracing.	Missing/insecure ties to bearers.	Nail plates/fasteners deformed, poor fixing.		0-10% 10-25%
CONC/CLAY BRICK	Missing mortar.				25-50%
TIMBER PILE	Severe borer.	Two tooth borer.			50-100%
JACK STUDS	Severe borer.	Two tooth borer.			
MODERATE (Needs attention within 18 months)				2	
ALL	Missing/rotten baseboards.	Non-structural cracks.			0-10%
CONCRETE WALL	Exterior plaster spalling.				10-25%
TIMBER PILE	Moderate/ minor borer.	Moderate/ minor timber decay.			25-50%
JACK STUDS	Moderate / minor borer.	Moderate/ minor timber decay.			50-100%
GOOD (Near new condition)				1	
ALL	Minor paint blemishes.				
EXCELLENT (New condition)				0	

ALL FASTENERS	TICK	FASTENER CONDITION		COND	FREQ
NO 8 WIRE & STAPLES.		SERIOUS	Base material > 50%	4	
WIRE DOGS			corroded through.		0-10%
GALV NAIL PLATES		POOR	50-100% failure of	3	10-25%
NON GALV ROD			coating, some pitting.		25-50%
GALV BOLTS		MODERATE	10-50%coating failure,	2	50-100%
GALV STRIP			no pitting.		
OTHER (STATE)		GOOD	0-10% coating failure.	1	
NONE		EXCELLENT	Coating completely intact.	0	

GENERAL COMMENTS:

SURVEY RECORD

SURVEYOR: ID NO =

NAME:

ADDRESS:

DATE: START TIME: FINISH TIME:

PHOTOS TAKEN: FRONT [ ] OTHER (STATE) [ ]

NUMBER OF STOREYS (IGNORE BASEMENT GARAGE) [ ]

	NUMBER OF ROOMS
BEDROOMS	
BATHROOMS	
LOUNGE/ SITTING	
SEPERATE DINING	
RUMPUS/GAMES	
STUDY/SEWING, ETC.	

MAINTENANCE

GENERALLY THE BUILDING WAS:	TICK
WELL MAINTAINED	
REASONABLY MAINTAINED	
POORLY MAINTAINED	

QUESTIONS

Q1/ HOW LONG HAVE YOU OCCUPIED THE HOUSE ?

Q2/ WHAT WORK HAS BEEN DONE ON THE HOUSE IN THE LAST 5 YEARS ? WHEN ?

Q3/ WHEN WERE THE EXTERIOR WALLS LAST REPAINTED ?

Q4/ WHEN WAS THE ROOF LAST REPAINTED OR REROOFED ?

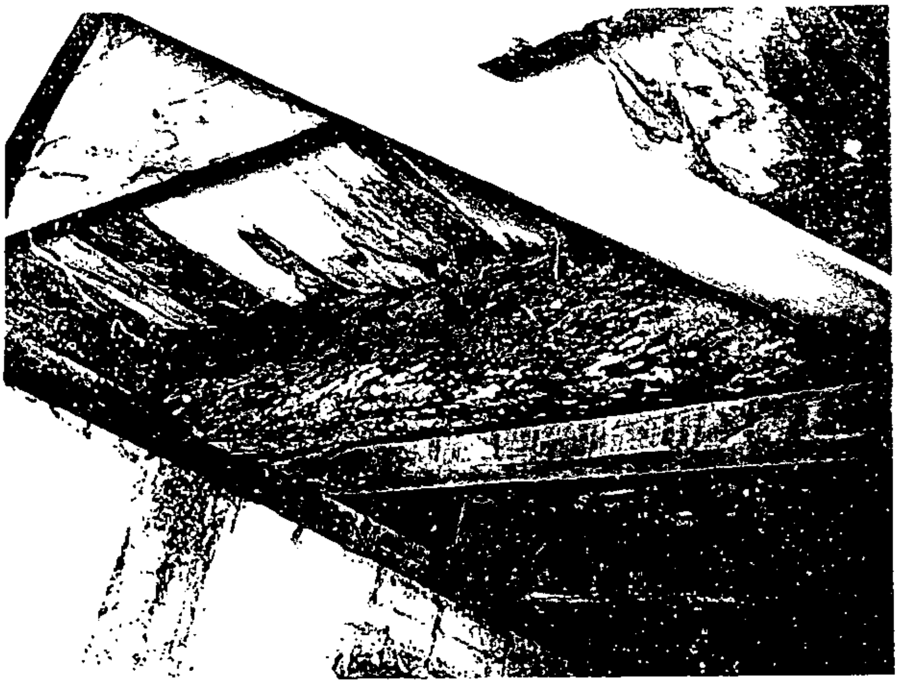
Q5/ HAS ANY BORER BEEN TREATED ?

Q6/ WHAT WORK IS IN PROGRESS NOW ?

Q7/ DO YOU HAVE ANY PLANS FOR MAINTENANCE, ALTERATIONS, REMODELLING OR ADDITIONS WORK IN THE NEXT 6 MONTHS ? RECORD THE DETAILS.

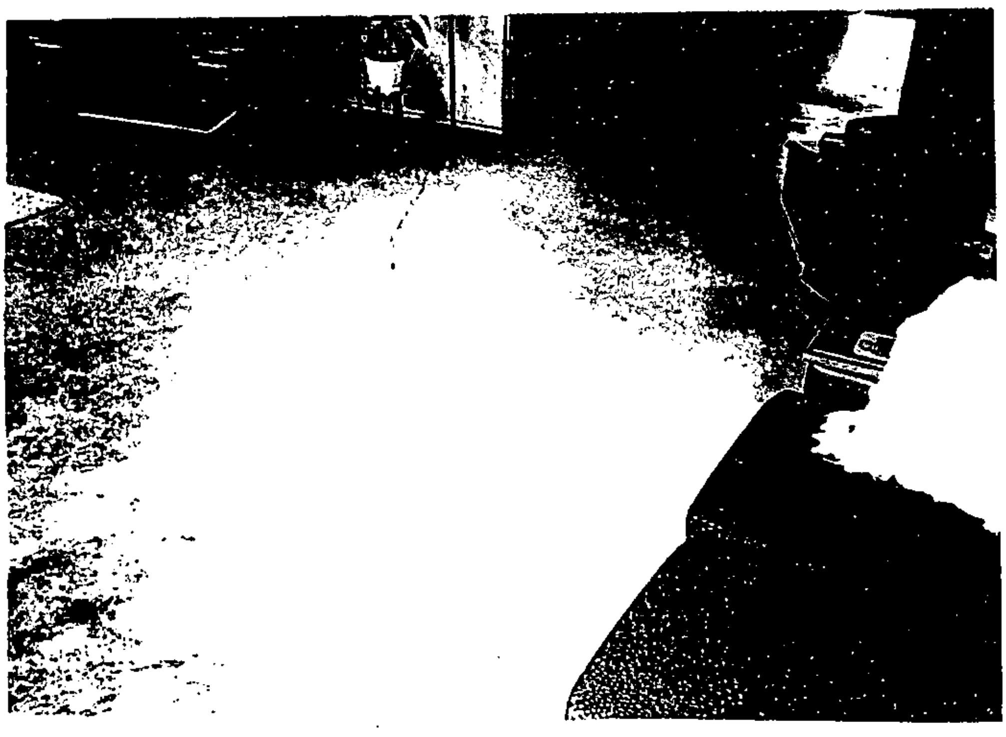
APPENDIX 4 Photographs of Defects.

Ten sheets of photographs follow, showing some of the exterior defects discovered in the BRANZ survey.

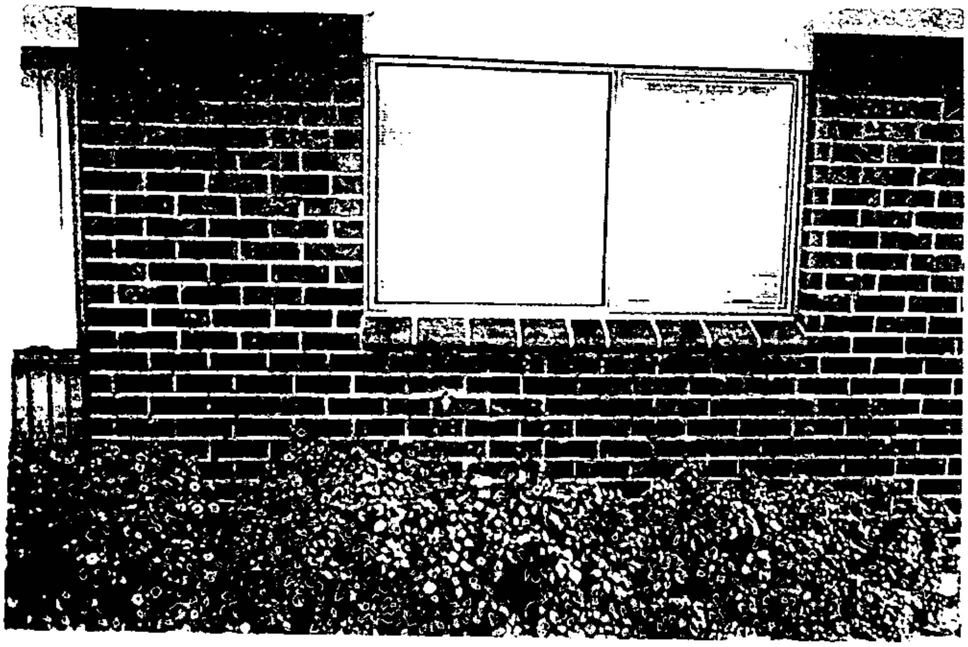


Mould growth on floor joist due to leaks from the bathroom above.

