STUDY REPORT

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Lifetime Housing – the Value Case

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Preface

This report compares the costs of fitting Lifetime Design (LTD) or user-friendly (UF) features into typical new and existing housing. A sample of 83 new homes and 112 existing houses were tested and costed for the fitting of UF features. There are two main specifications for provision of UF features, namely the LTD specification for new homes and the New Zealand Standard 4121:2001 Design for Access and Mobility – Buildings and Associated Facilities. They provide sets of dimensions and facilities, and are generally quite similar, with the former specification being used for costing typical new and retrofit housing.

Acknowledgments

This work was funded from the Building Research Levy.

Note

This report is intended for owners, designers and builders of housing.

Title of Study Report

BRANZ Study Report SR 263 [2011]

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Abstract

Much of our housing stock is less than user-friendly in terms of access, mobility and general safety. Provision of features addressing these aspects is of benefit to all age groups that may occupy a house over its lifetime. Provision of such features is generically called UF design and the particular specifications that have been developed include LTD NZS4121 and Universal Design. These features are not mandatory in housing. This report examines typical New Zealand houses and estimates the cost of installing UF features in both new and existing housing, using the LTD specification.

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1. INTRODUCTION

Ageing in place is the preferred public policy response to the ageing population in New Zealand (Schofield et al, 2006; Davey et al, 2004; Minister for Senior Citizens, 2001). Schofield et al continue on to say that “the values most strongly associated with ageing in place are choice, autonomy and independence”. The Ministry of Social Development (2002) says “for many older people the key to maintaining independence is remaining in their own home”.

There is a wealth of information available on the types of features required in housing to facilitate use by older persons. These features are of benefit to all age groups, such as mothers with young children, disabled and large-bodied people. This report examines the costs associated with providing these features, both in new housing, and for retrofitting existing housing.

2. SUMMARY

The main results of the research are:

- It is very much cheaper to build UF features into an individual new house than retrofit the same house later.
- For internal changes only, about 80% of new houses require either nil or minor changes to layout, doors and strengthening of bathroom fittings prior to construction. These changes add about $500 to the total new house cost. The other 20% of new houses require significant changes whilst still keeping the same layout, averaging about $8000 per house.
- In addition, many new houses require changes to the access consisting of wider parking areas and better approaches to the front door. These changes typically add another $1200 to the house cost.
- For the majority of single-storey houses the total extra costs are no more than $1700 or about 0.5% of the total cost for a single-storey house.
- It is cost effective to install UF features in all new housing rather than to retrofit these houses in the future to meet the expected growth in persons needing UF features (i.e. the elderly and disabled). This applies only if the growth in the number of disabled persons is accommodated in these new houses rather than in retrofit. Even so, most new houses are not occupied by the disabled but by “normal” households whom reap the benefits of living in these houses.
- When changes are made to existing houses the costs are significantly larger. Typically over $15,000 per house for internal work and another $7000 if ramps and other external access features are required.
- There are no local studies on the reduction of injury in houses with UF features, but initial estimates suggest there may be net benefits from the trade-off between the extra cost of UF in all new houses and the reduced cost of trip/fall injuries in homes. Further work on this is needed.

3. LITERATURE REVIEW

Saville-Smith et al (2009) state that “the existing housing stock will dominate the housing stock in 2050 and requires investment in repairs, maintenance, modification and thermal performance if it is to provide for the needs of older people”. In addition, “a sustainable transformation of the existing older housing stock requires awareness, know-how and, on the part of housing investors/suppliers, supportive Government policies and possibly incentive programmes” (Hugentobler, 2009). However, options are particularly limited for older home owners, especially renters. Renters have very limited influence over what their home looks like (Hugentobler, 2009) and “anecdotal reports suggest that rental accommodation is of a lower standard than privately-owned homes” (Davey et al, 2004)

Davey et al (2004) suggest that “the residential care population is ageing and people are at high levels of disability when they enter rest homes. This means that more very old people, even with disabilities, remain living in the community”. Therefore, better-designed homes that are not in need of many repairs or maintenance are important in relation to accidents and health. Despite this, “building industries tend to be conservative with new stock, largely replicating the design limitations of the past unless there are purposeful incentives to change” (Saville-Smith et al, 2009).

Much of the available literature suggests there will only be modest increases in the costs to build in features such as the Lifemark specification or NZS4121 to a new home. Saville-Smith et al (2007) state that “most estimates of the increase in cost to build in adaptable features are between 1-5% of total construction costs” and in 2009 suggest that “costs can be avoided if incorporated into design early enough”. Hanson (2001) noted, in the European context, “it can be very cost effective to design for, say 90-95% of a building’s potential users, but extremely costly to cater for the remaining 5-10% whose needs may be unique and so cannot be specified in advance”.

The Ministry of Social Development (Rashbrooke, 2009) considers the comparison between incorporating UF in all new housing and the need to retrofit a projected number of houses in the future. It finds that installing UF now in all new houses is cheaper than selected future retrofits. It does not consider whether any installation of UF (either in new housing or retrofit) is cost effective in terms of accident health cost savings. The analysis uses $2000 extra per new house with UF features, compared to a retrofit of $35,000 per house.

A UK study (Sangster 1997) found the incorporation of UF features into new housing adds 0.5% when UF is the basis of the initial design from the outset, up to about 1.5% extra when standard new house designs are adapted for UF features.

A significant amount of work has been done in Australia on the advantages of caring for older people in private housing. A summary of this work is included in an Australian Housing and Urban Research Institute (AHURI) paper (Bridges et al, 2008). One goal of the paper was to investigate the economics of home-based care compared to institutional care. The limited data available showed that home-based care costs were significantly lower than institutional care.

The Victorian Government (Department of Planning and Community Development 2010) produced a regulatory impact statement (RIS) on the compulsory inclusion of some UF features into new builds. The four measures were clear path and level entry from the car park, wider doorways and passageways, ground level disabled person toilet, and reinforced bathroom walls for subsequent fitting of grab rails. The extra cost on a typical new house was 0.3% or $A870. In comparison, retrofitting the same features was estimated at approximately 6% of the new build cost, or $A19,400. The same RIS attempted to quantify the benefits in terms of reduced falls/injuries, savings on care due to people remaining in their homes and reduced future adaptation costs to houses. It found these benefits were significantly less than the costs of requiring all new houses to have UF features. These were an expected annual saving of A$5.4 million and an expected annual cost of $A31 million. However, there are a number of unquantified benefits including reduced expenditure on crisis accommodation, shorter hospital stays, assisting carers and greater participation in community life. Taking these into consideration the Department "believes that the benefits of the preferred option would outweigh the costs". In effect, the Department is saying that these unquantified benefits are worth the net cost of about $A26 million per year.

As illustrated by the abovementioned, retrofitting UF features into existing housing is much more expensive than fitting into new housing. Cunningham (2008) quotes LTD's Saffron Gardner as saying "Incorporating LTD principles at the design and construction phase adds only minimal cost, and has been estimated to be 30 times less expensive than trying to modify a dwelling later on". Saville-Smith (2007) found in a survey of 73 respondents the average cost to adapt existing homes receiving Government assistance (including Accident Compensation Commission funding) was $30,158, though the median was a lot lower at $8500. Apart from this, no other data was found for the costs of retrofitting adaptable features to New Zealand houses.

4. WHAT IS A UF HOUSE

Sometimes the term "age-friendly" is used which is a misnomer because features that are useful for older people are usually of benefit for all age groups, hence the term "UF". For example, mothers with young families find easy front entrances as useful as older persons. Large-bodied persons of any age find adequate passage way widths as helpful as people in wheelchairs. But all age groups occupying such houses derive health cost saving benefits. Hence, UF housing designs use titles such as LTD (www.lifetimedesign.org.nz) or Universal Design (The Centre for Universal Design 2006). Because we do not wish to favour any particular specification we shall refer to these houses as UF.

It is important to note that provided the design is completed properly, UF houses do not look institutional and are indistinguishable from ordinary houses.

Two standards were examined to determine which features need to be analysed to establish whether a house is UF or not. In New Zealand, the New Zealand Standard 4121:2001 Design for Access and Mobility – Buildings and Associated Facilities is an acceptable solution for the NZBC Clause D1 Access. It is used mainly for non-residential building as its provisions are not mandatory for housing. The other standard is the Lifemark specification from the New Zealand organisation LTD and has many features in common with NZS4121. The Lifemark is an independent seal of approval for houses from a non-profit organisation.

4.1 NZS 4121:2001 versus Lifemark

Both standards set out minimum dimensions which are often very similar. Lifemark originally divided its design features under six headings and we will use these headings and design features to investigate the similarities and differences between the standards. Note that the Lifemark specification is under review at the time of writing and the following refers to the specification as at September 2011.

Not all details of both these standards will be listed and compared. For further information on either and to see the omitted provisions, please refer to the documentation.

Table 1 Lifemark and NZS4121:2001 Comparison

Lifemark and NZS 4121:2001 Comparison User-Friendly Buildings		
	Lifemark (at September 2011)	**NZS 4121:2001**
	ENTRANCE	
Car Park Width	3.5m	3.5m
Slip resisant path	Yes	Yes
Gentle Sloping	Yes	Not exceeding 1:50
Path Width	1200mm	1200mm
Landings	1200mm x 1200mm	1200mm
Lighting	sensor light at main entry	illuminated entry way
Threshold to main entry	20mm max	20mm max
Hallway width	1050mm	1200mm
Door clear opening	810mm	760mm
	KITCHEN	
Turning Circle	1500mm	Provided for by a 2700mm x 2100mm kitchen
Distance between benches	1200mm	
	LIVING ROOM	
Door Handles	Lever handles	Lever action
Socket Outlets	300mm above floor level	500mm-1200mm
Lever control windows	Yes	Yes
Window distance from floor	1200mm max	900mm-1200mm
Floor finish	slip resistant/accommodates wheeled traffic	slip-resistant/easy to maintain
Smoke alarm	audio and visual warnings	audible and visual
	BEDROOM	
Clear space around bed	800mm	Provided for by a 4.2m x 3m or 3.6m x 3.6m bedroom
Location	Primary living level	
Light Switch height	consistent 900-1200mm from floor	900-1200mm
Door Handles	consistent 900-1200mm from floor	900-1200mm
	BATHROOM & TOILET	
Location	Primary living level	Main entry level
Turning Circle	1500mm	1500mm
Entry level shower	1200mm x 1200mm	wet area showers
Wall pre-strengthening	Yes	Sustains force of 1100 N
	Multi-Storey Homes	
Handrails	Weight bearing on both sides	supports a weight of 110kg and on both sides
Width between handrails	900mm	900mm
Unobstructed platform/landing	1200mm x 1200mm	1200mm
Lift	Space for a 1200mm x 1200mm stair lift	
Note: All dimensions are minimum dimensions unless stated otherwise		

From Table 1 we can see the main principles of a UF house are accessibility, usability and inclusiveness. Accessibility is particularly important at the entrance. Upon exiting a vehicle, people should have an easy and unobstructed walk to a main entrance. The main entrance, both inside and outside the house, should have enough room for manoeuvrability. Once inside the house, internal hallways need to have enough room to ensure the entire house is accessible.

