BRANZ

External Research Report

Report ER24 [2017]

Falling from heights

Cost benefit analysis of scaffolding for single storey houses

Michael Bealing

Project LR0489

NZIER, funded by the Building Research Levy

1222 Moonshine Road
RD1, Porirua 5381
Private Bag 50 908
Porirua 5240
New Zealand

branz.nz

Funded from the Building Research Levy

Issue Date: 31/08/2017

ISSN: 2423-0839

Falling from heights

Cost benefit analysis of scaffolding for single storey houses

NZIER report to BRANZ

August 2017

About NZIER

NZIER is a specialist consulting firm that uses applied economic research and analysis to provide a wide range of strategic advice to clients in the public and private sectors, throughout New Zealand and Australia, and further afield.

NZIER is also known for its long-established Quarterly Survey of Business Opinion and Quarterly Predictions.

Our aim is to be the premier centre of applied economic research in New Zealand. We pride ourselves on our reputation for independence and delivering quality analysis in the right form, and at the right time, for our clients. We ensure quality through teamwork on individual projects, critical review at internal seminars, and by peer review at various stages through a project by a senior staff member otherwise not involved in the project.

Each year NZIER devotes resources to undertake and make freely available economic research and thinking aimed at promoting a better understanding of New Zealand's important economic challenges.

NZIER was established in 1958.

Authorship

This paper was prepared at NZIER by Michael Bealing.

It was quality approved by Laurence Kubiak.

The assistance of Matthew Curtis at BRANZ is gratefully acknowledged.

The author would also like to acknowledge information and input provided by the Ministry of Business, Innovation and Employment, Worksafe, BRANZ, and industry bodies and businesses.

L13 Willeston House, 22-28 Willeston St | PO Box 3479, Wellington 6140
Tel +64 4 472 1880 | econ@nzier.org.nz

Executive summary

The Building Research Association of New Zealand (BRANZ) commissioned NZIER to assess the benefits and costs of using scaffolding on single storey new build houses, following the introduction of stricter working at heights guidance in 2012. The guidelines recommend the use of scaffolding for working at heights for single storey residential construction, which is a change in common practice for single storey residential construction.

Prior to these guidelines, ladders, trestles and mobile platforms were the norm for working at heights on single storey residential construction. The cost of purchasing this equipment can be spread across many projects, which means the cost impact on individual projects is very low. In contrast, the costs of installation, removal and rental of scaffolding are non-trivial.

Injury rates decreased following the introduction of the guidelines

Injury or death is a risk when working at heights on a building site. There were 9 fatalities, 1,072 severe injuries and 2,563 non-severe injuries from falls from heights in residential construction from 2009 to 2011.

NZIER analysed the rate of falling from height injuries for residential building consents before and after the introduction of guidelines. There were some injuries in the falling from heights category that would not be affected by using scaffolding, such as falling through a hole in the floor. After adjusting for injuries that were not relevant, we reviewed injury rates per 1,000 consents for the periods 2009 to 2011 and 2012 to 2014. We found that injury rates decreased for all types of injury severity. Based on the lower injury rates, the avoided fatal, severe and non-severe injuries from using scaffolding on single storey new builds would be 13, 401 and 549, respectively, over the next 20 years.

The cost of scaffolding depends on the size and complexity of the house

Research by Nielsen found that the median and average cost scaffolding for a new single storey house was $4,972 and $6,743 (excluding GST and overhead margin), respectively. The average cost of house with a floor area between 151 and 200 sqm was $4,728 and for a floor area of 250 sqm or more was $10,280 (excluding GST and overhead margin).

The cost of scaffolding is partially offset by the productivity benefits. The productivity benefits were estimated to offset 41% of the cost scaffolding.

The results

The combined result of the estimated benefits and costs of scaffolding is shown in Table 1. The present value of total safety benefits from a decrease in injuries was estimated to be $234.2 million. The present value of productivity benefits was estimated to be $295.8 million and the inspection benefits were estimated to be $7.3 million. The cost of using scaffolding for all new single storey houses is estimated to be $757.5 million. The net present value of these benefits and costs was a net cost to society of $220.2 million over 20 years. The benefit cost ratio was 0.71. This result indicates that costs are disproportionate to the benefits.