Reinforcing corrosion in lintel.

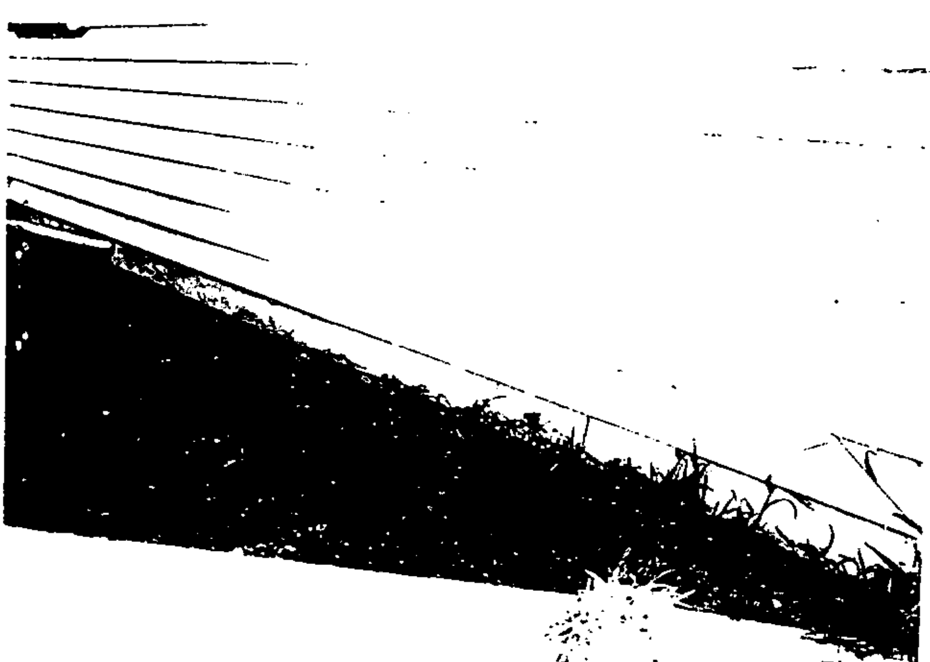


Crack in concrete floor slab.

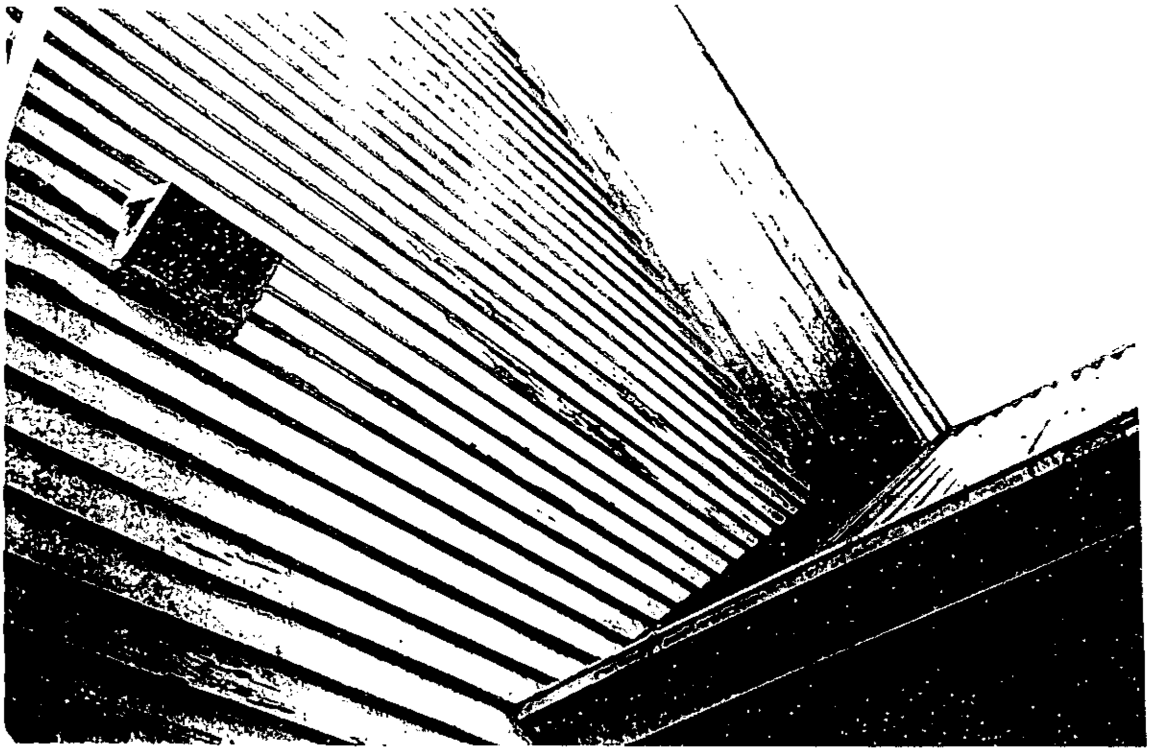


Vegetation blocking sub - floor vents.

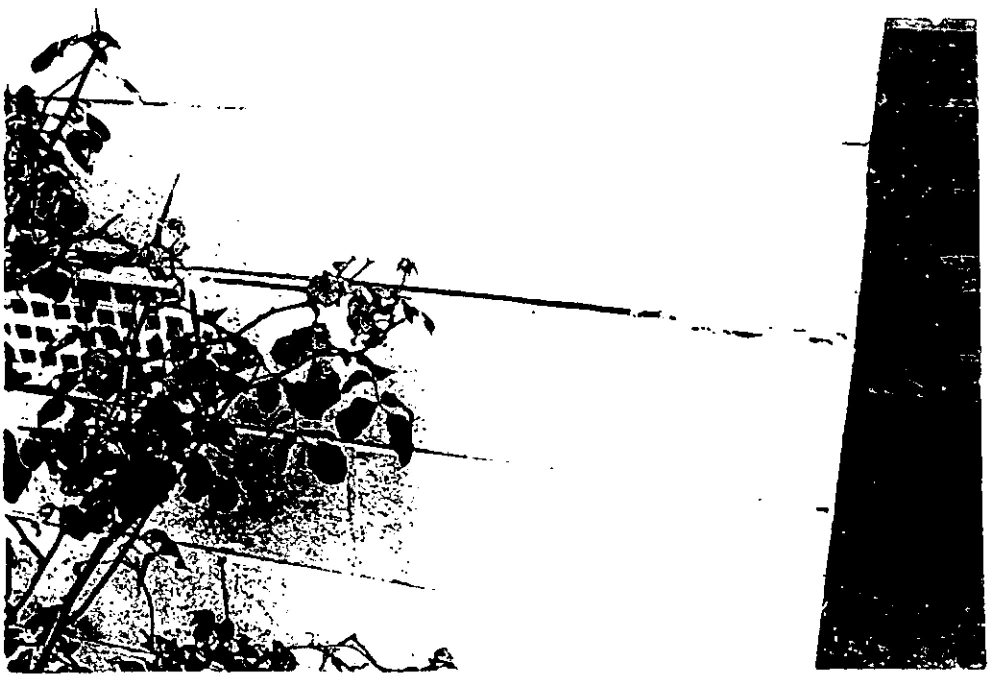
Firewood blocking sub- floor vents.



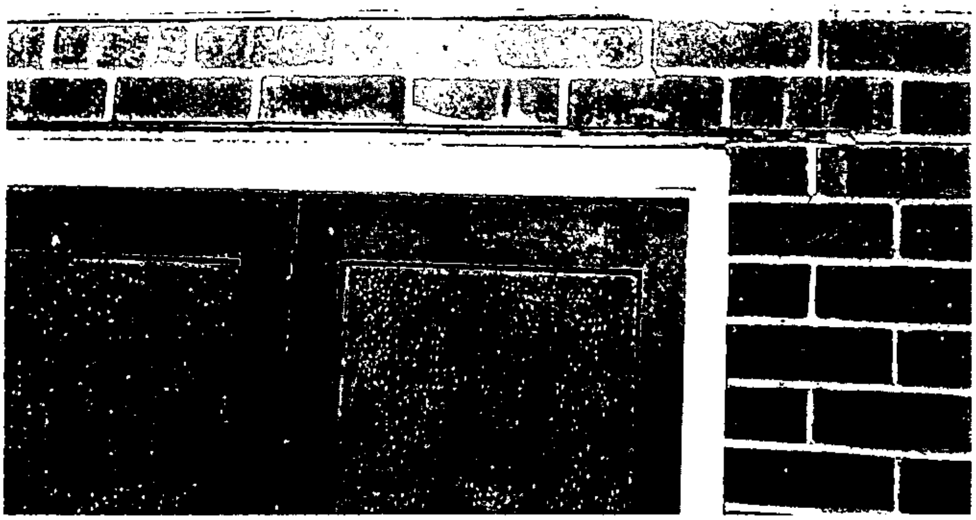
Nil vents provided. Path in contact with cladding.