Usability is important for any house. Particularly the kitchen, at least one bedroom and the bathroom/toilet must be usable for everyone. The dimensions of these rooms must be sufficient to enable the easy use of appliances, power sockets and switches, as well as bed, shower and toilet. Ensuring that a house is liveable by having a large enough bedroom on the primary living level and easy access to the bathroom and toilet from this bedroom, greatly reduces the need to move out of the house. By having weight-bearing handrails on both sides and enough space for a platform lift to be installed, the stairs will become less of an obstacle.

4.2 UF Features

The features examined to determine whether or not a house meets UF standards and how much it will cost to meet these standards were:

- All internal passageways must be at least 1050mm-wide.
- The main bedroom, or the largest bedroom on the primary living level, must be at least 4400mm x 3150mm or 3800mm x 3750mm. This will be large enough to fit a queen-sized bed with 800mm clear space all around. If more clear space is required, a smaller bed can be used.
- The kitchen must be at least 2700mm x 2100mm to provide the turning circle and distance between benches required.
- The space for the bathroom and toilet must be 2950mm x 2100mm. If the bathroom and toilet are separate but next to each other, the combined size is used. If they are not next to each other, the bathroom is used. Where the main bathroom and toilet are not on the main living level, the ensuite is used.
- All internal and external doors require a 810mm clear opening. Where this information is not available, the clear opening is assumed to be 760mm.
- The strengthening of walls is achieved by the addition of dwangs to two walls in the bathroom and toilet.
- All power sockets and light switches need to be at the right height above floor level.

Next, the cost of the abovementioned UF features was examined for single-storey houses. Initially, just one house was analysed to set out the costing method. However, because houses differ greatly in layout, later sections of the report look at a variety of new and existing houses to compare the range of costs for incorporating the UF features into new builds and retrofitting existing houses.

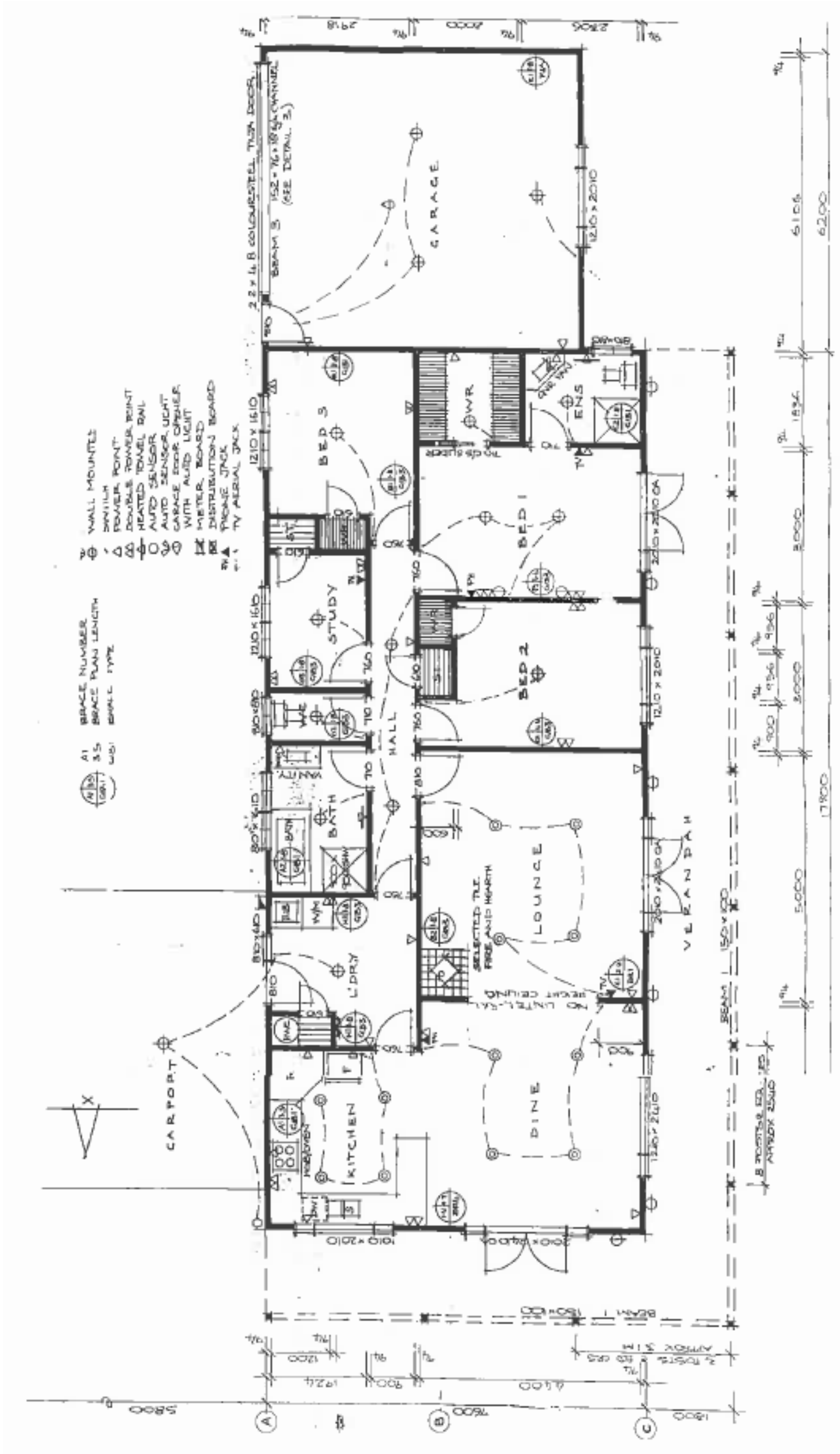
5. COST OF UF-DESIGNED HOUSES

Generally it is cheaper to build UF features into new homes rather than retrofit at a later date and usually the additional initial costs are quite low. To identify some of the issues involved in providing UF features we examine the floor plan of a randomly-chosen house built in the last 15 years and ask two questions:

- If we are building this house from new, what UF features do we incorporate and what is the extra construction cost?
- If we are retrofitting this existing house, what UF features do we incorporate and what is the cost of these features?

The aim is to identify factors that impinge on the cost of providing UF features. The floor plan for the sample house, as unmodified for UF features, is shown in Figure 1.

Figure 1 Typical Simple New House Floor Plan



5.1 Typical New House with UF Features

The typical house, Figure 1, falls short of the UF specification in a number of areas including that the entrance to the house is unsheltered, it has a narrow passageway, slightly narrow doors (760mm instead of 810mm), and a wheelchair-unfriendly bathroom and toilet arrangement. Also, an assumption is made for purposes of illustration that the house has a fairly basic and steep approach, which is likely in places such as Wellington but is less likely in other areas. The costs for upgrading these shortfalls are in Table 2.

Table 2 New House UF Features Cost

Typical additional UF costs - single storey house concrete floor		
	Floor area 176sqm incl garage ($246,000)	
	Items	$
Outside	Carpark area	297
	Path slope/ width	261
	Roof over entrance	563
	Sensor lamp	25
		1146
Inside	Hallway (widen house by 150mm)	3759
	Internal doors 860mm (7 of)	350
	Bathroom/toilet combined remove partition wall	-1140
	Extra size shower, seat, grab rail, strengthen walls	1000
		3969
	Total additional cost (option 1 - All Outside and inside measures)	5115
Total additional cost (option 2 - All measures except no floor area addition)		1356

The car parking and footpath items allow for slightly-wider-than-normal spaces (parking area needs to be increased from 2.5m to 3.5m-wide and footpath from 0.9m to 1.2m-wide). The path gradient (assumed to be 20 degrees) is reduced slightly to the recommended maximum of 15 degrees. A small roof is provided over the entrance and extra is spent on a sensor entrance light (above the cost of a standard outdoor light). The outside details are fairly cheap to remedy. Inside the house, the main problem is the width of the hallway which is only 900mm instead of the recommended 1050mm.

There are two ways to consider the hallway issue. First, the whole house is widened by 150mm along the line of the hallway to provide the required hall width. This is an extra 2.69sqm of floor area at $1400 per sqm, or $ giving a total of $5115 (option 1). The second alternative is to shift the passageway wall into the bedroom and lounge, reducing their space slightly. This has nil additional cost (assuming the change is done before construction starts), but the amenity provided is slightly less than the first option because the lounge and bedroom floor space has been lost. The owners may be quite happy with the small reduction in floor space in which case we omit $3759 from the table and the actual cost of UF design reduces to $1356 (option 2) or a 0.6% cost increase on the house price. Further, many sites are flat so there is no requirement to reduce access slopes, saving another $261.

The table shows a reduction in cost by combining the toilet with the bathroom and removing a wall. This provides sufficient turning circle and the savings on the partition wall are calculated to more than offset the extra cost of a level entry shower and wall strengthening for the grab rails at the shower and toilet. It could be argued that amenity is reduced by having the toilet and bathroom combined. If their separation was to be maintained, then extra expense would be required to lengthen the bathroom to achieve the required turning circle.

5.2 Typical Retrofitting with UF Features

We have previously assumed the house in Figure 1 is new and is on a concrete slab. Now assume it is on timber piles and further, that it is not new but needs to be retrofitted.

The cost details for the retrofit are in Table 3. Because the house is elevated on timber piles an entry ramp is required to the front door. This is quite expensive because NZS4121 specifies a maximum slope of 1 to 12, giving ramp lengths of about 8m for typical timber floor houses. Details of the ramp cost are in the Appendix. Other requirements include replacing internal doors, which is expensive, and there is some work needed to shift switches and power outlets to the recommended mid-wall height. The hallway is too narrow and needs shifting. The total cost of about $19,800 is significant and if funds were limited, some owners may get by without widening the passageway, saving about $5400.

Table 3 Retrofitted House with UF Features Cost

Typical retrofit UF costs - single storey house timber floor		
	Floor area 176sqm incl garage	
Items		$
Outside	Carpark area	297
	Ramp to front door	5592
	Roof over entrance	563
	Sensor lamp	258
		6710
Inside	Lever handle taps (2 off)	295
	Internal doors replaced with 810mm (7 doors)	2613
	Lever handles on some doors (5 doors)	445
	Power sockets/ switches moved. (16 sockets & 16 switches)	1440
	Bathroom/toilet (move partitn wall, fill in doorway, new entry shower, seat, strengthen walls, grab bars).	2920
	Hallway (shift walls to 1050 width 9m @ $600/m =	5400
		13113
	Total additional cost (option 1 - All Outside and inside measures)	19823
	Total additional cost (option 2 - All measures except no shift of hall walls)	14423

In summary to the questions at the start of this chapter we find:

- It is very much cheaper to incorporate UF features in a new house than to retrofit a similar house.
- In new houses the additional cost is quite small assuming there is some flexibility to change the internal layout while keeping the overall footprint the same.

- Timber floor houses are usually suspended above ground level and start with a disadvantage because of ramp entry costs. If the house is on a concrete slab the retrofit cost is reduced, but is still significant.
- If hallway width is minimal the cost penalty is high for retrofit.

The above mentioned findings are for a particular house and serve to illustrate some issues involved in assessing the costs of providing for UF features. The remainder of the report examines a range of typical houses, which is more realistic than just considering one design. The analyses done were:

- A range of typical new house plans were costed for the modifications required to incorporate UF features. The costs were calculated separately for modifications at the design stage and for retrofit after construction.
- A range of typical existing house plans were costed for the modifications required to incorporate UF features. This differs from retrofitting new houses because the layouts of older houses are quite different compared to new housing.
- Projections of the number and cost of UF houses required in the future and the various scenarios to meet these needs.