Table 1 Estimated costs and benefits 2018-2037, based on the median cost of scaffolding

2018-2037

Median cost of scaffolding $4,972 excl. GST and overhead margin	
Assumptions	
Productivity benefit	41.0%
Cost of scaffolding	$4,972.00
Overhead margin	5%
Discount rate	6%
Avoided injuries	
Fatalities	13
Severe injuries	401
Non-severe injuries	549
Present value of the discounted benefits and costs ($ million)	
Fatal injury benefits	$31.8
Severe injury benefits	$178.2
Non-severe injury benefits	$24.2
Total injury savings	$234.2
Productivity benefits	$295.8
Inspection benefits	$7.3
Total benefits	$537.3
Total costs	$757.5
Overall result	
Net present value ($ million)	-$220.2
Benefit cost ratio	0.71

Conclusion

There are safety, productivity and inspection benefits from using scaffolding for working at heights for all single storey new builds. However, the cost of using scaffolding was found to greater than the benefits.

The Health and Safety at Work Act 2015 (HSWA 2015) requires the person conducting a business or undertaking (PCBU) to take a reasonably practical approach to eliminate or mitigate health and safety risks in the workplace. They are required to consider and weigh up the following:

- The likelihood of risk occurring
- The degree of harm if associated with the risk
- What is known about the risk and the way of either eliminating or mitigating it

- The availability and suitability of options to eliminate or mitigate the risk
- Whether the cost of elimination or mitigation is grossly disproportionate to the risk.

The legal test is whether the cost of managing the risk is grossly disproportionate to the level of the risk. Grossly disproportionate has not been defined, and NZIER has not been asked to consider the level at which costs might be considered grossly disproportionate. Our task was to quantify the costs and benefits of using scaffolding.

The estimated costs of using scaffolding for single storey new builds are disproportionate to the benefits, but whether the costs are grossly disproportionate is not clear. A robust definition of when the costs are deemed grossly disproportionate to the benefits would provide clarification for industry. This may be developed through the courts over time.

There is scope to improve the guidelines for working at heights. The guidelines could be improved by:

- Summarising the implications of the HWSA 2015 in the context of working at heights
- Defining the key terms at the beginning of the guidance
- Clarifying which practices in the guidelines are recommended versus required
- Using more diagrams and graphics to demonstrate good practice

A refresh of the guidelines would be timely given the introduction of the HSWA 2015.

Contents

Figures

Tables

1. Purpose and context

The Building Research Association of New Zealand (BRANZ) commissioned NZIER to assess the benefits and costs of using scaffolding on single storey new build houses, following the introduction of stricter working at heights guidance in 2012. The primary research questions were:

1. What are the costs and benefits of stricter working at heights safety regulations for one storey residential home building?
2. Are there ways to improve the guidelines?

To answer the second question, we reviewed the approach taken in Australia, and compared it to the New Zealand approach.

The context

Stricter working at heights (WAH) guidance for the residential construction sector was published in 2012. Its aim was to reduce workplace injuries from falls. The guidelines recommended the use of safety constraints (e.g. scaffolds and safety nets) for all outside domestic construction of single storey new builds. Prior to the introduction of the guidelines scaffolding was rarely used on single storey houses, although for multi-storey construction scaffolding was frequently used.

Different views of the claims of benefits and costs of the WAH guidance

Among the concerns raised over the introduction of the WAH guidance was whether there had been enough consideration of the benefits and costs. A study by BRANZ on the costs and benefits of the new WAH guidelines (Norman et al. 2014), was commissioned by the Scaffolding and Rigging Association of New Zealand, to fill this gap, but was hampered by the fact that only a year had elapsed since the introduction of the guidelines and data was therefore very limited. BRANZ commission NZIER to improve the understanding of the costs and benefits.

Nielsen was also commissioned to investigate the costs of scaffolding for single storey new builds, through a substantial industry survey. The Nielsen research was the first detailed survey into the cost of using scaffolding for single storey new builds.

The legal requirements and economics

The Health and Safety at Work Act 2015 requires the person conducting a business or undertaking (PCBU) take a reasonably practical approach to eliminate the health and safety risks in the workplace or mitigate the risk where elimination is not possible. The PCBU's are to consider and weigh up:

- The likelihood of injury occurring
- The degree of harm of associated with the risk
- What is known about the risk and the way of either eliminating or mitigating it
- The availability and suitability of option to eliminate or mitigate the risk
- Whether the cost of elimination or mitigation is grossly disproportionate to the risk.

The legal test is whether the cost of managing the risk is grossly disproportionate to the level of the risk. Grossly disproportionate has not been defined, and NZIER has not been asked to consider the level at which such a cost might be considered grossly disproportionate. Our task was to quantify the costs and benefits of using scaffolding.