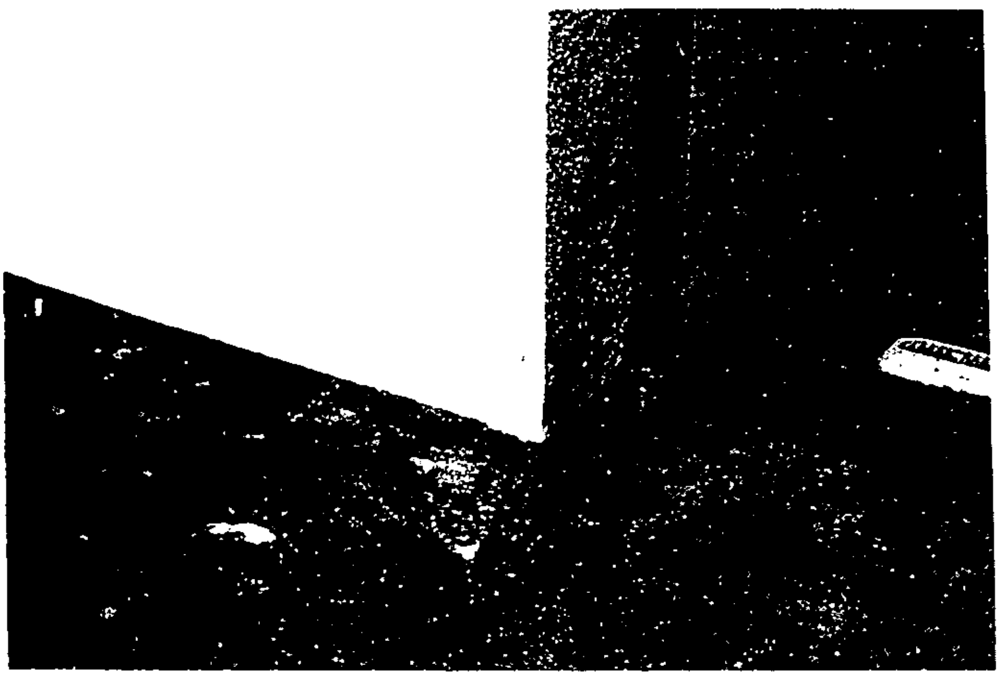
TOP &
MIDDLE.
Paint deterioration
to bare timber.



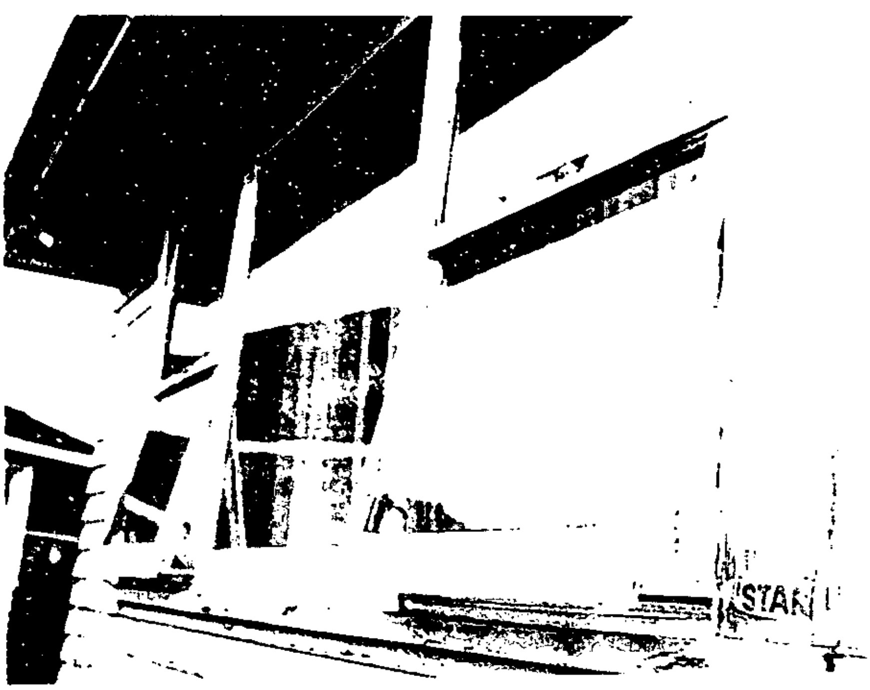
Cracks in concrete
masonry due to
foundation
settlement.



Brick lintel cracks.



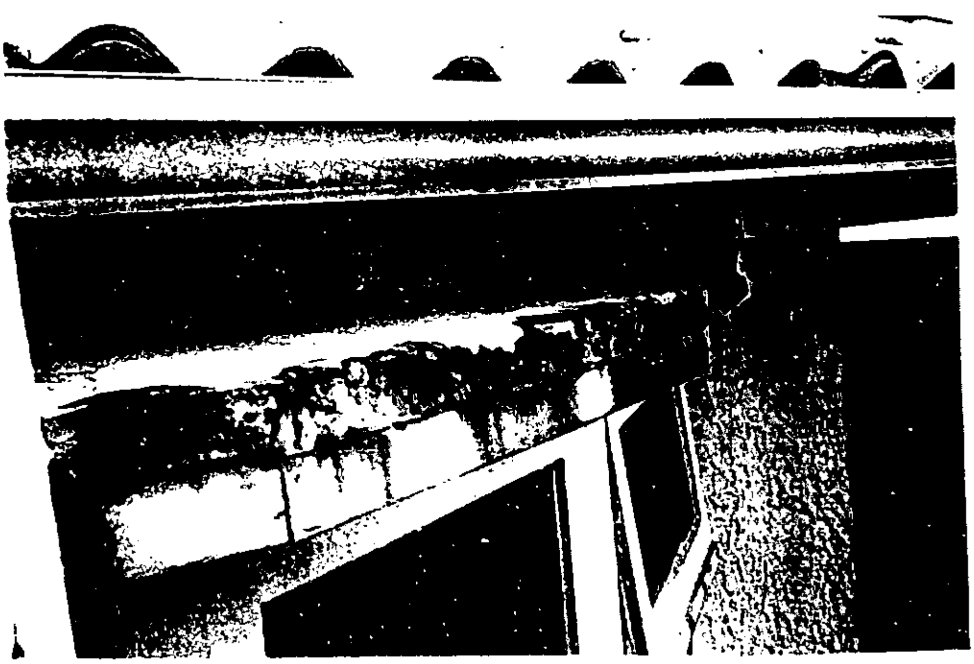
Plaster loss in stucco.



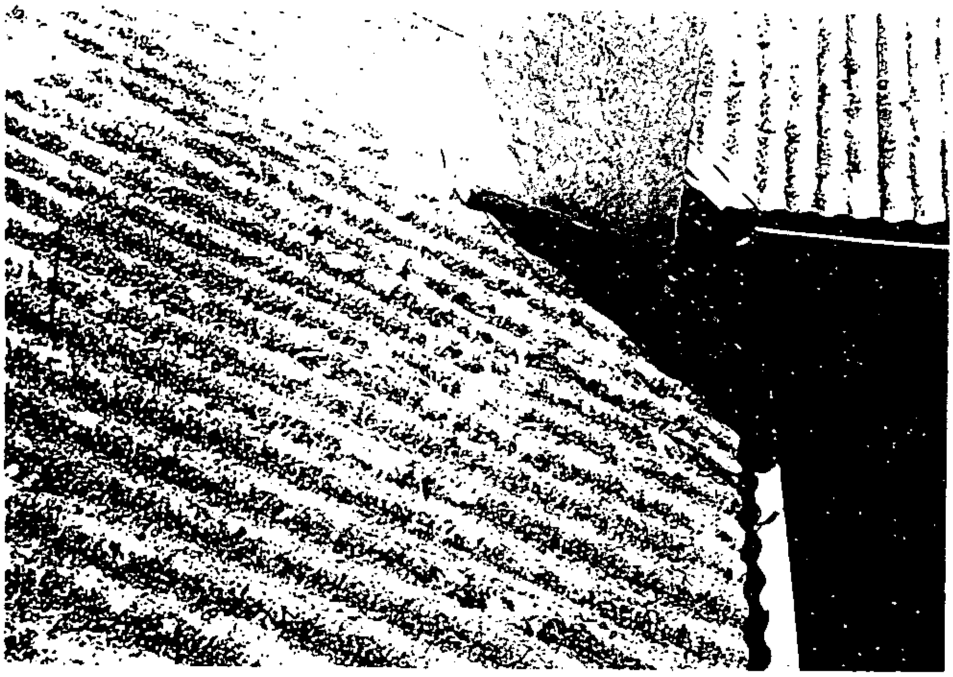
Poor window and weatherboard conditions.