6. HOUSE SURVEY RESULTS

6.1 New House Survey

A total of 83 new house plans from 9 different major house construction firms were investigated for their current dimensions. We looked particularly at the dimensions of the entry hallway, internal hallway, main bedroom, kitchen, main bathroom and toilet to ascertain whether they had enough space to meet UF standards. The external aspects, i.e. parking and approach to the front door, were not examined.

The distribution of these houses by floor area is shown in Table 4 below. The table also provides 2010 consent data on new house distribution by floor area. Our sample has given a greater emphasis to smaller houses as we believe that larger houses will have fewer problems meeting the requirements than smaller houses.

Table 4 Distribution of New Houses by House Area (sqm)

Distribution by House Area New Houses			
	Sample Number	%	All new houses 2010 % (1)
Less than 150	23	27.7	23.4
150-199	24	28.9	23.8
200-224	22	26.5	14.0
225+	14	16.9	38.7
Total	83	100	100

(1) from building consents, Statistics New Zealand
Deviation from 100% is due to rounding

Firstly, we will separate these houses based on their layout. Secondly, we will look at these houses and the costs of the changes that need to be made before the houses are built to meet UF standards. Finally, we will look at the same houses and calculate the costs of retrofitting UF features after the house has been built.

6.1.1 Layout Changes

Not all new house plans meet the UF standards. Only 12% of those surveyed did so. Using the dimensions of our sample houses, we were able to determine whether or not there was enough space within the current plan to meet the standards. In the tables that follow, three categories of change have been used:

- Major change – requires a significant plan alteration, including shifting room locations to meet the standards. Therefore, all houses in this category are assumed to require additional area to reasonably maintain the current plan.
- Minor changes – requires small modifications to the layout involving shifting of some walls and reducing space in some rooms to create space in others.
- No change – no alterations to the walls or total floor area are necessary to meet the required standards.

Table 5 summarises the changes required for the sample of 83 houses. It shows all of the houses that were less than 150sqm required changes. For the other house sizes, 14-21% needed no changes with the largest proportion needing minor changes only.

Table 5 Layout Changes in New Houses

Layout Changes in New Houses Percentage of houses					
	<150	150-199	200-224	225+	All Houses
Major Change	34.8	4.2	13.6	14.3	16.9
Minor Change	65.2	75.0	72.7	71.4	71.1
No Change	0.0	20.8	13.6	14.3	12.0
Total	100	100	100	100	100

6.1.2 Major Change Before Building Starts

Most houses have enough space to fit the standards with nil or minor layout changes. However, in the case of the major-change-required category, this would involve a significant alteration to the plan. For this category, we assumed that the general layout of the house is maintained. Therefore, the only way to meet the requirements set out by the standards is to increase the area of the house. Housing construction firms will have their own structure for charging for changes in plans. For consistency, we assumed that changes in area are charged at $1400 per sqm.

The preferred approach would be for owners to select a design that requires minor or nil changes, but to allow unfettered choice of layouts, this section calculates the cost to provide UF features for these "unfriendly" designs.

Table 6 shows which rooms in the houses in our major change category are not meeting UF standards. The houses in the 150-199sqm range all require widening of the entrance and internal hallway, as well as a larger bedroom for both a double or queen-size bed. For the houses in the 225+sqm range, the largest bedroom was upstairs, therefore a smaller bedroom on entry level had to be used. The area of the bedroom could not be made large enough within the current dimensions without either reducing the width of the internal hallway or reducing the size of rooms on the opposite side of the internal hallway; both options would still not meet the standards. The extra area required for hallways, bedrooms, main bedroom, bathroom and kitchen are shown in the first line of Table 7.

Table 6 Major Change Dimensional Problem by Proportion

Major Change Dimensional Problem by Proportion Changes Required				
	<150	**150-199**	**200-224**	**225+**
Entrance Hallway	13%	100%	0%	0%
Internal Hallway	88%	100%	67%	0%
Bedroom (Double Bed)	75%	100%	0%	100%
Bedroom (Queen Bed)	100%	100%	0%	100%
Kitchen	25%	0%	0%	0%
Bathroom (With Bath)	88%	0%	67%	0%
Bathroom (Without Bath)	0%	0%	0%	0%

Other additions are required to meet UF standards. Often, the widening of doors and strengthening of walls in the toilet and bathroom is needed. Both the larger internal and external doors are assumed to cost approximately $50 more than standards doors. However, money will be saved on linings and claddings as there will be less wall area. The number of internal doors includes walk-in wardrobes and ensuites, but does not include cupboards or standard wardrobes.

Table 7 Major Change Costs Before Building Starts

Major Change Costs Before Building Starts				
	<150	**150-199**	**200-224**	**225+**
Extra area needed (sqm)	6.93	5.41	1.20	5.50
Cost @ $1400/sqm	**$9,706**	**$7,576**	**$1,676**	**$7,700**
Average number of External doors	1.5	2.0	2.0	2.0
Saving in Linings and Cladding/door (1)	-$42	-$42	-$42	-$42
Extra Cost of larger door	$50	$50	$50	$50
Average cost per door	**$8**	**$8**	**$8**	**$8**
Average number of Internal doors	7.8	12.0	12.7	11.5
Saving in Linings/door (2)	-$10	-$10	-$10	-$10
Cost of larger door	$50	$50	$50	$50
Average cost per door	**$40**	**$40**	**$40**	**$40**
Average Cost of Strengthening Walls in Toilet and Bathroom	**$69**	**$73**	**$75**	**$81**
TOTAL Average Additional Cost	**$10,095**	**$8,142**	**$2,270**	**$8,254**
Average House Cost @ $1400/sqm	**$364,751**	**$455,471**	**$488,187**	**$536,784**
% of House Cost	**2.8%**	**1.8%**	**0.5%**	**1.5%**

(1) Assumes 10mm thick standard plasterboard linings and Brick Veneer Cladding. Add $14-60 per door for Weatherboards.
(2) 10mm thick standard plasterboard.

The largest additional cost of meeting UF standards in Table 7 is the extra area required. The additional cost only makes up a small percentage of the overall house cost at between 0.5-2.8%.

6.1.3 Minor Change Before Building Starts

The minor change category recognises that it will often be possible to make small modifications to the existing plan to meet UF standards. This involves moving walls within the existing floor area. In most cases, overall wall area is slightly reduced, but this theoretical saving has been ignored.

The biggest problem for the new house plans we surveyed was that the internal hallway was too narrow. Increasing the width of the hallway results in a net decrease in the wall area and therefore a reduction in the cost of implementing UF features. However, overall the cost of increasing/decreasing wall area is heavily dependent on the individual house.

Table 8 Minor Change Dimensional Problem by Proportion

Minor Change Dimensional Problem by Proportion Changes Required				
	<150	150-199	200-224	225+
Entrance Hallway	7%	0%	0%	0%
Internal Hallway	80%	83%	56%	80%
Bedroom (Double Bed)	60%	33%	44%	20%
Bedroom (Queen Bed)	80%	72%	69%	40%
Kitchen	0%	6%	0%	0%
Bathroom (With Bath)	47%	22%	25%	0%
Bathroom (Without Bath)	0%	0%	0%	0%

Very few entrance hallways or kitchens require changes in this category, with bedrooms for a queen-size bed having the second-greatest proportion behind internal hallways.

Table 9 Minor Change Costs Before Building Starts

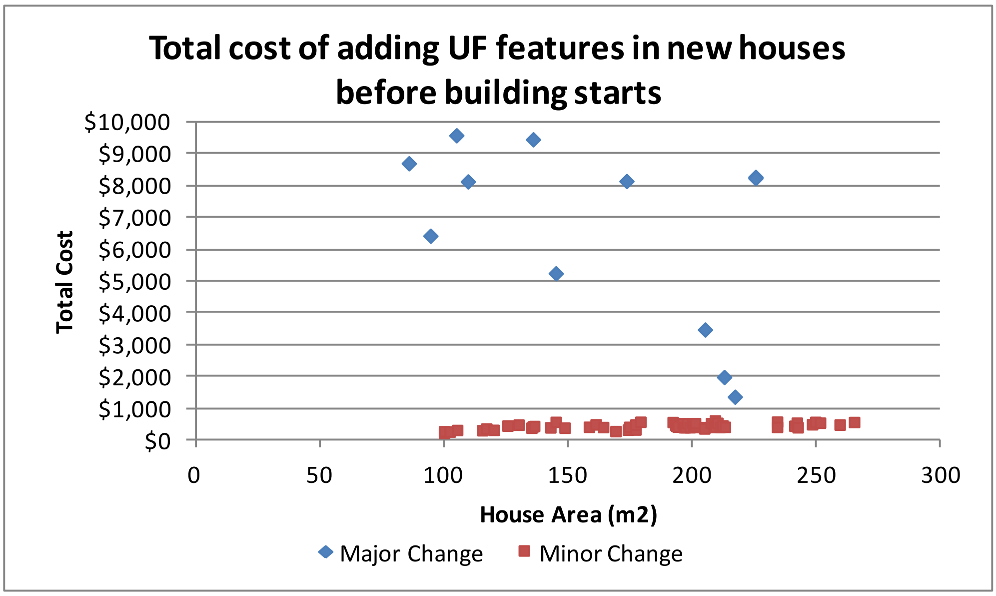
Minor Change Costs Before Building Starts				
	<150	**150-199**	**200-224**	**225+**
Average number of External doors	1.5	2.0	2.1	2.1
Saving in Linings and Cladding/door (2)	-$42	-$42	-$42	-$42
Extra Cost of larger door	$50	$50	$50	$50
Average cost per door	**$8**	**$8**	**$8**	**$8**
Average number of Internal doors	7.3	8.8	9.2	10.3
Saving in Linings/door (3)	-$10	-$10	-$10	-$10
Cost of larger door	$50	$50	$50	$50
Average cost per door	**$40**	**$40**	**$40**	**$40**
Average Cost of Strengthening Walls in Toilet and Bathroom	**$70**	**$77**	**$78**	**$80**
TOTAL Average Additional Cost (4)	**$374**	**$442**	**$461**	**$506**
Average House Cost @ $1400/sqm	**$364,751**	**$455,471**	**$488,187**	**$536,784**
% of House Cost	**0.1%**	**0.1%**	**0.1%**	**0.1%**

(1) In most cases the internal wall area is reduced. However, these theoretical cost savings have not been included.
(2) Assumes 10mm thick standard plasterboard linings and Brick Veneer Cladding. Add $14-$60 for Weatherboards.
(3) 10mm thick standard plasterboard.
(4) The total additional cost assumes no extra area is added and no walls have been changed.

The major contributor to the total average cost is the larger internal doors. The additional cost of incorporating UF standards for this category is approximately 0.1% of the average house cost, but can vary based on the amount of wall area needing to be added or removed.

Figure 2 is the scatter plot of all new houses examined, showing the cost to install UF features before construction starts. The majority of changes are low cost and minor, but as discussed above, some houses require significant floor area additions and hence the cost increase is significant.

Figure 2 Cost of Installing Internal Modifications into New Houses Before Building Starts



6.2 Retrofit Changes

In this section we consider the same house plans as the previous section arranged in the same major change, minor change and no change categories. However, this section considers the cost of retrofitting the UF features into the houses rather than before the house is built. From Table 5 we know that 71% of the homes surveyed could be adapted within the current available area to meet the standards, 12% did not require any changes and 17% could not be changed within the current dimensions.