2. Methodology

The primary aim of our research is to estimate the costs and benefits of using scaffolding for the construction of new single storey housing.

NZIER's ten-step cost-benefit analysis (CBA) is a proven methodology for assessing whether the costs outweigh the benefits of interventions. Table 2 summarises our ten-step process.

Table 2 NZIER's CBA methodology for good practice policy development

NZIER's Ten-step CBA process
1. Define the problem/opportunity
2. Decide whose benefits and costs count (standing)
3. Select options and specify the baseline (i.e. the 'without') scenario
4. Classify the kinds of benefits and costs and select the measurement indicators
5. Quantify the consequences (via the measurement indicators) over the life of the options
6. Value (attach dollar values to) the benefits and costs
7. Discount future benefits and costs to obtain present values
8. Calculate decision criteria
9. Analyse sensitivity of the results to assumptions
10. Make a recommendation and document the assessment

Source: NZIER

We considered three principle categories of benefit: safety benefits, productivity benefits and time savings on inspections. We analysed injury statistics and surveyed builders about their injury experiences before and after the introduction of the guidelines to estimate the safety benefits.

As the approach can sometimes appear counter-intuitive to non-economists, we will first explain why we count some things as benefits or costs, but not other things that appear to be similar at first glance.

Taking a national welfare perspective

We evaluate the costs and benefits for New Zealanders from the falling from heights guidelines, in accordance with a national welfare analysis (The Treasury 2015). The scope of the CBA needs to capture how the costs and benefits fall on businesses and households.

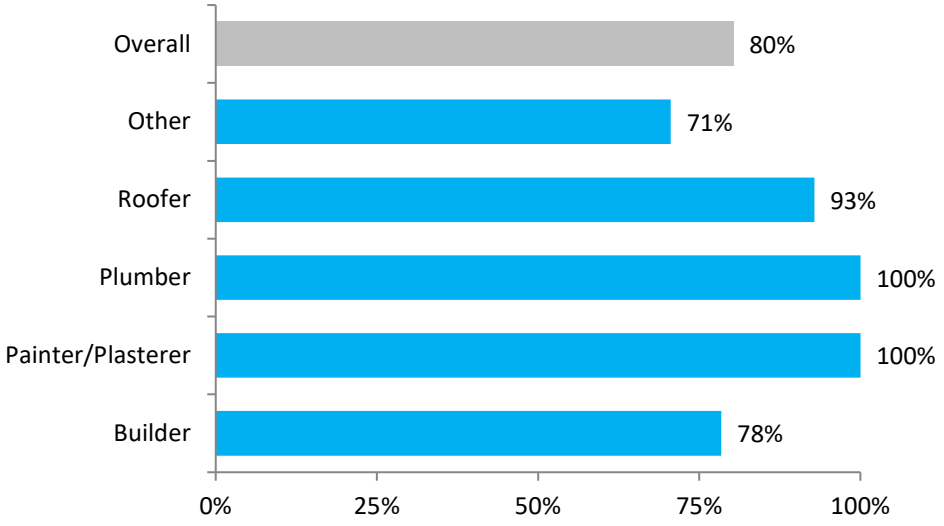
We only count incremental benefits and costs

We needed to establish these to establish the *incremental* benefits and costs of the intervention. For example, we are only interested in incremental changes to accident rates that can attributed to the intervention. Another important factor was the tendency to use scaffolding prior to the guidelines.

Figure 1 shows the percentage of survey respondents by occupation who said they did not use scaffolding on a single storey new residential build before 2012. Overall 80% of construction industry professionals said they did not use scaffolding on single storey residential house projects prior to the introduction of the guidelines. Of the builders that responded to the survey, 78% said they did not use scaffolding prior to the introduction of the guidelines. Roofers, indicated that they did not typically use scaffolding on single storey houses. To account for the existing use of scaffolding prior to the introduction, the benefits and costs were reduced by 20%.

Figure 1 The percentage of workers that did not use scaffolding before 2012

Percentage of Builders Survey respondents that answered they did not use scaffolding prior to the guidelines



Source: NZIER based on BRANZ Tradespeople Survey, 2015

Commercial market assumptions for cost estimation

In our analysis, we have assumed that scaffolding is hired rather than owned and the typical hire costs reflect the cost of scaffolding generally. The results of the Nielsen survey support this assumption. The majority (78%) of respondents said the scaffolding used on their last house build was hired or leased, when asked by Nielsen.