Opened joints in timber window frame.

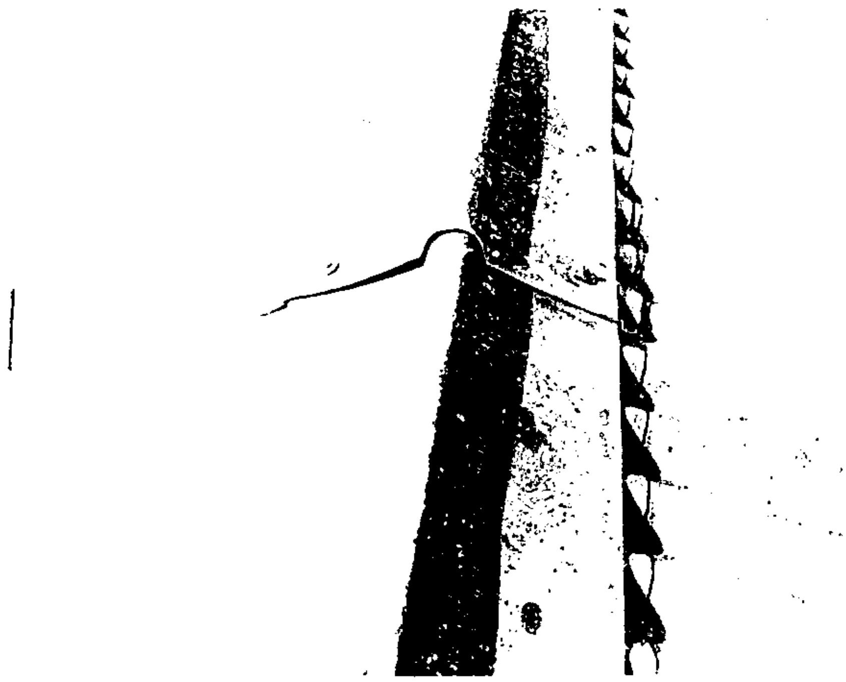
Pitting corrosion in an anodised aluminium frame.



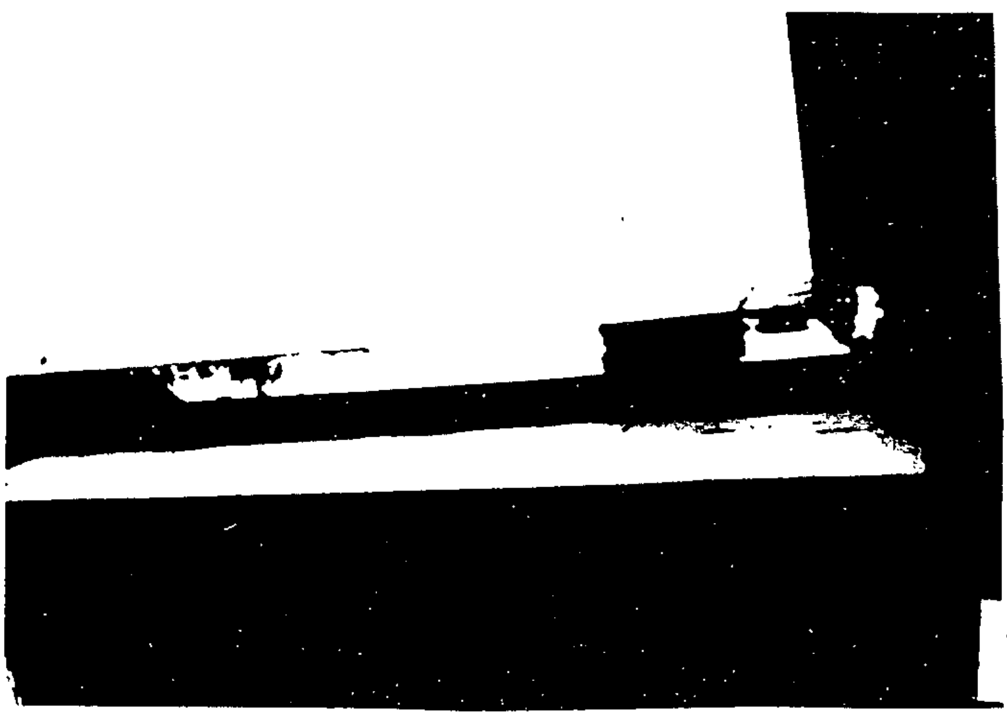
Serious corrosion in window head flashings.



Heavy lichen growth on an aluminium roof.

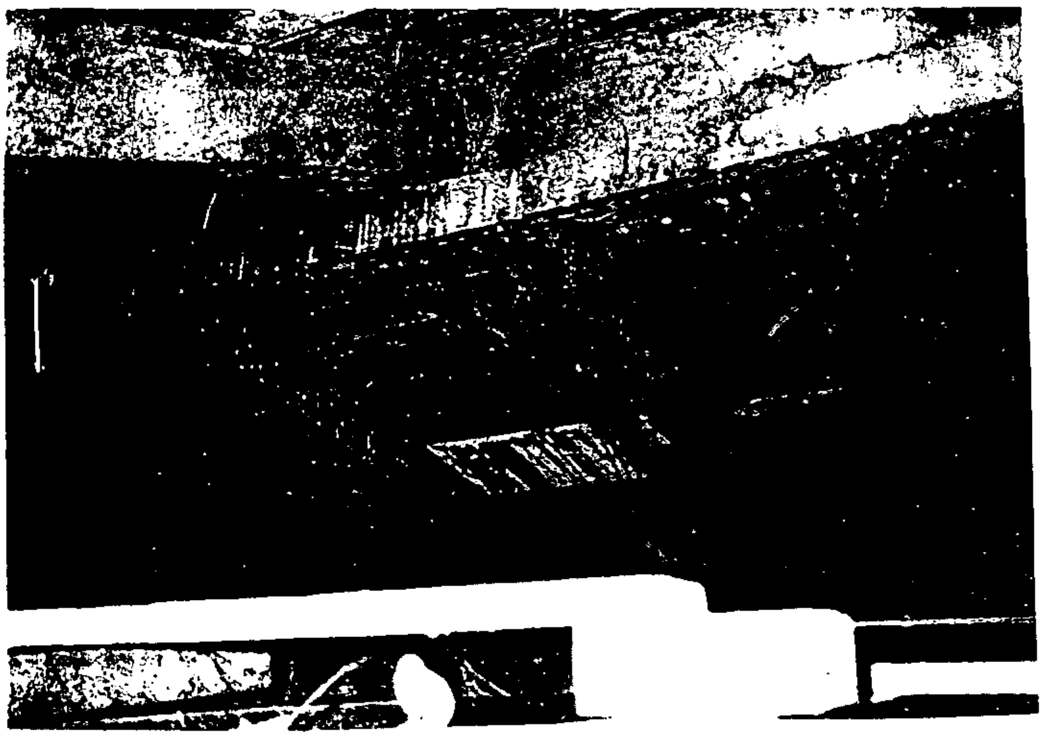


Poorly fitted ridge cap.



Corrosion in spouting.

Unsafe chimney construction.



Extensive borer in ridge board and rafters.

Underlay shrinkage.

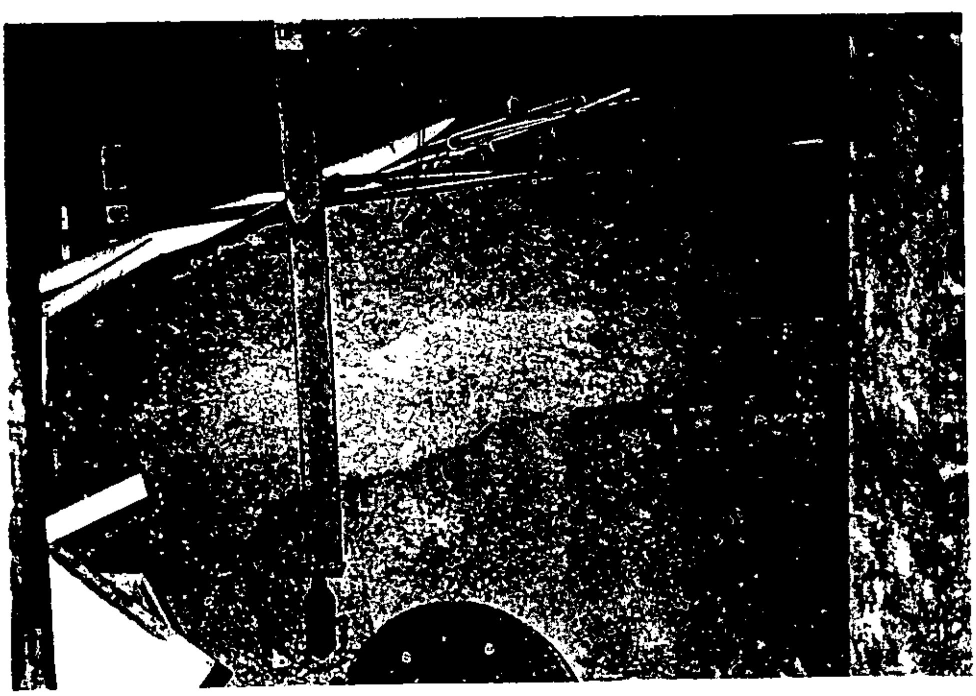
TOP LEFT.
Unsafe support to the header tank.