6.2.1 Major Change Retrofit

The costs of adapting the same house once it has been built increases significantly right across the floor area ranges. The cost of adding area to an already-built house is more expensive than for a new house as there are additional costs related to partial demolition, noise and dust control, protection of existing structures, access problems, and electrical and plumbing. The cost of replacing doors also increases substantially. No longer is it a matter of the additional cost of a larger door, which is partially offset by the savings in linings and claddings, but a whole new door needs to be purchased at considerable expense (approximately $1030 for an external door and $210 for an internal door), the existing structure needs to be partially demolished to make room for a larger door, plasterboard will need to be replaced, door handles attached to the door, and finally painting.

There is also a large increase in the cost of strengthening the walls in the toilet and bathroom. The existing lining has to be removed and the dwangs added before fitting the new lining and finishing. This is considerably more expensive than adding a dwang in the process of building the house.

Overall, the average additional cost of these features is 3.7-7.6% of the average house cost.

Table 10 **Major Change Costs Retrofit**

Major Change Costs Retrofit Changes				
	<150	**150-199**	**200-224**	**225+**
Extra area needed (sqm)	6.93	5.41	1.20	5.50
Cost @ $2600/sqm	**$18,025**	**$14,070**	**$3,112**	**$14,301**
Average number of External doors	1.5	2.0	2.0	2.0
Cost of extra door space (1)	$385	$385	$385	$385
Cost of larger door	$1,030	$1,030	$1,030	$1,030
Average cost per door	**$1,415**	**$1,415**	**$1,415**	**$1,415**
Average number of Internal doors	7.8	12.0	12.7	11.5
Cost of extra door space (2)	$522	$522	$522	$522
Cost of larger door	$210	$210	$210	$210
Average cost per door	**$732**	**$732**	**$732**	**$732**
Average Cost of Strengthening Walls in Toilet and Bathroom (3)	**$868**	**$916**	**$948**	**$1,020**
Power sockets/ light switches moved	**$1,064**	**$1,440**	**$1,735**	**$2,045**
TOTAL Average Additional Cost	**$27,752**	**$28,040**	**$17,897**	**$28,614**
Average House Cost @ $1400/sqm (4)	**$364,751**	**$455,471**	**$488,187**	**$536,784**
% of House Cost	**7.6%**	**6.2%**	**3.7%**	**5.3%**

(1) Assumes replacement door frame, studs for one side and top of door and 10% of weatherboards on one side needing replacement.
(2) Includes partial demolition of existing wall, new wall stud, 10mm thick standard plasterboard, new door frame and door handle and painting.
(3) Includes removal and disposal of lining, addition of dwangs, new lining and finishing.
(4) Average house cost includes average section prices for 2010

6.2.2 Minor Change Retrofit

As with the major change category, the average additional cost in this category has increased significantly, for much the same reasons. The big exception is that the walls must now be moved at $600 per metre of wall to create more space in some rooms or the hallways. For post-build changes, the moving of walls is expensive and has been included in the total additional cost.

Table 11 Minor Change Costs Retrofit

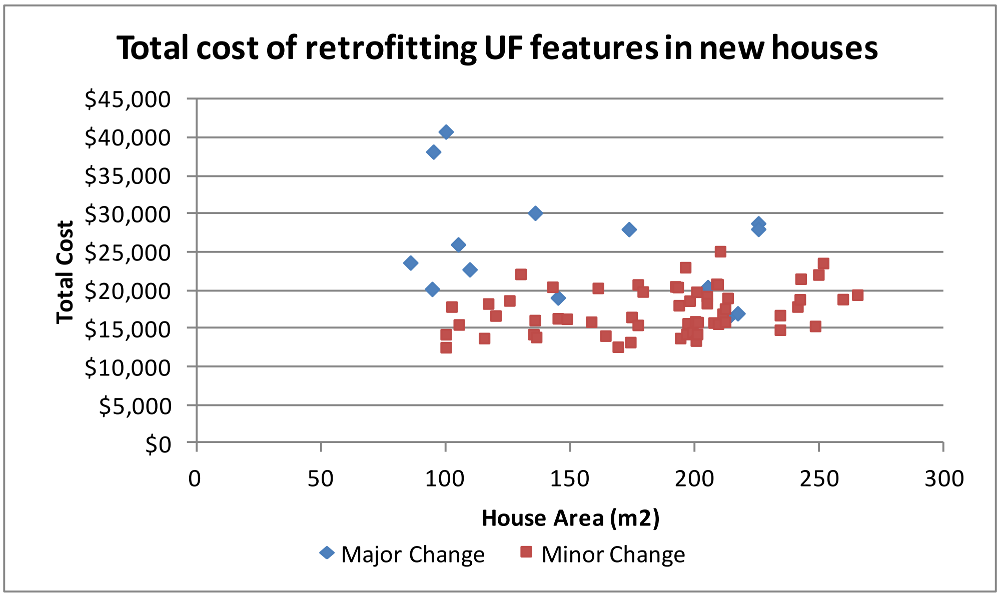
Minor Change Costs Retrofit Changes				
	<150	150-199	200-224	225+
Moving Walls				
Cost per m of wall moved	$600	$600	$600	$600
Average wall area that needs moving (metres)	11.7	9.0	7.9	8.2
Average cost of moving walls	$7,020	$5,388	$4,739	$4,892
Average number of External doors	1.5	2.0	2.1	2.1
Cost of extra door space (1)	$385	$385	$385	$385
Cost of larger door	$1,030	$1,030	$1,030	$1,030
Average cost per door	**$1,415**	**$1,415**	**$1,415**	**$1,415**
Average number of Internal doors	7.3	8.8	9.2	10.3
Cost of extra door space (2)	$522	$522	$522	$522
Cost of larger door	$210	$210	$210	$210
Average cost per door	**$732**	**$732**	**$732**	**$732**
Average Cost of Strengthening Walls in Toilet and Bathroom (3)	**$883**	**$968**	**$990**	**$1,010**
Power sockets/ light switches moved	**$1,064**	**$1,440**	**$1,735**	**$2,045**
TOTAL Average Additional Cost	**$16,505**	**$17,051**	**$17,196**	**$18,459**
Average House Cost @ $1400/sqm	**$364,751**	**$455,471**	**$488,187**	**$536,784**
% of House Cost	**4.5%**	**3.7%**	**3.5%**	**3.4%**

(1) Assumes replacement door frame, studs for one side and top of door and 10% of weatherboards on one side needing replacement.
(2) Includes partial demolition of existing wall, new wall stud, 10mm thick standard plasterboard, new door frame and door handle and painting.
(3) Includes removal and disposal of lining, addition of dwangs, new lining and finishing.
(4) Average house cost includes average section prices for 2010

The average additional cost to retrofit UF standards in this category is between 3.4-4.5%.

Figure 3 is a scatter plot of the same new houses as listed above, which are retrofitted after construction.

Figure 3 Cost of fitting UF features into new houses



6.3 Existing House Survey

As for the new house survey, we obtained plans for existing houses. From these plans, we selected 112 fitting into 8 categories/eras of housing. The smaller the number of houses surveyed in each category, the larger the margin of error will be, so more caution needs to be taken, particularly when looking at state houses, as well as villas and bungalows. The groups have been adapted from other work related to energy efficiency measures. This was done for convenience as the total stock numbers in each era are known. Also, it is useful to use these groups since they indicate the level of existing insulation and hence, the likely costs to upgrade the thermal envelope, though insulation costs are not included in this report, except in Table 14.

Table 12 Distribution of Existing Houses in Sample by House Era

Distribution by House Era Existing Houses	
	Number
Villa (1880-1920)	7
Bungalow (1920-1930)	7
State House (1930-1970)	3
1970-1978	38
1978-1990 (80s)	18
1990-1996	10
1996-2007	15
Post 2007	14
Total	112

Table 13 illustrates the rooms that require attention in existing homes. The proportions are for houses with at least one dimensional problem (Table 14 shows the percentage of houses with no dimensional problems, by decade). The most common problem across the eras is the internal hallway. Unlike the new house survey listed above, there are bathrooms that do not meet the standards even without the bath. Not all houses had an entrance hallway as they have become less common in more recent years.

Table 13 Existing Houses Dimensional Problem by Proportion

Dimensional Problem by Proportion Existing Houses								
	Villa (1880-1920)	Bungalow (1920-1930)	State House (1930-1970)	1970-1978	1978-1990 (80s)	1990-1996	1996-2007	Post 2007
Entrance Hallway	100%	86%	0%	74%	56%	40%	27%	50%
Internal Hallway	100%	100%	100%	92%	94%	100%	93%	100%
Bedroom (Double Bed)	43%	29%	0%	32%	39%	70%	33%	29%
Bedroom (Queen Bed)	71%	43%	100%	63%	78%	70%	73%	57%
Kitchen	29%	0%	0%	8%	28%	10%	7%	14%
Bathroom (With Bath)	71%	57%	67%	68%	72%	50%	40%	36%
Bathroom (Without Bath)	14%	43%	33%	24%	33%	20%	20%	14%

The percentage of houses meeting the requirements was low throughout the eras. The two earliest (villa and bungalow) had the highest proportion meeting the standards from the houses surveyed. However, no state houses, houses built between 1970-1996 or houses post-2007 that we surveyed met the requirements.

Prior to 1978 wall insulation was not required in new housing, so the cost of insulation has been added for those houses. Therefore, there is a large difference between the costs for those houses built prior to 1978 and those built afterwards. The cost of retrofitting insulation is the largest single cost for existing houses.

The total average additional cost is between $14,943 and $29,712, see Table 14. This is approximately 3-7% of the average house cost. The average house cost was ascertained from sale prices in 2010 for homes within each of the eras and includes the land the house was built on.

It is important to note the existing house retrofit costs in Table 14 do not include external costs that may be needed such as parking areas, access to front door, ramps and covered entrances. As calculated in Table 2 and the next section, these costs could amount to an extra $7000 depending on particular circumstances.