Parameterising the cost benefit analysis

Three surveys, several interviews, and an in-depth statistical analysis of a large-scale Accident Compensation Corporation (ACC) databases were used establish the change in the number of injuries and injury rates over time.

The cost benefit analysis drew on inputs from a range of sources including the single storey residential new builds survey by Nielsen for Worksafe. The survey used a mixed self-completion survey approach, consisting of mail survey pack and an option of completing it online. The target population for the survey was builders and specialist tradespeople which work at height as part of their job and had worked on a single storey residential new build in the last 12 months. In total, 1,208 surveys were completed, with an overall response rate of 17.5%.

The responses for the cost of scaffolding were used in the cost benefit analysis because they represented the best available estimates of the cost of using scaffolding for single storey new builds.

Quantifying the productivity benefits was important in a part of the CBA, because of the potential contribution these benefits make to offsetting the cost of scaffolding. The results of a survey of tradespeople were used to estimate the productivity benefits in relation to the cost. The total number respondents to the Tradespeople survey was 151 and the response rate was 20%. The most common respondents were builders (90), followed by roofers (14), painters or plasterers (8), company directors or project managers (8), plumbers (4), other (8) and unstated occupation (19). An additional survey of 73 building inspectors was conducted to establish whether scaffolding had benefits for the process and purpose of building inspectors.

The approach

The structure of our analysis follows the standard CBA approach by estimating the net benefits (or net costs) for each year and discounting them back to the present value. Our time horizon is 20 years.

The estimation of benefits is the sum of three components: the safety benefits derived from a reduction in estimated injuries, the productivity benefits derived from cost savings and the time savings for building inspectors. In all cases, we are interested in the incremental benefits as discussed above.

The estimation of the cost of scaffolding was based on results from the Nielsen Survey (307 responses). The cost savings from scaffolding were associated with operational productivity, rather than a reduction in the cost of equipment such as ladders or trestles. There are no equipment cost savings on ladders or trestles because this equipment is still required for other parts of residential construction.

3. Estimating the benefits

This section focuses on the potential benefits of using scaffolding on single storey residential construction projects. We focus on the new residential builds market. The main types of benefits considered are safety benefits from the reduction in injuries, productivity benefits and benefits for improved access for inspectors.

To give some context, Nielson found when they surveyed trades people that:

- 36% agreed or strongly agreed, 34% neither agreed nor disagreed, and 31% disagreed or strongly disagreed that *the costs associated with scaffolding are offset by the benefits of having it on site*.[1]
- 70% agreed or strongly agreed that *scaffolding has improved safety on site*.
- Half (54%) said that one of the top three advantages to their business/the business they work for of using scaffolding on single storey residential new builds was that it was *easier to work at height/convenient/provides a level surface*. 31% said that scaffolding was *more efficient/productive or provided time/cost savings*.
- When prompted, half agreed or strongly agreed that *scaffolding has improved access for our work* (55%) and *scaffolding speeds up the building process* (50%).
- Almost half (49%) agreed or strongly agreed with the statement: *I am certain that scaffolding has saved lives or prevented injuries on our site(s)/sites I have worked on*. The most commonly mentioned advantage of using scaffolding (61%) was that the *site was safer/providing protection from falls* (for people and tools).

These results indicate that respondents think there are safety and productivity benefits from using scaffolding but are uncertain about whether the benefits offset the costs.

3.1. Quantifying the safety benefits

Two categories of injury were investigated in the process of quantifying the safety benefits from the introduction of the guidelines:

- Injuries from falling from heights
- Injuries from being hit by objects falling from above.

Although, injuries from falling from heights were the primary focus of the analysis of safety benefits, we later expanded the scope to include injuries from being hit by objects falling from above. Because this category of injuries was identified as a safety benefit in the Nielsen survey.

Analysis of the incident descriptions revealed that the "being hit by falling objects from above" dataset included injuries sustained by individuals dropping objects and/ or injuring their lower body. These types of injuries are not relevant. Only a small share of injuries could be clearly identified as attributable to a situation where scaffolding

[1] Percentages may not equal 100% due to rounding.

would protect people from being hit by objects falling from above, such as tools falling from the roof line that could injure workers below. The analysis of the potential benefits of this category of injuries was included as in the sensitivity analysis.

Further research and more detail incident descriptions may shed more light on the role of scaffolding in reduce the risk of injuries from falling objects.