TOP RIGHT
Rafters and joists cut to accommodate installation of flues.

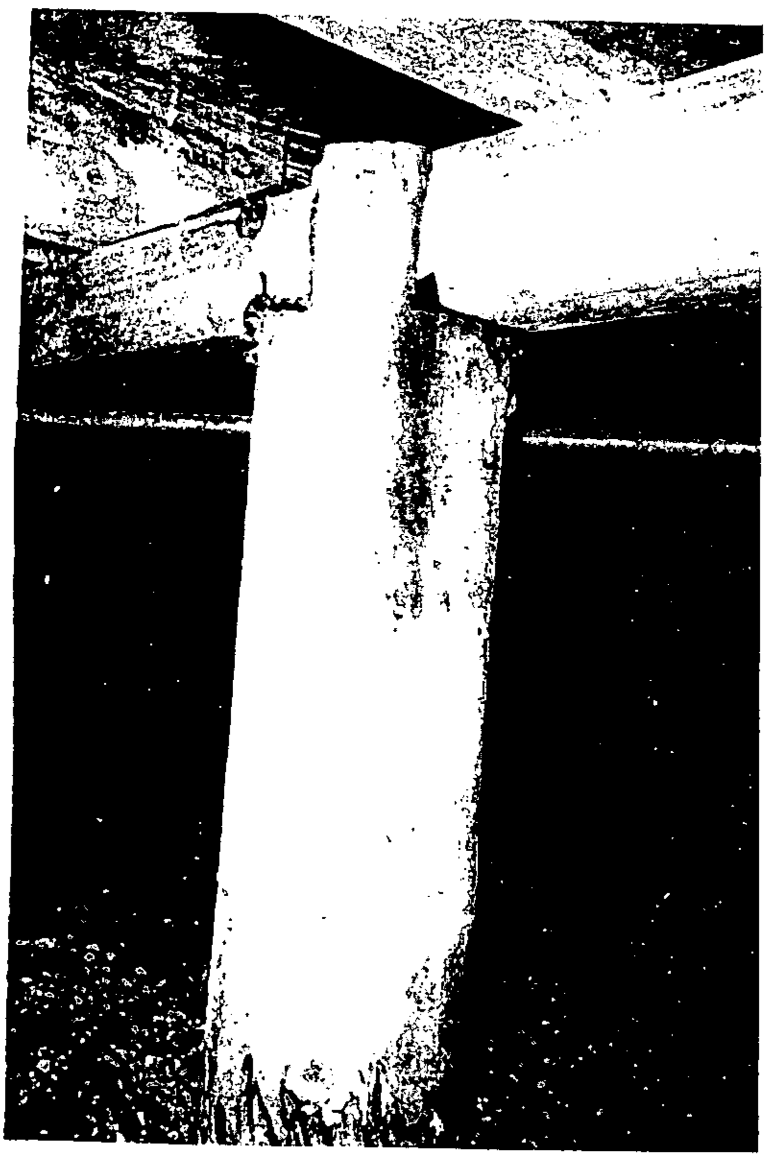
LEFT
Cracks in brick chimney.

Bearer resting on a two brick pile.

Inadequate connections to the foundation and bearers.



Unsafe temporary props during excavation.



TOP.
Studs in
contact with
the earth.

Insufficient pile
material at bolt
fixing to the
bearer.

APPENDIX 5 Error Analysis. Regional Composite Condition, and Housing New Zealand Houses

This appendix shows the margins of error in the calculation of composite condition and the condition of Housing New Zealand (HNZ) houses.

As indicated in Table A2 the margin of error at the 95% confidence level is around 0.2 condition points for most age cohorts. Because of the smaller sample sizes in 1880 and 1890 the error is somewhat higher at around 1.1.

TABLE A2 COMPOSITE CONDITION ERROR ANALYSIS

DECADE BEGINNING	NUMBERS IN COHORT	COMPOSITE CONDITION	SAMPLE DEVIATN	ERROR AT 95% CONF LEVEL
1880	2	2.20	0.13	1.17
1890	5	1.47	0.88	1.09
1900	14	2.14	0.51	0.29
1910	24	2.14	0.54	0.23
1920	49	1.97	0.58	0.17
1930	32	1.88	0.42	0.15
1940	27	1.65	0.61	0.24
1950	54	1.65	0.51	0.14
1960	80	1.43	0.60	0.13
1970	67	1.23	0.62	0.15
1980	36	0.83	0.48	0.16
1990	12	0.45	0.50	0.31
TOTAL	402	1.42		

The variability in the composite scores is shown graphically in Figure A1. Each point on the diagrams represents one house.

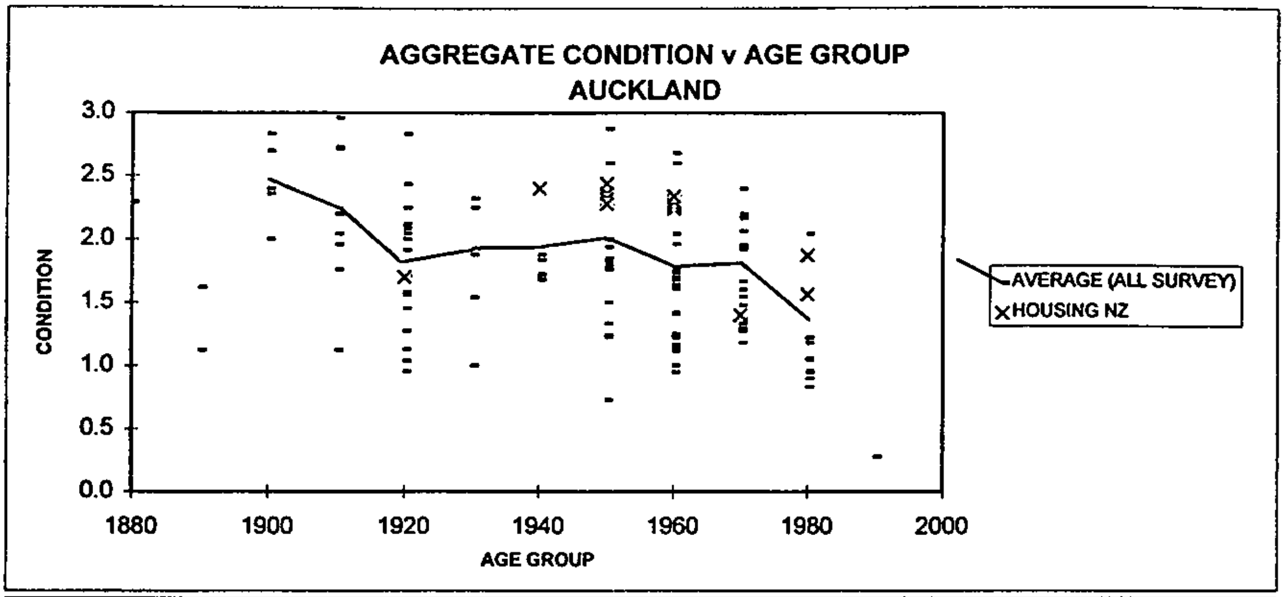
HNZ houses are shown seperately. A total of 29 HNZ houses were included in the survey. Their composite condition was slightly above the sample average, i.e. they were in slightly worse condition, mainly due to the Auckland HNZ sample which had a significantly poorer condition than the average for that region. A statistical analysis (Table A3) shows that only the Auckland 1950, 1960 and 1980 houses were significantly different in average composite condition from the other houses.