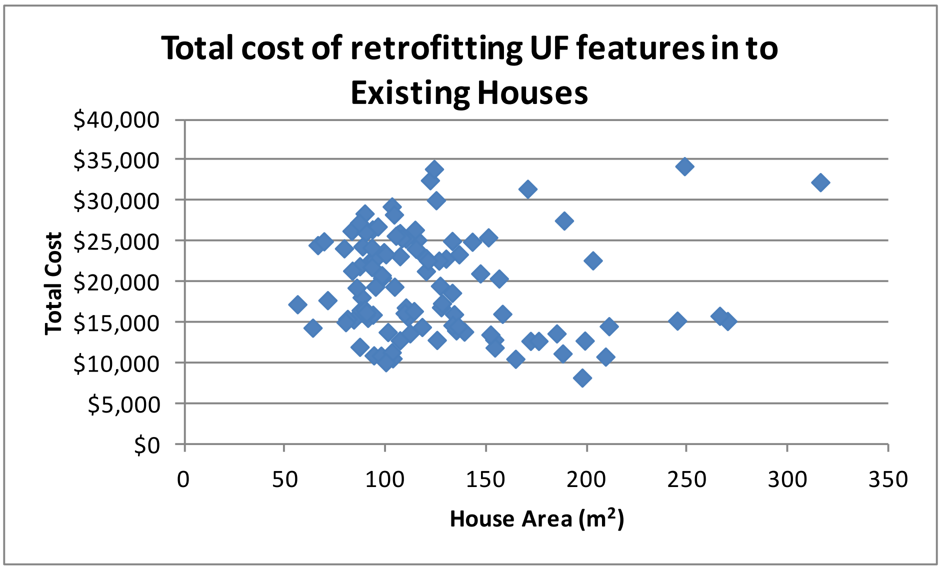
Table 14 Costs by Housing Era

Costs by Housing Era Existing Houses	Villa (1880-1920)	Bungalow (1920-1930)	State House (1930-1970)	1970-1978	1978-1990 (80s)	1990-1996	1996-2007	Post 2007
Percentage Meeting Requirments	14%	14%	0%	8%	0%	0%	7%	0%
Moving Walls								
Average wall area that needs moving (m)	8.7	5.3	7.1	9.9	12.9	12.0	8.8	8.2
Average cost of moving walls @ $600/m	$5,229	$3,150	$4,271	$5,936	$7,742	$7,222	$5,307	$4,907
Average number of External doors	3.4	2.8	2.2	1.8	1.2	1.0	1.1	1.9
Cost of extra door space (1)	$385	$385	$385	$385	$385	$385	$385	$385
Cost of larger door	$1,030	$1,030	$1,030	$1,030	$1,030	$1,030	$1,030	$1,030
Average cost per door	**$1,415**	**$1,415**	**$1,415**	**$1,415**	**$1,415**	**$1,415**	**$1,415**	**$1,415**
Average number of Internal doors	8.0	8.5	7.4	7.2	7.8	7.6	7.8	8.8
Cost of extra door space (2)	$522	$522	$522	$522	$522	$522	$522	$522
Cost of larger door	$210	$210	$210	$210	$210	$210	$210	$210
Average cost per door	**$732**	**$732**	**$732**	**$732**	**$732**	**$732**	**$732**	**$732**
Average Cost of Strengthening Walls in Toilet and Bathroom (3)	$849	$863	$825	$843	$873	$870	$997	$930
Power sockets/ light switches moved	$1,136	$1,123	$1,031	$1,170	$1,202	$1,385	$1,466	$1,636
Average Cost of Adding R2.8 Wall Insulation in Pre-1978 Houses (4)	$12,085	$11,421	$7,831	$9,852	-	-	-	-
Total Average Additional Cost	$29,996	$26,742	$22,502	$25,648	$17,145	$16,414	$15,033	$16,615
Average House Cost	$457,938	$485,099	$369,311	$367,980	$403,616	$474,236	$534,416	$524,139
% of House Cost	6.6%	5.5%	6.1%	7.0%	4.2%	3.5%	2.8%	3.2%

(1) Assumes replacement door frame, studs for one side and top of door and 10% of weatherboards on one side need replacing
(2) Includes partial demolition of existing wall, new wall stud, 10mm thick standard plasterboard, new door frame and door handle and painting.
(3) Includes removal and disposal of lining, addition of dwangs, new lining and finishing.
(4) Includes the removal and disposal of lining, adding pink batts R2.8 wall insulation, re-lining, painting and trim

The scatter plot for retrofitting older existing houses is shown in Figure 4.

Figure 4 Cost of Retrofitting Features into Older Existing Houses



7. ENTRANCE CHANGES

Modifications to the interior of the house are not the only features that need changing. The exterior is an important area and one that varies greatly between houses. In this section, we will investigate the costs associated with adding ramps and porches to houses.

7.1 Ramps

For older houses (approximately pre-1980) the entrance is not level to the ground as they are on timber or concrete piles with steps up to the entrance doorway. However, these are often not suitable, especially for parents with children, wheelchair users or the elderly. A ramp will be required and the maximum gradient is 1 in 12. This means that for every metre the ramp ascends, the ramp must extend 12 metres.

The cost of building a ramp does not change between a new or existing house. However, the need is likely to be greatly reduced in building a new house as they are generally built on a concrete slab. Also, in existing houses, steps up to the entrance doorway may already exist that will either need to be demolished at extra expense or can be adapted to make a ramp to reduce the cost.

We investigated two ramp heights, 500mm and 600mm, which are common heights obtained from the House Condition Survey (Clark et al, 2005). Approximately 60% of suspended ground floors are 600mm or more above ground level, 20% being around 500mm and the other 20% less than 500mm above ground level.

A ramp that is 500mm-high and extends 6m, a landing of 1.2m x 2.4m halfway up the ramp and a 1.2m x 2m landing before the entrance door will be needed. The same was done for a 600mm-high ramp. Table 15 and Table 16 show the costs of building both a concrete and a timber ramp. Further details are in the Appendix.

Table 15 Concrete Ramp Costs

Concrete Ramp Costs		
	Total Cost	Cost/sqm
500mm	$6,566	$526
600mm	$7,299	$524

Table 16 Timber Ramp Costs

Timber Ramp Costs		
	Total Cost	Cost/sqm
500mm	$5,592	$448
600mm	$6,011	$432

For both ramp heights, a timber ramp is considerably cheaper.

7.2 Porch

The entrance to the house needs to be under cover and slip-resistant. A structure such as a porch will need to be erected over the entranceway to provide shelter. A roof overhead is essential and walls will often be helpful in the event of wind. Table 17 examines both the cost of a porch with or without walls and details of the costs will be in the Appendix.

Table 17 Entry Porch Costs

Porch Costs		
	Total	**Cost/sqm**
With Walls	$2,205	$919
Without Walls	$1,104	$460

8. COST COMPARISON OF NEW UF HOUSES VS RETROFIT

What is the cost comparison of building new houses with UF features to retrofitting new houses at a later time with UF features as demand arises?

The data from earlier tables is used to calculate average house costs for incorporating UF in new houses or retrofitting these new houses at a later date, see Table 18.

Table 18 Cost of Adaptation vs New House with UF

Cost to adapt new houses with User-friendly features					
	Percentage				
Type of adaption (1)	<150sqm	150-199	200-224	225+	All (5)
Major	35	4	14	14	17
Minor	65	75	72	72	71
Nil	0	21	14	14	12
	100	100	100	100	100
Incorporated in new house	Cost per house $ (2)				
Major	10095	8142	2270	8254	
Minor	374	442	461	506	
Nil	70	77	78	80	
Average house cost (3)	3776	673	661	1531	1720
Retrofitted	Cost per house $ (4)				
Major	27752	28040	17897	28614	
Minor	16505	17051	17196	18459	
Nil	868	916	948	1020	
Average house cost (3)	20441	14102	15019	17439	16990
	Percent of new houses by floor size				
In total population (6)	23	24	14	39	100
(1)Adaption to make age-friendly. From sample of 83 new houses.					
(2) Cost to adapt is from Tables 7 and 9. The Nil adaptation category allows					
for the strengthening of bathroom walls.					
(3) Ave house cost is Major % x Major cost + Minor % x Minor cost					
(4) Cost to retrofit is from Tables 10 and 11.					
(5) Ave hse cost for All = ∑ (ave hse cost x Hse size % in total population)					
(6) From building consents, Statistics NZ.					

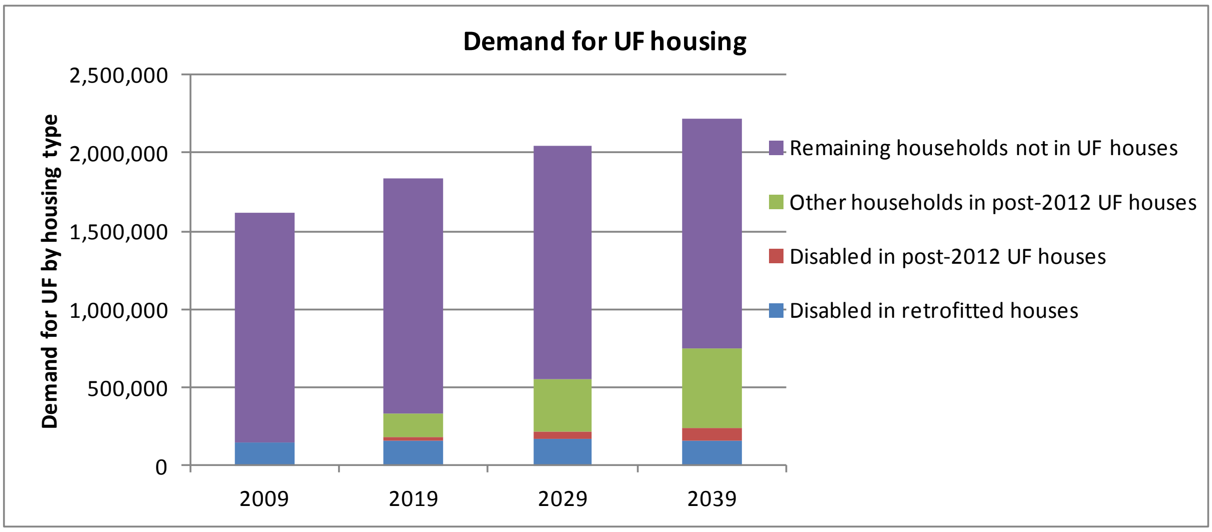
The table indicates that new houses with UF features on average cost an additional $1720. Retrofitting these new houses at a later date cost an average of $16,990.

The question that arises: Is it better to build UF into all new houses or retrofit these houses at a later stage as required?

The Appendix has this analysis for 3 scenarios starting from 2012 and costed out to the Year 2039, with a summary in Table 19. The results depend on the assumptions made about whether persons needing UF features will shift to the new houses with UF or whether they remain in their existing home and retrofit. The first scenario is for retrofitting on demand existing new houses which had no UF features. That is initially cheaper than the other two scenarios but over the long term the third scenario is cheaper. The latter is where people needing UF all occupy post-2012 housing which has mandatory UF features.

The second scenario has UF in all post-2012 houses but whether the persons needing UF (for argument, these persons are assumed to be the disabled) actually occupy these is random, based on the proportion of UF houses in the total stock. It turns out that in this scenario relatively few new houses built with UF are occupied by the disabled and most people retrofit, at considerably higher cost, than if the disabled actively sought out the post-2012 houses. This is illustrated in Figure 5 for Scenario 2, where the current total number of households is about 1.6 million, with about 145,000 disabled person households, based on Rashbrooke (2009). By 2019, with mandatory UF in new housing, the number of disabled in the post-2012 houses is quite low and most of these are occupied by “ordinary” households.

Figure 5 Projected Households and UF houses – Scenario 2



Which scenario is most likely to represent reality? It would appear the majority of the disabled would actively seek UF houses and hence Scenario 3 is considered to be more likely, and is the cheapest of the three.

Table 19 Cost Analysis of New House UF Features vs Retrofit

Retrofit for UF or install UF in all new houses - cost summary		
Annual costs and present value (PV)		
	Cost per yr $ M	PV $M
	1st 7 years	to 2039
Scenario 1 Increase in disabled accomodated in retrofit houses as required (1).	72.6	1258
Scenario 2 Incorporate UF in all new houses but random allocation of UF houses (2).	461.4	8296
Scenario 3 Incorporate Uf in all new houses and newly disabled shift to post 2011 houses (3).	76.2	915
(1) As disabled number increase retrofit more houses. Assumes that as disabled die or are institutionalised their house is used by other disabled.		
(2) All new houses have UF features installed but their likelihood they are occupied by a disabled person is in proportion to their number in the total housing stock. Similarly for retrofitted houses which subsequently become available after the death (or departure) of the previous occupant. The shortage in new UF houses is meet by retrofits.		
(3) All new houses have UF features installed and all the disabled go into these houses built since 2012. In the first 7 years to 2012 their are insufficient new houses and some retrofits are needed , but after that there is sufficent supply of UF houses built post-2012.		