Falling from heights' injuries

NZIER worked with Worksafe to analyse the description of injuries in the Worksafe injury databases to quantify the proportion that were attributable to the introduction of the guidelines.

Starting with falls from heights' injuries in all construction from 2009 to 2014 we eliminated non-residential building, and heavy and civil construction to focus on the relevant areas of construction:

- Residential building
- Construction services which include specialist services such as bricklaying, roofing and painting among others.

The number of injuries for the three years before and after the introduction of guidelines is shown in the table below to provide the context for the level of injuries. There was decrease in fatal and severe injuries. Non-severe injuries increased by 2.1%. This indicates that there has been a reduction in the severity of injuries from falls from heights since the introduction of the guidelines.

Table 3 The number of falling from heights' injuries

Falling from heights injuries for 2009-2011 and 2012-2014

Injury severity	2009-2011	2012-2014
Fatal	9	2
Severe	1,072	942
Non-severe	2,563	2,627

Source: NZIER based on Worksafe data

Not all the injuries from falls from heights were relevant or preventable with the introduction of scaffolding because the "falls from heights" dataset includes injuries that could not to be prevented through introduction of scaffolding including for example injuries from:

- Falling through a hole in the floor
- Falling from the roof into the building
- Falling inside the building.

NZIER and Worksafe worked together to analyse the description of accidents in the dataset to determine the proportion of injuries that were relevant to the guidelines. The results of this analysis are shown in Table 4.

Table 4 Relevant proportion of fall injuries based on description analysis

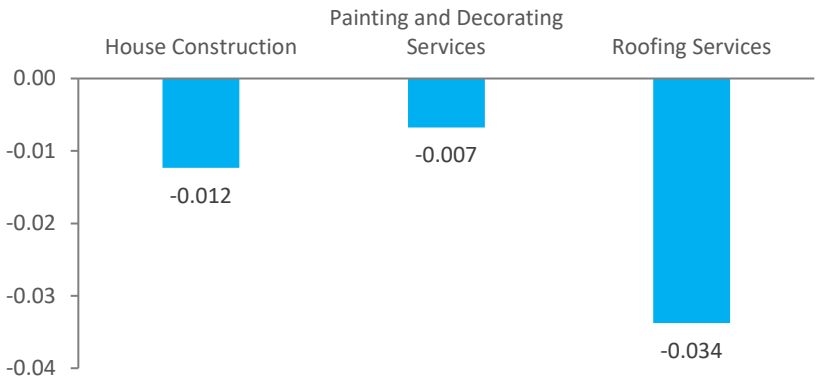
Construction sector and sub-sector	Relevant proportion of injuries
Residential construction	
House construction	100%
Non-residential building construction	0%
Other residential building construction	0%
Construction services	
Bricklaying services	100%
Carpentry services	70%
Concreting services	60%
Electrical services	15%
Fire and security alarm installation services	0%
Glazing services	50%
Hire of construction machinery with operator	45%
Land development and subdivision	0%
Landscape construction services	0%
Other building installation services	10%
Other construction services	10%
Painting and decorating services	63%
Plastering and ceiling services	10%
Plumbing services (includes guttering installation)	60%
Roofing services	100%
Site preparation services	0%
Structural steel erection services	35%
Tiling and carpeting services	0%

Source: NZIER

Once the proportion of relevant injuries were estimated, we compared the rate of injuries per 1,000 building consents (new and alterations) to calculate the change in injuries per 1,000 consents by injury severity and relevant construction subsector. We did this is to account for changes in levels of activity which could affect the injury levels due changes in exposure to the risk of injury. We used injuries per 1,000 residential building consents rather than a rate of injuries per full-time equivalent employee to avoid having to make additional assumptions about the average number of employees per new build. The decrease in the rate of fatal injuries is shown in Figure 2.

Figure 2 Fatal fall injuries before and after the introduction of the guidelines

Difference in injury rates between 2009-2011 and 2012-2014



Source: NZIER

The change in the severe injury rates per 1,000 consents is shown in Table 5. The largest decrease was in housing construction followed by painting and decorating services.

There was a small in increase in the injury rate for structural steel erection services. This is the subsector that includes the installation of scaffolding, so a small increase is not surprising as the use of scaffolding, and therefore the exposure to possible injury, increased following the introduction of the guidelines in 2012.