TABLE A3 HOUSING NZ HOUSES COMPOSITE CONDITION

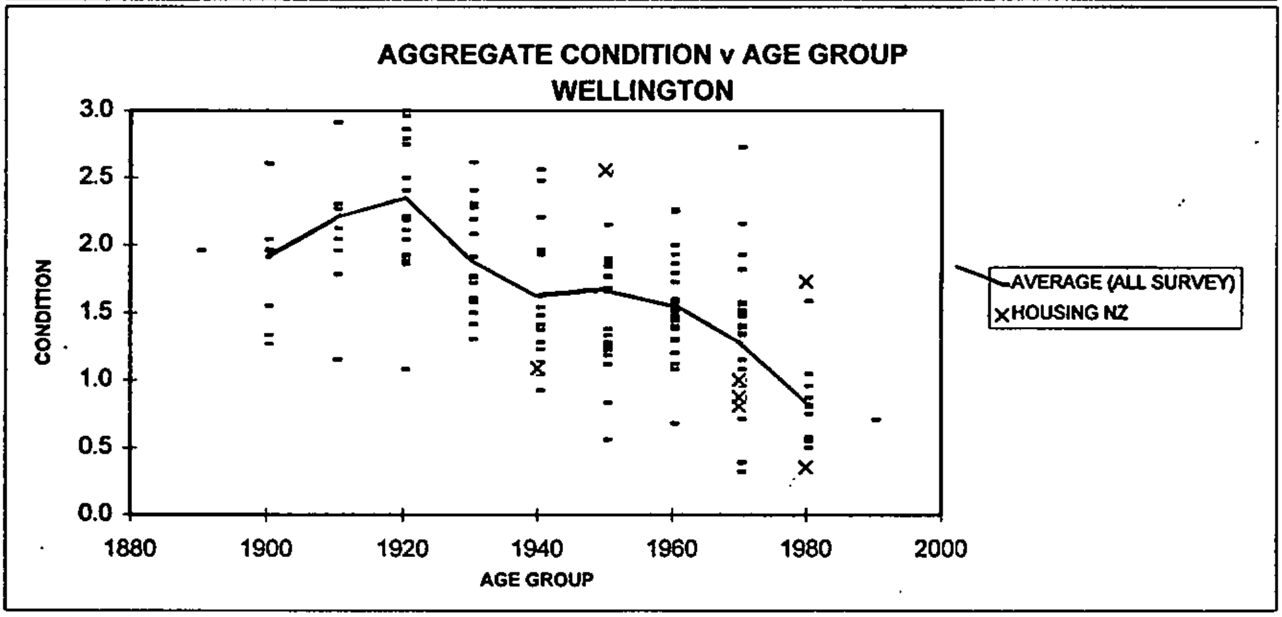
AGE GROUP	NUMBER OF HNZ HOUSES	AVERAGE CONDITION (1) HNZ	OTHERS	DIFFERENCE	95% CONFIDENCE LEVEL (2)
AUCKLAND 1950	4	2.35	1.74	0.61	0.49
AUCKLAND 1960	4	2.28	1.65	0.63	0.35
AUCKLAND 1980	3	1.83	1.03	0.80	0.56
WELLINGTON 1970	3	0.90	1.33	-0.43	0.57

(1) The average condition of all 26 components.
(2) The margin of error for the difference between the means from the 2 sets of houses.

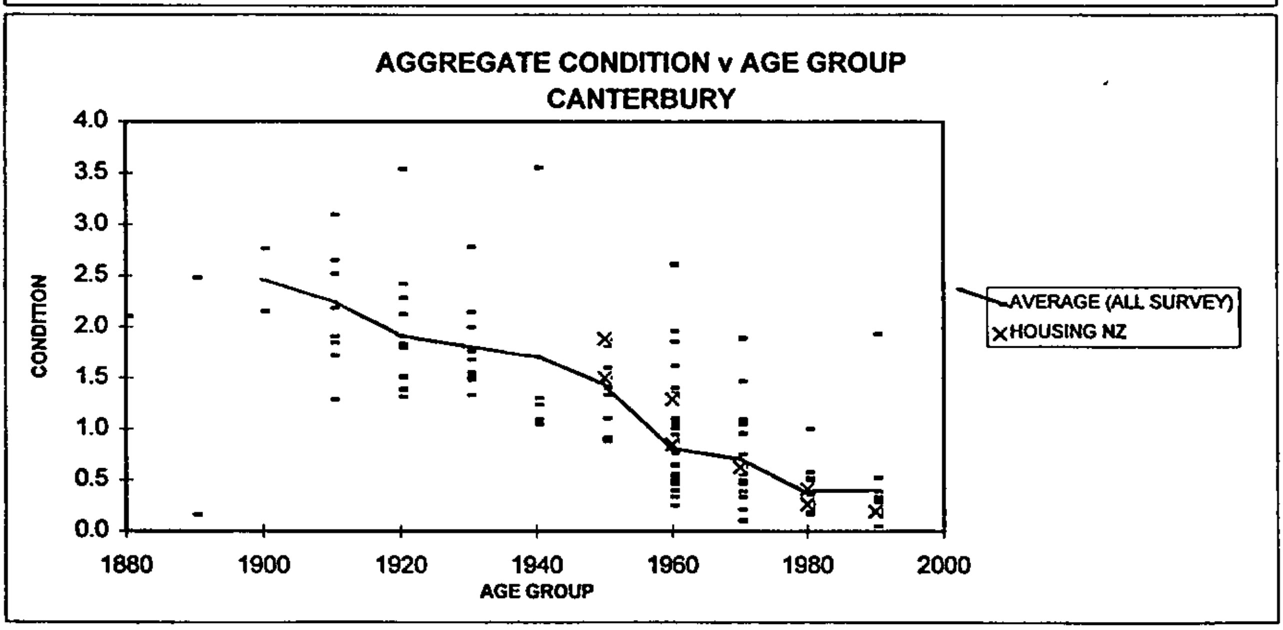
FIGURE A1



AGGREGATE CONDITION v AGE GROUP
AUCKLAND
CONDITION
AGE GROUP
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1880
1900
1920
1940
1960
1980
2000
AVERAGE (ALL SURVEY)
HOUSING NZ



AGGREGATE CONDITION v AGE GROUP
WELLINGTON
CONDITION
AGE GROUP
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1880
1900
1920
1940
1960
1980
2000
AVERAGE (ALL SURVEY)
HOUSING NZ



AGGREGATE CONDITION v AGE GROUP
CANTERBURY
CONDITION
AGE GROUP
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1880
1900
1920
1940
1960
1980
2000
AVERAGE (ALL SURVEY)
HOUSING NZ

APPENDIX 6 VNZ Condition Rating versus Survey Condition Rating.

VNZ use a four point scale, namely good, average, fair and poor. The rating is compared to that obtained on the survey five point scale and uses a regression analysis to calculate the correlation. The results of the analysis are given in Table A4.

The table indicates that the correlation is low. Using the whole sample gives an R squared for the wall and roof conditions of only 0.13 and 0.10 respectively. The correlation is little better for the composite condition, with an R squared of 0.18. In the latter the VNZ roof and wall cladding condition was combined and regressed against the composite (26 components) condition from the survey.

The latter part of the table checks whether the VNZ data identifies the worst defects conditions in the survey. For the wall, conditions of 3 and 4 only were regressed against the VNZ condition, giving a R sq of only 0.07.

Reasons for the poor correlation are:

- The triennial VNZ revaluation is unlikely to involve an on-site inspection unless a building consent has been issued in the period for alterations or additions. The condition rating remains unchanged until an inspection occurs.
- Even if inspections occurred every three years there would be an inspection time difference of 1.5 years, on average, between the BRANZ and VNZ data. Repairs, and to a lesser extent deterioration, will have occurred in the interim, so that the two datasets record different conditions. This will most likely be the case for serious defects where repairs are needed urgently, hence the low R squared value for the wall condition 3 and 4 comparison in Table A4.

TABLE A4 VNZ CONDITION RATING versus SURVEY CONDITION RATING

	REGRESSION ANALYSIS RESULTS		
COMPONENT	R SQ	C1	C2
WALL	0.13	0.64	0.69
		(3.6)	(6.9)
ROOF	0.10	0.85	0.64
		(4.6)	(5.9)
COMPOSITE	0.18	0.68	0.27
		(6.3)	(8.5)
WALL (COND 3&4 ONLY)	0.07	3.00	0.18
		(20.6)	(2.5)
COMPOSITE (COND > 1.9 ONLY)	0.12	1.94	0.12
		(13.2)	(3.3)

Regression equation is: Survey Condition = C1 +C2* VNZ Condition Score.
R SQ = Coefficient of Determination.
( ) Bracket values are the T statistic.
Composite = average condition for all 26 components in the survey and the two cladding components in the VNZ data.

APPENDIX 7 Defect Repair Cost and Time Data

This appendix includes data on the cost of repairing component defects and estimated time for components to reach the next defect level. This enables the cost implications of existing maintenance, and delays in maintenance, to be estimated.

Table A5 shows the unit costs used in calculating the costs of repairs.

Table A6 shows the assumed number of years required for an unmaintained component to deteriorate to the next condition level. The time periods are based on expert opinion from BRANZ durability researchers and technical advisors. This data is used to calculate the cost implications of delay in maintenance.

Tables A7 and A8 have the data illustrated in Figures 5 and 7 on average component repair costs.

Figure A2 shows the scatter plot for cost of repair versus aggregate condition for each house. There is an approximate linear relationship with the correlation cofficient being 0.14 in Auckland, 0.34 in Wellington and 0.51 in Christchurch.