The above analysis uses the present value method where future costs have been discounted back to the current time. The details of the analysis are in the Appendix. Looking out to 2039, the cost savings from installing UF features in all new houses at the time of construction is approximately $343 million cheaper in present values, than retrofitting as required in the future.

Is it cost effective supplying UF features in housing at all?

The analysis so far is based on the relative costs of installing UF in new housing compared to retrofits. We have not addressed the question of how effective the installation of UF features is in terms of reducing accidents and in keeping the aged/disabled in their own homes for longer before people are institutionalised.

There are monetary values associated with these benefits but it is difficult to get data on them. For example, accident rates in homes which could be attributed to the absence of UF features are lacking. ACC data[1] indicates there are about 260,000 trips and falls per year at home at an average cost (medical only) of about $1040 each. If widespread use of UF features reduced these by 10%, this would be a saving of $27 million per year, which helps offset some of the initial cost. Avoiding institutional care is a significant cost saving, at approximately $35,000 per year per person. Assume 20% of the growth in persons with disabilities is avoided by UF features, then this represents an additional saving of approximately $20 million per year. Together these savings significantly offset the cost of providing UF features in new housing. Note that we do not have firm data to justify the percentages used above. Instead we have shown that it could well be cost effective from an injury reduction viewpoint to require UF in all new housing and further work on injury prevention from UF features is required.

9. DISCUSSION

It is clear from the literature and the calculations in this report that it is significantly cheaper to install UF features in new housing rather than retrofit houses later. The analysis was done for the whole population rather than for individual households. The latter are likely to move house several times over their lifetimes and it is difficult to predict the need for UF features for a particular household. However, in total there are cost advantages in fitting all new housing with UF features at the time of construction because there is quite a large likelihood, which grows over time, that the new house will be occupied by a disabled/aged person. This assumes the future aged population will occupy new housing rather than retrofit an existing house because of the cost advantages of the former.

Most new houses can be modified comparatively cheaply for UF features, typically about $500 per house for interior work. Some new builds require major changes amounting to about $8000 per house, but even then it would be possible to redesign the layout including room size and location within the overall footprint, and avoid most of this cost.

The floor plans used for the costings of new houses are in the Appendix. All of our cost analyses are heavily reliant on the accuracy and completeness of house plans. Many of the plans did not have dimensions for some or all of the rooms and therefore an amount of careful measuring was required. With this in mind, there is some margin of error with our measurements, particularly with the smaller floor area plans.

Where additional floor space is required, the values of $1400 per sqm for new housing and $2100 for existing houses were obtained by analysing values and floor areas from the BRANZ Materials Survey (BUILD 2005) over the last 12 months. These are average costs and will vary between territories and building companies. They are also heavily dependent on the work that needs to be done.

The costs are indicative of the average expenses to add UF features to houses. These costs are all inclusive (i.e. include materials and labour). Savings can be achieved wherever changes can be made either by the owner rather than hiring contractors or when materials can be obtained at less than market price. Also, labour costs can vary.

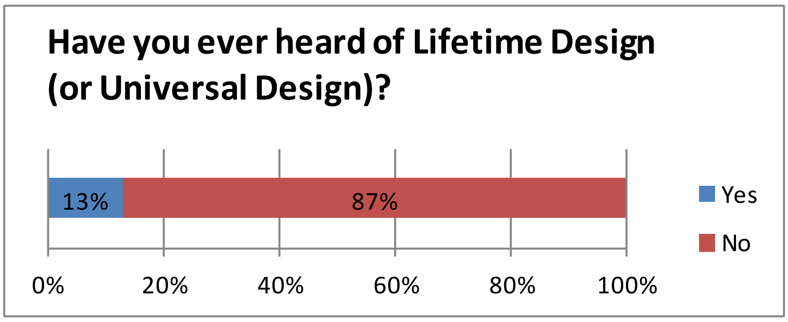
[1] Press Release 15 Aug 2011 Assoc Minister for ACC "Falls cost New Zealanders millions each year."

Additional costs are minimal for houses which are well designed to begin with. Therefore, checking dimensions of the house, ensuring the master bedroom is on the entry level and that the bathroom and toilet are near the master bedroom, can ensure minimal increases in the costs for new housing.

We were unable to find hard data on the reduction in accidents and institutional care savings when houses are fitted with UF features. It seems likely that benefits of providing UF housing can significantly offset the cost of providing UF features in new housing. Further work on this is needed. In addition, there are intangible benefits of persons remaining in the community rather than being institutionalised. The case for the automatic inclusion of UF features in new housing is strong. This could be influenced through education of designers and potential new owners or through regulation.

What awareness is there in the community of UF housing? A survey of new homeowners was undertaken by BRANZ in 2011. Almost 30% of the surveys sent out were returned. We asked if they had ever heard of LTD and if they included any LTD features in their new home. The majority of respondents had not heard of LTD, see Figure 6. We have not surveyed designers on this but it is likely they have a higher awareness than owners of LTD. In any case, more publicity of the advantages of incorporating UF features in new housing is needed. Further survey results on awareness are in the Appendix.

Figure 6 Have You Ever Heard of LTD?



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11. APPENDIX

This Appendix has four sections:

- Cost Analysis for Construction of Ramps
- Lifetime Costs of Retrofit vs all New Houses with UF
- Awareness of LTD Among Owners
- House Plans

11.1 Ramp Cost Details

The data source for costing ramps was from Rawlinson NZ Cost Handbook 2010.

Table 20 500mm-high Concrete Ramp Cost Details

Concrete Ramp Cost Details 500mm high	
	Cost
19.8m of 115 x 115mm H5 Posts @ $81/m	$1,604
40m of 75 x 50mm H3.2 Upstands and Safety Rails @ $11.7/m	$468
22.5m of 45mm diameter Handrail @ $45.1/m	$1,015
17 Galvanised Bolts @ $23.3 each	$396
13.5sqm of formwork @ $120/sqm	$1,620
3.5 cubic m of reinforced concrete @ 386/cub m	$1,351
0.38 cubic m of reinforced concrete @ $295/cub m	$112
TOTAL	**$6,566**

Table 21 600mm-high Concrete Ramp Cost Details

Concrete Ramp Cost Details 600mm high	
	Cost
20.7m of 115 x 115mm H5 Posts @ $81/m	$1,677
45m of 75 x 50mm H3.2 Upstands and Safety Rails @ $11.7/m	$527
25m of 45mm diameter Handrail @ $45.1/m	$1,128
17 Galvanised Bolts @ $23.3 each	$396
15sqm of formwork @ $120/sqm	$1,800
4.3 cubic m of reinforced concrete @ 386/cub m	$1,660
0.38 cubic m of reinforced concrete @ $295/cub m	$112
TOTAL	**$7,299**

Table 22 500mm-high Timber Ramp Cost Details

Timber Ramp Cost Details 500mm high	
	Cost
19.8m of 115 x 115mm H5 Posts @ $81/m	$1,604
39.7m of 200 x 50mm H3.2 Joists @ $21.6/m	$858
40m of 75 x 50mm H3.2 Upstands and Safety Rails @ $11.7/m	$468
22.5m of 45mm diameter Handrail @ $45.1/m	$1,015
13.5sqm of 40mm decking @ $65/sqm	$878
51 Galvanised Bolts @ $12.90 each	$658
0.38 cubic m of reinforced concrete @ $295/cub m	$112
TOTAL	**$5,592**

Table 23 600mm-high Timber Ramp Cost Details

Timber Ramp Cost Details 600mm high	
	Cost
20.7m of 115 x 115mm H5 Posts @ $81/m	$1,677
43.3m of 200 x 50mm H3.2 Joists @ $21.6/m	$935
45m of 75 x 50mm H3.2 Upstands and Safety Rails @ $11.7/m	$527
25m of 45mm diameter Handrail @ $45.1/m	$1,128
15sqm of 40mm decking @ $65/sqm	$975
51 Galvanised Bolts @ $12.90 each	$658
0.38 cubic m of reinforced concrete @ $295/cub m	$112
TOTAL	**$6,011**

Table 24 Porch Cost Details

Cost Details of Porch With and Without walls	
	Costs
5.2m of 115 x 115mm H5 Posts @ $81/m	$421
7.2m of 100 x 50mm H3.2 Rafters @ $14.7/m	$106
9.6m of 150 x 50mm H3.2 Framing @ $19.3/m	$185
5.8sqm of Translucent Roofing @ $57/sqm	$331
12 Galvanised Bolts @ $5.10 each	$61
7.7sqm of Timber Weatherboards @ $143/sqm	$1,101
TOTAL with walls	**$2,205**
TOTAL without walls	**$1,104**

11.2 Cost Analysis of Retrofit vs Installing UF in all New Houses

Three scenarios were examined:

Scenario 1 -- Retrofit existing houses as required to meet the growth in disabled persons. The current number of these households is about 145,071 persons based Ministry of Social Development work and it assumed all of these disabled persons' households are adequately retrofitted now. In the future, the number of disabled persons' households increases and only the increase in numbers is included in the costs. That means we are assuming that as the occupants move on in future years, the vacated house is used by another disabled person.

Scenario 2 -- UF features in all new housing is mandatory from 2012. However, it is assumed that the disabled are not forced to move into these new houses and the likelihood they occupy a UF house immediately prior to their disability is the same as the general population. That means a significant proportion of the disabled retrofit their existing house even where "spare" post-2012 UF houses are available.

Scenario 3 -- UF features in all new housing is mandatory from 2012. The disabled all occupy either existing retrofits or post-2012 houses. In the early years there are not enough new UF houses and some existing houses are retrofitted. But over time the stock of UF houses expands and retrofits are no longer required.

The analysis uses projected numbers of UF houses from the paper by Rashbrooke (2009). In summary, he is saying we need an additional 3500 UF houses per year for the next 20 years, which represents about 15% of new builds per year. The building costs are in current prices, hence a low real discount rate of 3% has been used. Changes in the discount rate do not alter the relative merits of new UF versus retrofit, since at any time the cost of installing UF in all new housing is lower than the cost of retrofit required. Looking out to 2039, the analysis indicates the cost savings from installing UF features in all new houses at the time of construction is approximately $390 million cheaper in present values, than retrofitting as required in the future (see Scenario 3 compared to Scenario 1).