Table 5 Change in severe injury rates for falls from a height

Difference in injury rates between 2009-2011 and 2012-2014

Subsector	Change injuries per 1,000 consents
Bricklaying services	-0.04
Carpentry services	-0.20
Concreting services	-0.04
Electrical services	-0.06
Glazing services	-0.02
Hire of construction machinery with operator	-0.01
House construction	-0.55
Other building installation services	0.00
Other construction services	0.00
Painting and decorating services	-0.35
Plastering and ceiling services	0.00
Plumbing services	-0.16
Roofing services	-0.16
Structural steel erection services	0.01

Source: NZIER

The largest decreases in non-severe injuries per 1,000 consents were in housing construction and roofing services (see Table 6).

Table 6 Change in non-severe injury rates for falls from a height

Difference in injury rates between 2009-2011 and 2012-2014

Subsector	Change injuries per 1,000 consents
Bricklaying services	-0.1304
Carpentry services	-0.2883
Concreting services	0.0153
Electrical services	-0.0711
Glazing services	-0.0826
Hire of construction machinery with operator	0.0035
House construction	-0.6387
Other building installation services	0.0166
Other construction services	-0.0327
Painting and decorating services	-0.2757
Plastering and ceiling services	0.0059
Plumbing services	-0.0982
Roofing services	-0.5811
Structural steel erection services	-0.0098

Source: NZIER

The overall estimated reduction in injuries per 1,000 consents from falling from heights, following introduction of the guidelines, are shown by severity in Table 7. This reduction in injuries suggests that the guidelines have been successful in decreasing the risk of injury for all severity types.

Table 7 Overall changes in the injury rate per 1,000 consents

Difference in injury rates between 2009-2011 and 2012-2014

Injury severity	Difference in Injury rates per 1,000 consents	Change compared to 2009-2011
Fatal	-0.05	-74.4%
Severe	-1.58	-26.4%
Non-severe	-2.17	-15.4%

Source: NZIER

3.2. The potential level of construction activity

The impact on the number of injuries required the estimation of the potential number of single storey new builds in the future. Our estimate is based on the following three assumptions:

- 65% of new builds are single storey
- The rate of growth in new builds is consistent with BRANZ's projections for new dwellings between 2018 and 2023
- A long run population growth rate (0.86% per year) is applied to project consents after 2023.

Figure 3 shows the distribution of new residential construction by the number of storeys in different parts of New Zealand. Most of the new houses built in New Zealand are single storey. Auckland and Wellington are the main exceptions where there is a preference for two or more storey homes which allow a larger floor area on smaller plots of land.

We estimate that the number of new single storey house projects will be 16,240 in 2018, increasing to 16,640 by 2037.[2] This projection is used to model the impact of the additional costs and benefits. Variation in the level of activity will affect the magnitude of the net results, but the cost benefit ratio will not change materially because marginal costs and benefits occur at the project level.

To estimate the number avoided injuries for the reduction in injury rates was applied to the projected number of single storey new builds over the 20-year period. Table 8 shows the estimated number of avoided falling from heights injuries over 20 years.