TABLE A5 MAINTENANCE COSTS TO BRING TO AN AS NEW CONDITION

CONDITION	FOUNDATIONS FDNS	 FASTNRS	SUB FLOOR JOISTS/ BEARERS	 FLOOR	 SUB-FLR VENTS (CONCRETE)	WALL CLADDING CLADDING (FIBRE CEM)	 WINDOWS (ALUMIMUM)	CHIMNEY	ROOF CLADDING	 SPOUTING	ROOF SPACE RAFTERS/ JOISTS	 OTHER
EXCELLENT	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
MODERATE	300	150	300	400	700	800	1000	1000	1000	200	200	100
POOR	400	300	400	3000	1000	2000	1500	1200	2000	400	600	200
SERIOUS	5000	500	4000	3000	2000	5000	5200	1500	5000	600	3000	500
					(OTHER)	(OTHER)	(OTHER)					
					0	0	0					
					0	0	0					
					300	1200	1000					
					400	2500	1500					
					1000	8000	7100					

CONDITION	BATHROOM WHITEWR	 OTHER	KITCHEN JOINERY/ BENCH	 RANGE	 OTHER	LAUNDRY JOINERY/ TUB	 HWC	 OTHER	INTERIOR LININGS ETC DOORS/ HARDWR	 LININGS
EXCELLENT	0	0	0	0	0	0	0	0	0	0
GOOD	0	0	0	0	0	0	0	0	0	0
MODERATE	300	400	500	50	400	300	50	300	300	800
POOR	900	800	1000	100	800	400	150	500	600	1500
SERIOUS	1500	1500	2000	800	1500	800	800	800	1000	3000

NOTE: The above costs are for 100% replacement of the component for a standard 130 sqm house. These unit costs are factored by the frequency of the defect and the ratio of the floor area:130 sqm standard size, to obtain the actual cost for each individual house. The average costs so derived are shown in Table A7.

TABLE A6 NUMBER OF YEARS TO THE NEXT CONDITION LEVEL

CONDITION	FOUNDATIONS: FDNS (CONCRETE)	FOUNDATIONS: FASTENERS (SUB FLR)	FOUNDATIONS: JOI/BEARER	FOUNDATIONS: FLOOR (PART BD)	WALL CLADDING: TIMBER (PAINTED)	WALL CLADDING: FIBRE CEMENT (PAINTED)	WALL CLADDING: BRICK/ CONCRETE MASONRY	EXTERIOR DOOR	WINDOWS: TIMBER	WINDOWS: ALUMIMUM	CHIMNEY (BRICK/ MASONRY)	ROOF CLADDING: CLADDING GALV, SITE PAINTED.	ROOF CLADDING: COIL COATED/ METAL TILES
EXCELLENT													
GOOD	30	20	40	35	4	5	40	4	4	8	30	6	12
MODERATE	30	20	30	15	4	5	20	4	4	8	15	3	5
POOR	20	15	15	10	4	30	20	4	4	8	15	20	20
SERIOUS	10	15	5	5	6	10	20	6	3	6	10	5	5

CONDITION	CLAY/ CONCRETE TILES	SPOUTING: PVC	SPOUTING: GALV (PAINTED)	ROOF SPACE: RAFT/JOIST	BATHROOM: WHITEWARE	BATHROOM: LININGS	KITCHEN: JOINERY/ BENCH	KITCHEN: LININGS	LAUNDRY: JOINERY/ TUB	LAUNDRY: LININGS	OTHER ROOMS: DOORS/ HARDWARE	OTHER ROOMS: LININGS
EXCELLENT												
GOOD	12	10	7	40	15	8	12	8	12	8	12	12
MODERATE	10	7	3	30	10	5	7	6	7	6	7	9
POOR	20	7	7	30	5	3	4	30	4	30	4	30
SERIOUS	10	7	3	20	3	2	2	10	2	10	2	10

NOTES: The number in any cell is the number of years duration to get to that condition from the previous condition level assuming no maintenance.
e.g. Sub-floor joists and bearers take 30 years from condition Good to condition Moderate.
The cells are additive so that it takes, for example, 42 years on average for clay/ concrete roofs to go from Excellent to Poor condition without maintenance.
The durations shown in the table are for typical houses in an average urban environment. However actual durations for individual houses will vary widely dependent on the particular location and environment.
Durations for fasteners assume dry, ventilated, sheltered conditions. Particle board flooring durations assume dry conditions.

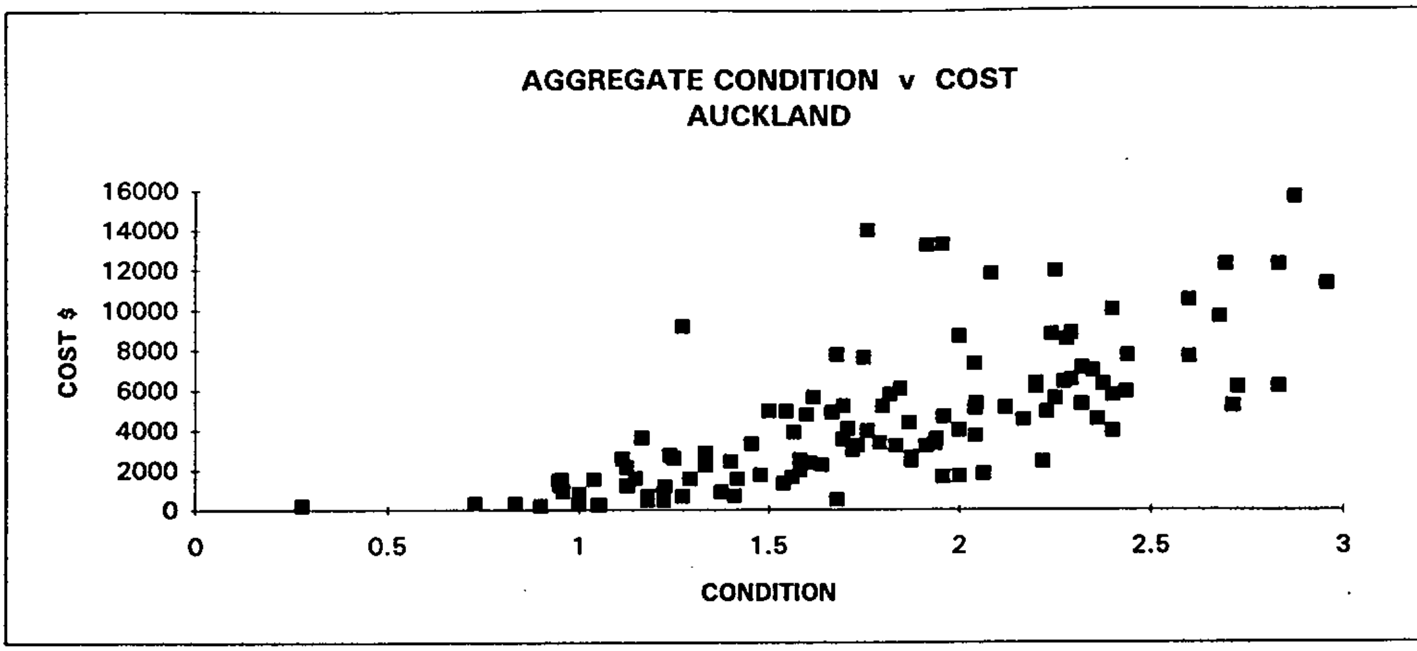
TABLE A7 AVERAGE COSTS OF MAINTENANCE OUTSTANDING