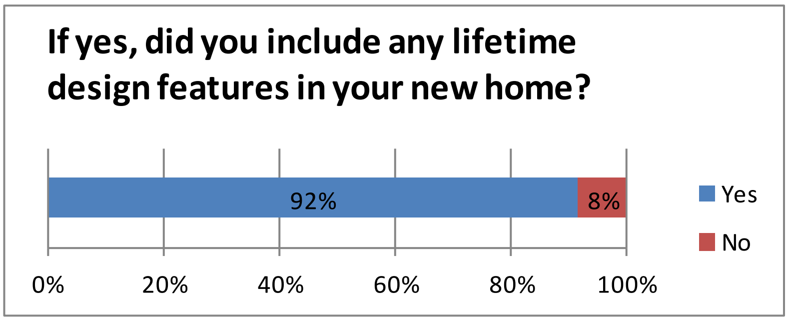
Table 25 Cost Analysis of New House UF Features vs Retrofit

Cost analysis of New UF houses versus retrofit houses					
	2009	2019	2029	2039	
Projected need for UF houses (1)	145071	179647	215192	241742	
Increase in UF hses needed since 2009		34576	70121	96671	
Scenario 1 Retrofit houses as required (# per yr).		3458	3555	2655	
Cost to retrofit $M per year		76.1	78.2	58.4	
Scenario 2 Incorporate UF in all new hses (# per yr) (2)		24000	22000	20000	
and random allocation of UF houses					
Number new UF hses at year (million) (3)		0.168	0.388	0.588	
Total occupied housing stock (million) (4)	1.20	1.42	1.62	1.80	
Likelihood a newly disabled person already in a new UF house (5)		11.8%	24.0%	32.7%	
Disabled persons in new UF houses # (6)		21254	51540	78969	
Likelihood a newly disabled person already in a retrofit UF house (7)		10.2%	11.1%	12.0%	
Disabled persons in retrofit UF houses # (8)		18353	23863	28901	
Remainder of increase in disabled in retrofitted houses # (9)		140040	139789	133872	
Total UF houses stock		179647	215192	241742	
Scenario 3 Incorporate UF in all new hses (# per yr) (2)					
and all newly disabled go into new UF houses only (new since 2012).					
Number new UF houses		168,000	388,000	588,000	
Remainder of disabled in retrofitted houses # (9)		11,647	0	0	
Costs					
Scenario 2		$ million per year (10)			
Incorporate UF in all new houses $M		41.3	37.8	34.4	
Remainder of disabled in retrofit $M		440.1	439.3	420.7	
Total cost per year (3)		481.4	477.2	455.1	
Scenario 3					
Incorporate UF in all new houses $M		41.3	37.8	34.4	
Remainder of disabled in retrofit $M		36.6	0	0	
		77.9	37.8	34.4	
Present value $ million (9)					Total (11)
Scenario 1		474	542	301	1318
Scenario 2		2999	3310	2349	8658
Scenario 3		485	262	178	925
(1) Number required from Rashbrooke (2009) Table 4.					
(2) BRANZ estimate of all new housing					
(3) Start at 2012 so 7 years to 2019.					
(4) BRANZ estimate of stock allows for demolitions					
(5) Ratio of previous two lines i.e. Number of new UF houses/ Total stock					
(6) First row x Likelihood row, ie.Person becoming disabled has the					
same likelihood as all households to already be in a new UF house.					
(7) Number of retrofitted houses (i.e. 145071 at start of 2019 decade)/Total stock					
(8) First row x likelihood row.					
(9) If not in a new UF house the disabled need a retrofit.					
(10) Cost = Number of new houses or retrofits x Adaption costs				$	
for new or retrofit.	UF in new house (ave extra cost $)			1720	per hse
		Retrofit typical cost $		22000	per hse
(11) Present value for expenditure up to 2039.	Assume discount rate =			3%	
		USPWF r/10yrs and 7yrs		8.530	6.230

11.3 LTD Awareness Survey

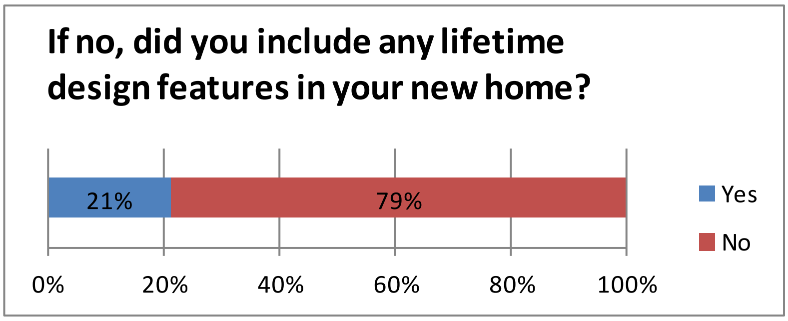
The awareness of LTD by owners is quite low at 13%, as reported earlier. Those who have heard of LTD are likely to include features such as wider passageways and doorways, and wet area showers in their home. To date, 92% of respondents that have heard of LTD have included such features in their new home.

Figure 7 If "Yes", Did You Include LTD Features in Your New Home?



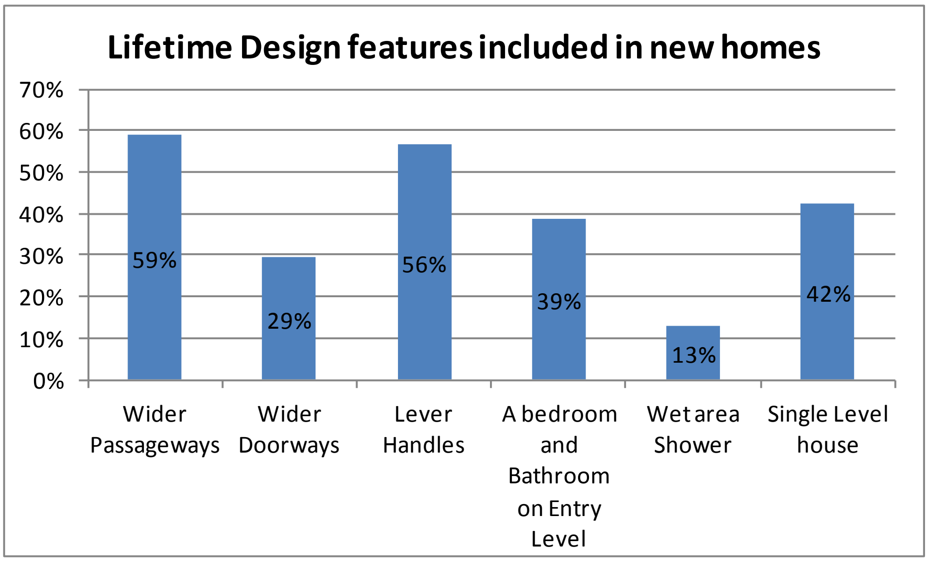
Those who haven't heard of it have also included some lifetime design features in their new home.

Figure 8 If "No", Did You Include LTD Features in Your New Home?



Almost 60% of houses with LTD features included have wider passageways, the most common LTD feature in new homes. Lever handles are the next most common and 39% of multi-storey homes have a bedroom and bathroom on the entry level. Other common features include larger room design, extra insulation and either space identified for a lift to be installed in the future or a lift having been included in the build.

Figure 9 LTD Features Included in New Homes



11.4 House Plans

The following are the 83 new house plans used in the analysis. In many cases the room dimensions were provided. In other cases outside dimensions only were provided and scaling was needed to estimate room or passageway dimensions.

The existing house plans are not provided because they are sketches produced by the Household Energy End-use Project (HEEP) inspectors and generally are not of good quality. For a general description of the HEEP sample see the Year 9 study report (BRANZ 2005).

11.4.1 Less than 150 square metres

Major Change:


bed1
3.8x2.9
bed3
3.3x2.9
living
6.9x3.4
bed2
3.1x3.4
dining
3.7x3.0

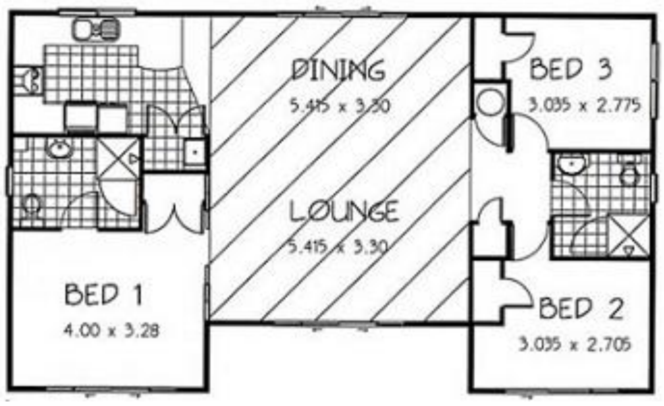

bed1
3.3x3.4
bed3
2.6x2.9
bed4
2.6x2.9
living
4.5x3.8
bed2
3.7x2.9
dining
4.8x2.6


bed2
3.5x2.9
bed4
2.6x2.9
living
6.4x3.6
bed1
3.6x3.7
bed3
3.5x2.7
dining
2.9x2.7


DINE
3.61x2.90
BED2
2.67x3.31
LOUNGE
5.90x3.54
BED3
2.83x3.54
BED1
3.61x3.03


dining
3 130 x 4 120
kitch.
2 700 x 2 720
bed 4
3 330 x 2 720
wc
bath
1 930 x 2 720
ldy
1 930 x 1 530
lounge
6 510 x 3 970
entry
bed 3
3 220 x 3 250
bed 2
3 010 x 3 220
ens
2 130 x 2 920
w/r
2 130 x 1 770
master bed
3 220 x 4 000
deck
3 220 x 1 110

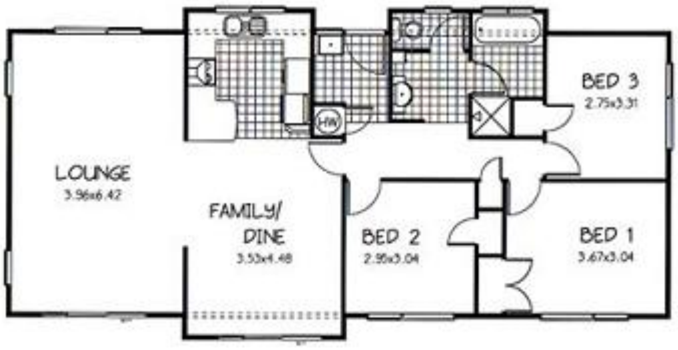
Minor Change:




BED 1
4.00x4.55
LOUNGE/ DINE
BED 3
2.82x3.08
BED 2
3.50x3.27


STUDY/
MEDIA
BED 1
LOUNGE/ DINE
BED 3
BED 2


HW
BED3
DINE
BED1
LOUNGE
BED2

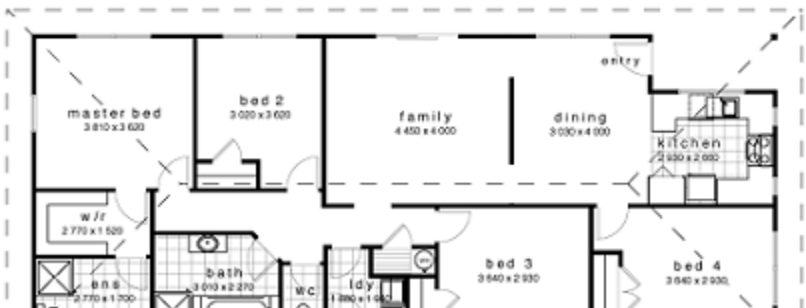

HW
BED 3
2.75x3.31
LOUNGE
3.96x6.42
FAMILY/
DINE
3.53x4.48
BED 2
2.95x3.04
BED 1
3.67x3.04


FAMILY
4.50x3.60
STUDY
2.88x 2.45
BED1
3.45x3.65
DINE
2.92x3.155
LOUNGE
4.12x3.91
BED2
3.05x3.26
BED3
3.00x3.26


BED3
3.4x2.9
BED 2
3.5x3.2
LOUNGE
4.0x3.9
BED4
3.4x2.9
FAMILY
3.8x4.0
DINE
4.0x3.1
BED 1
3.5x4.0