Table 8 Estimated number of avoided falling from heights injuries over 20 years

2018 - 2037

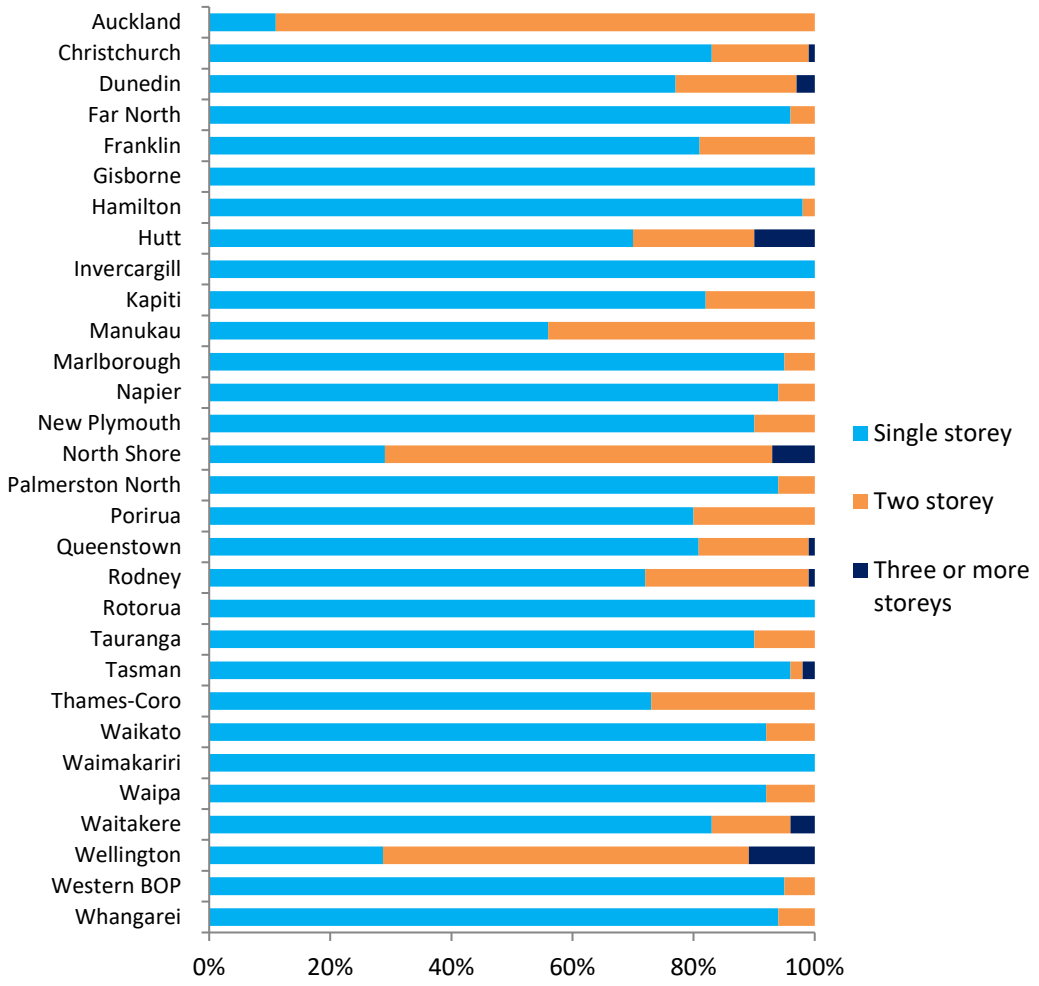
Injury type	Estimated reduction in injuries
Fatality	13
Severe injury	401
Non-severe injury	549

Source: NZIER

[2] After adjusting for the 20% of new single storey projects that used scaffolding prior to the introduction of the guidelines.

Figure 3 Percentage of house construction by location and storey

Based on a sample of houses from each area in 2014



Source: BRANZ, 2015

3.3. The value of the safety benefits

One approach would be to value the cost of injury based on the average ACC payment associated with the injury severity. However, this approach only covers the financial cost of ACC compensation and excludes other costs such as the following:

- Cost of loss of life and life quality
- Loss of output
- Medical costs
- Property damage costs
- Potential legal and court costs.

The social cost of injuries used in transport policy analysis incorporates these elements. The social costs of fatal, serious, and minor injuries were applied to monetise the cost of fall injuries to ensure the estimates are complete and consistent

to the approach used in other areas of safety policy analysis. The following social costs per injury were used:[3]

- Fatality – $4.14 million
- Severe injury – $776,000
- Non-severe injury – $77,000.

3.4. Does scaffolding generate cost savings for construction industry professionals?

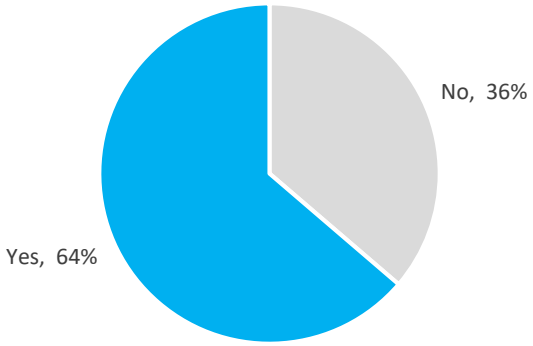
Direct measuring the productivity effects of using scaffolding compared to other approaches would require a methodology such as a time-in-motion study. This could include the productivity differences for working at heights and the productivity differences of the overall construction project. Further research could be done in this area.

The alternative approach is to use estimates based on survey results. The Nielsen Survey did not cover specific productivity benefits and cost savings. We have used the best information available to assess these benefits. To understand the additional benefits of scaffolding compared to other options, the BRANZ Tradespeople Survey asked industry professionals the following question:

"Does scaffolding provide better access and time savings on a job compared to alternative working platforms (e.g. trestles) previously used for single storey builds on level sites?"