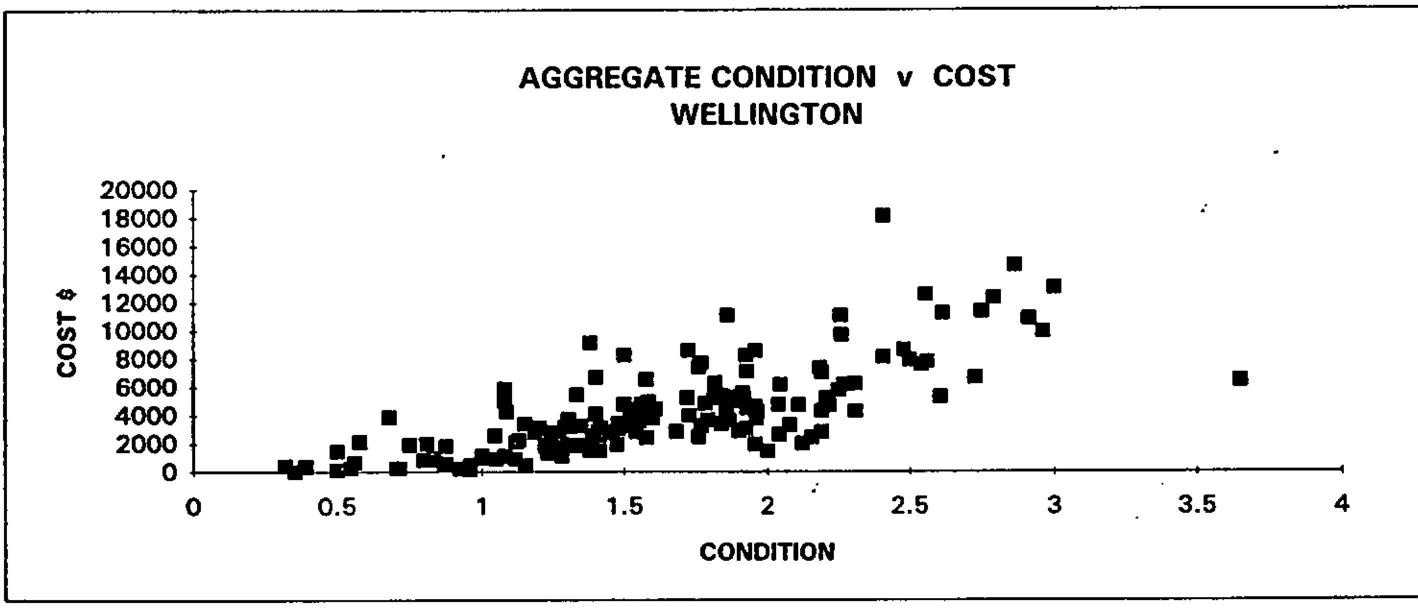
	FOUNDATIONS	SUB FLOOR				WALL CLADDING			ROOF CLAD		ROOF SPACE		BATHROOM		KITCHEN			LAUNDRY			OTHER ROOMS		TOTAL
	FNDS	FASTNRS	JOIST/ BE	FLOOR	VENTS	CLAD	WINDOWS	CHIMNEY	CLAD	SPOUTING	RAFTERS	HEADER/ OTHER	WHITE/ WEAR	LININGS	BENCH/ JOINERY	RANGE	LININGS	TUB/ JOINERY	HWC	LININGS	DOORS/ HARDWR	LININGS	
	AVERAGE $ TO BRING ALL DEFECTS TO AN AS NEW CONDITION.																						
AUCK	237	16	15	44	714	225	234	204	292	38	41	95	390	409	360	57	334	195	154	211	137	589	4992
WELL	133	20	37	48	677	238	251	338	287	32	28	140	365	332	370	15	322	157	77	211	133	506	4716
CHCH	124	21	60	114	634	242	205	363	248	38	32	69	172	220	177	9	113	85	17	118	82	252	3396
NZ	161	19	38	67	673	235	231	305	276	35	32	104	312	320	307	26	260	146	81	182	119	452	4381
	AVERAGE $ OF CONDITION =4 ONLY.																						
AUCK	205	10	11	0	381	54	119	113	117	19	3	0	79	60	68	36	57	76	31	33	6	139	1616
WELL	111	2	18	11	253	100	87	75	103	15	5	11	149	103	70	5	65	19	8	27	14	104	1355
CANT	97	11	41	28	462	106	77	143	70	22	5	0	50	74	45	0	39	23	10	31	0	39	1373
NZ	135	7	23	13	357	88	93	108	97	19	5	4	97	81	62	18	54	37	15	30	7	84	1438
	AVERAGE $ OF CONDITION 4 AND 3 ONLY																						
AUCK	236	11	11	33	651	142	179	113	210	20	36	89	367	351	282	47	255	154	154	133	50	371	3897
WELL	126	14	26	38	549	181	160	75	210	15	18	136	332	225	280	8	262	106	76	138	45	294	3313
CANT	115	14	52	105	573	199	142	144	147	22	26	62	123	161	110	3	79	53	15	67	18	136	2367
NZ	155	13	29	57	565	174	160	108	190	19	28	99	276	242	227	18	202	104	80	114	38	267	3182

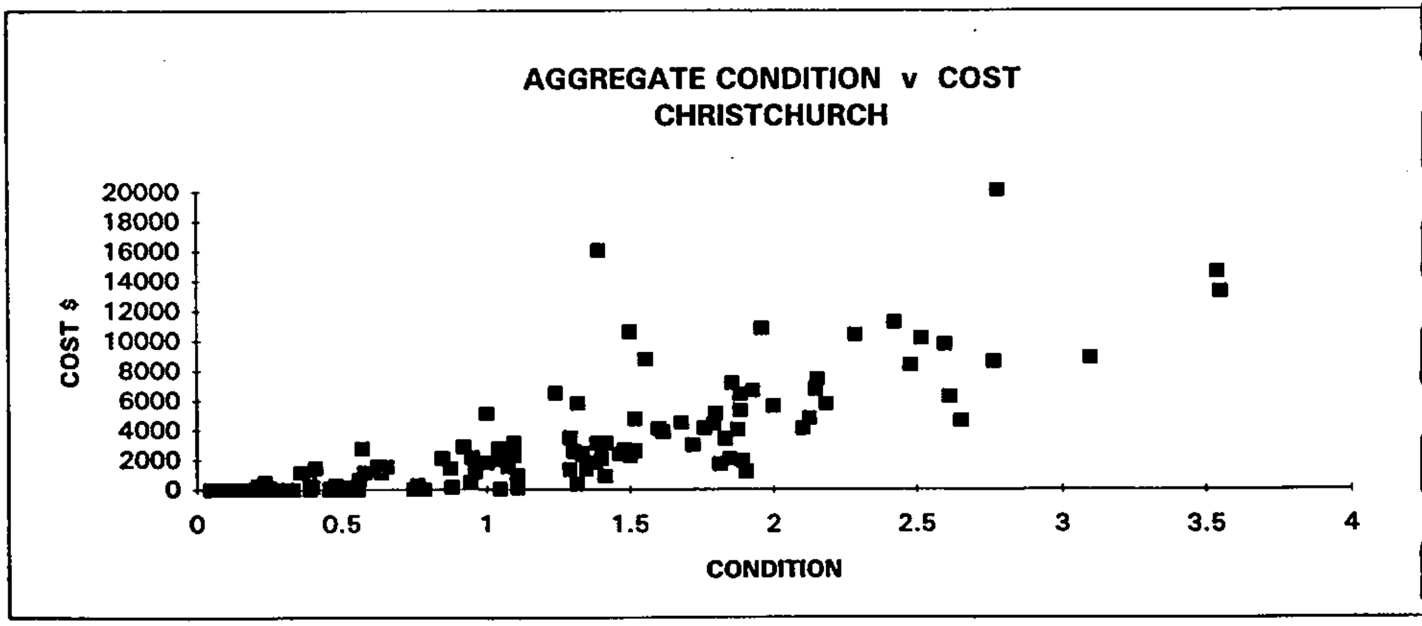
TABLE A8 ADDITIONAL AVERAGE COSTS OF MAINTENANCE DUE TO DELAY

	FOUNDATIONS	SUB FLOOR				WALL CLADDING			ROOF CLAD		ROOF SPACE		BATHROOM		KITCHEN			LAUNDRY			OTHER ROOMS		TOTAL
	FDNS	FASTNRS	JOI/BEAR	FLOOR	VENTS	CLAD	WINDOWS	CHIMNEY	CLAD	SPOUTING	RAFTERS	HEADER/ OTHER	WHITE/ WEAR	LININGS	BENCH/ JOINERY	RANGE	LININGS	TUB/ JOINERY	HWC	LININGS	DOORS/ HARDWR	LININGS	
	ADDITIONAL COSTS WITH A 5 YEAR DELAY IN MAINTENANCE																						
AUCK	246	0	6	0	0	332	283	0	184	32	0	0	275	536	231	0	0	130	0	0	116	0	2371
WELL	133	0	68	0	0	287	343	0	217	26	0	0	258	525	227	0	0	114	0	0	109	0	2307
CANT	116	0	89	0	0	245	275	0	171	37	0	0	173	327	76	0	0	53	0	0	77	0	1639
NZ	161	0	56	0	0	287	304	0	192	31	0	0	236	466	180	0	0	99	0	0	101	0	2115
	ADDITIONAL COSTS WITH A 10 YEAR DELAY IN MAINTENANCE																						
AUCK	845	0	6	67	0	883	723	0	346	100	0	0	696	536	1025	0	121	682	0	174	532	0	6837
WELL	441	0	68	66	0	724	888	0	409	93	0	0	619	525	1052	0	148	604	0	164	507	0	6310
CANT	430	0	89	57	0	593	718	0	371	108	0	0	444	327	669	0	102	343	0	96	372	0	4720
NZ	558	0	56	64	0	730	785	0	378	100	0	0	587	466	923	0	125	515	0	146	472	0	5906

FIGURE A2


AGGREGATE CONDITION v COST
AUCKLAND
16000
14000
12000
10000
8000
6000
4000
2000
0
COST $
0
0.5
1
1.5
2
2.5
3
CONDITION


AGGREGATE CONDITION v COST
WELLINGTON
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
COST $
0
0.5
1
1.5
2
2.5
3
3.5
4
CONDITION


AGGREGATE CONDITION v COST
CHRISTCHURCH
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
COST $
0
0.5
1
1.5
2
2.5
3
3.5
4
CONDITION

APPENDIX 8 The Relationship between Sub-floor Vents and Component Defects

A slight positive correlation between sub-floor vent areas and defects in the sub-floor components was found. The correlation is shown in Table A9 below.

TABLE A9 CORRELATION COEFFICIENTS FOR SUB-FLOOR VENTS AREA, MOISTURE CONTENT AND FASTENERS

CORRELATION COEFFICIENT BETWEEN	AUCKLAND	WELLINGTON	CANTERBURY
VENT AREA /MOISTURE CONTENT	0.07	0.21	0.19
VENT AREA /FASTENER CONDITION	-0.03	0.21	0.58
VENT AREA /FLOOR CONDITION	0.21	0.20	0.58
FASTENER CONDITION /MOISTURE CONTENT	0.02	0.36	0.02

NOTE: Moisture content is the average % content in the floors and joists.

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