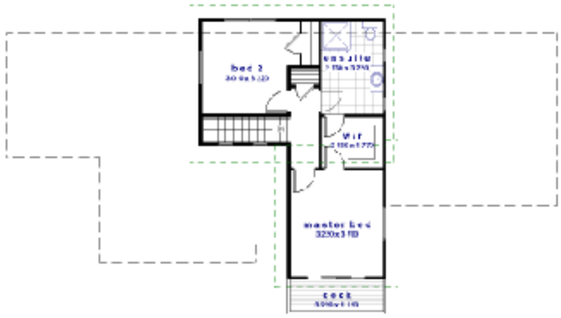

DINING
LOUNGE
LIVING
KITCHEN
ENTRY
BEDROOM 1
BEDROOM 2
BEDROOM 3
BATHROOM
BEDROOM 4
ENSUITE
GARAGE


DINE
3.20x2.92
FAMILY
3.12x3.00
BED4
2.88x3.07
LOUNGE
6.02x3.50
STUDY
2.59x2.79
BED2
3.27x3.29
BED3
3.10x3.29
BED1
3.27x3.78

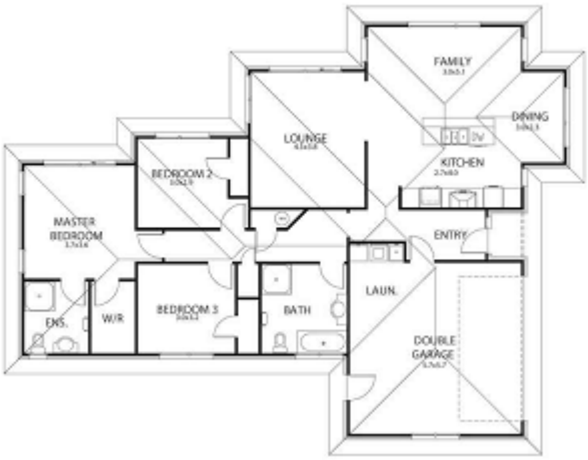

entry
master bed
3 810 x 3 620
bed 2
3 020 x 3 620
family
4 450 x 4 000
dining
3 030 x 4 000
kitchen
2 930 x 2 000
w/r
2 770 x 1 520
ens
2 770 x 1 700
bath
3 010 x 2 270
wc
ldy
bed 3
3 640 x 2 930
bed 4
3 640 x 2 930

11.4.2 150-199sqm

Major Change:



Minor Change:




FAMILY
DINING
LOUNGE
KITCHEN
MASTER BEDROOM
BEDROOM 2
BEDROOM 3
BEDROOM 4
ENS
W/R
BATH
LAUN
DOUBLE GARAGE


DOUBLE GARAGE
BED 3
BATH
ENS
MASTER BEDROOM
HALL
LAUN
BED 2
LOUNGE
ENTRY
KITCHEN
DINING


ldy
double garage
bed 3
bed 2
wc
bath
ens
w/r
master bed
pantry
kitchen
entry
lounge
study
dining / living


Dining
Kitchen
Entry
Lounge
Bed 3
Garage
Bed 1
Bath
Bed 2


Store
Garage
Ldy
Bed 4
Bed 3
Bath
Bed 2
Ens
Bed 1
Wir
Lin
Entry
Kitchen
Lounge
Family Room
Dining


LOUNGE
DINING
PORCH
ENTRY
PATIO
KITCHEN
GARAGE
MAIN BEDROOM
WIR
BEDROOM 2
EN SUITE
BATH
W/C
BEDROOM 3


GARAGE
PORCH
BEDROOM 1
BATHROOM
BEDROOM 2
ENTRY
LAUNDRY
KITCHEN
LOUNGE
WIR
EN-SUITE
MAIN BEDROOM
DINING
PATIO

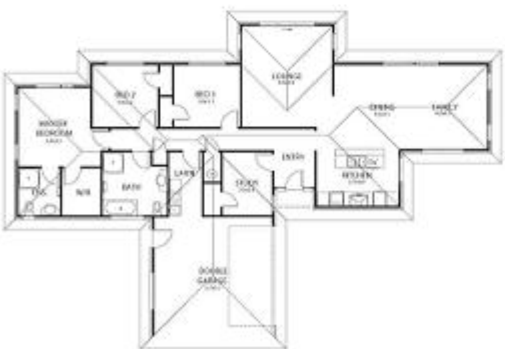

Bedroom 2
Bedroom 3
Bathroom
Master Bedroom
Ensuite
Kitchen
Family
Garage
Entry
Dining
Living
Loggia

No Change:

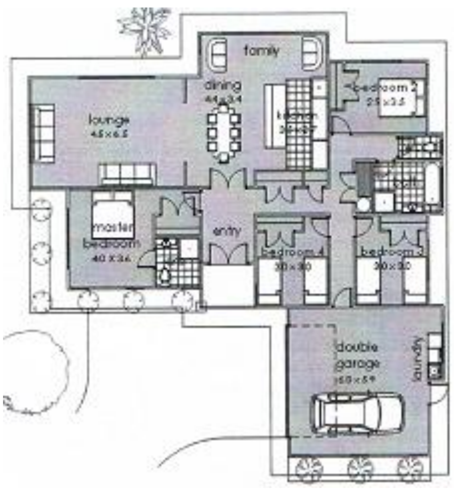
11.4.3 200-224sqm

Major Change:

Minor Change:




FAMILY
LOUNGE
DINING
KITCHEN
ENTRY
MASTER BEDROOM
ENS
W/R
BED.2
BED.3
BATH
BED.4
DOUBLE GARAGE


family
dining
lounge
kitchen
bedroom 2
bath
master bedroom
entry
bedroom 4
bedroom 3
double garage
laundry


Lounge
Bath
Garage


Entry
Study
Kitchen
Family
Garage
Bath

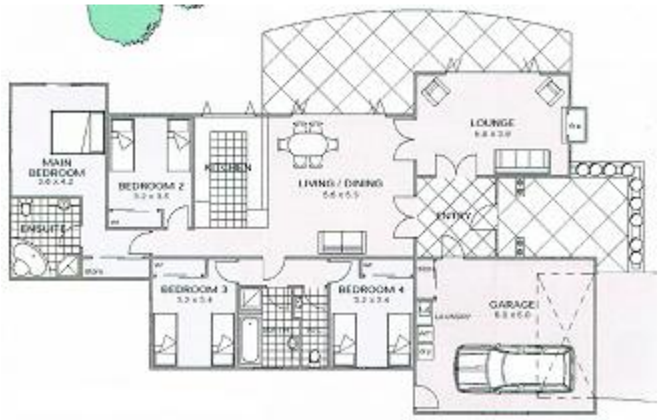

Ens
Robe
Bed 1
Bed 3
Lounge
Bed 2
Kitchen/ Dining
Entry
Bath
Bed 4
Garage


Main Bedroom
Lounge
Store
Store
Foyer
Garage


Garage
Ldy
St
Bath
Lin
Bed 3
Bed 2
Wir
Ens
Bed 1
St
Bed 4
Media
Entry
Dining
Lounge
Family
Kitchen


Garage
Ldy
Bath
Lin
Bed 3
Bed 2
Wir
Ens
Bed 1
St
Media
Bed 4
Bed 5
Kitchen
Dining
Entry
Lounge
Family

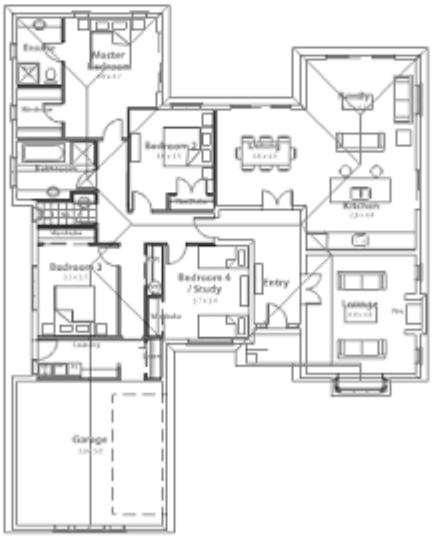

WC
BATH
LAUNDRY
GARAGE
WIR
BEDROOM 2
BEDROOM 3
STUDY
MAIN BEDROOM
ENTRY
KITCHEN
DINING
LOUNGE
FAMILY

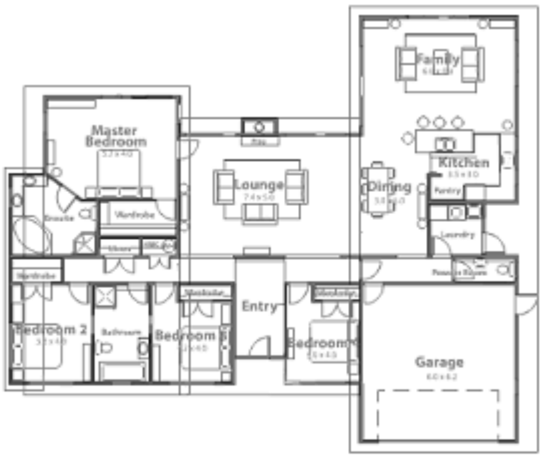

LOUNGE
MAIN BEDROOM
BEDROOM 2
KITCHEN
LIVING / DINING
ENSUITE
ENTRY
BEDROOM 3
BEDROOM 4
GARAGE


GARAGE
LAUNDRY
BATH
WC
BEDROOM 4
3.2 x 3.0
BEDROOM 3
3.2 x 3.0
WIR
ENSUITE
MAIN BEDROOM
LIVING
3.5 x 4.4
KITCHEN
BEDROOM 2
ENTRY
DINING
FAMILY


Lounge
Dining and Family
Entry
Kitchen
Garage
Walk in W/R
3.8 x 2.0
Landing
1.2 x 2.0
Ensuite
2.2 x 2.2
Bedroom 1
3.6 x 4.3

No Change:



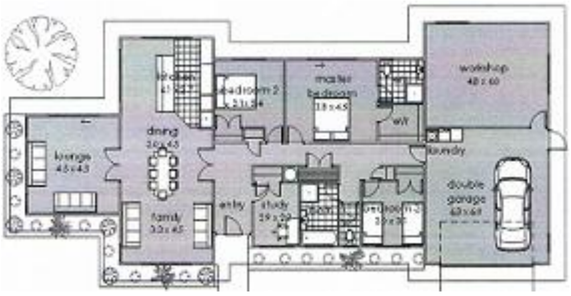


11.4.4 225+sqm

Major Change:

Minor Change


double garage
bed 5
bed 4
bed 3
bed 2
bath
master bed
nook
study
kitchen
entry
living
dining/family


workshop
master bedroom
lounge
dining
family
entry
study
laundry
double garage


LOUNGE
FAMILY
KITCHEN
GARAGE
BEDROOM 1
BEDROOM 4


LIVING
DINING
KITCHEN
LOUNGE
ENTRY
BEDROOM 1
BEDROOM 2
BEDROOM 3
BEDROOM 4
BEDROOM 5
GARAGE


BEDROOM 2
BEDROOM 3
BEDROOM 4
GARAGE
MAIN BEDROOM
WIR
STORE
ENTRY
LOUNGE
LIVING
DINING

No Change