Of the 151 tradespeople that were surveyed, 113 answered this question. Their responses are shown in Figure 4. The majority (72 or 64%) of respondents reported that scaffolding provided additional access or a time savings benefit compared to alternative apparatus.

Figure 4 Does scaffolding have additional productivity benefits?

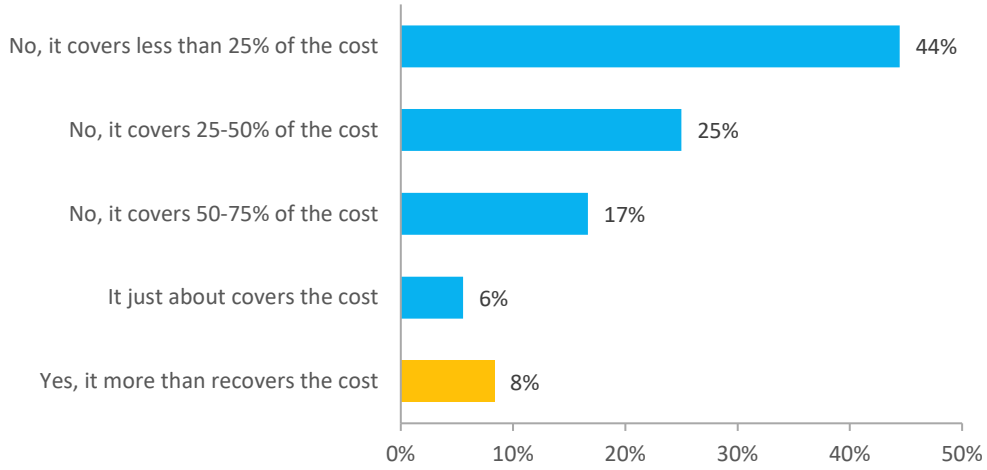


Source: BRANZ Tradespeople Survey, 2015

[3] http://www.transport.govt.nz/assets/Uploads/Research/Documents/Social-cost-of-road-crashes-and-injuries-2016-update-final.pdf

Are the benefits large enough to offset the costs of using scaffolding? To investigate the scale of the additional benefits we asked the same group of tradespeople to say how much of the cost of scaffolding was offset by the benefits. Figure 5 shows the range of responses. The majority of respondents who said there were additional cost saving benefits, said that those benefits covered less than 25% of the cost of scaffolding. A quarter of the affirmative respondents said that those benefits covered 25% to 50% of the cost and 17% of those that said there are additional benefits answered that the benefits covered between 50% and 75% of the costs. Another 6% said that the benefits just about covered the costs. Another 8% thought that the benefits exceeded the costs.

Figure 5 Do the additional benefits cover the costs?



Source: BRANZ Tradespeople Survey, 2015

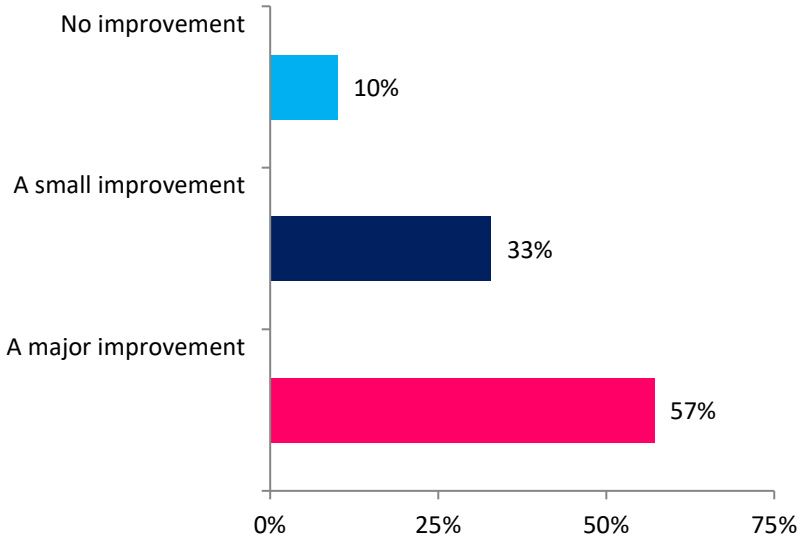
Overall 69% of those that said there were additional benefits compared to alternative solutions for working at heights said the benefits covered no more than half the cost of scaffolding. Of these respondents 86% did not think the additional productivity benefits covered the costs. However, another 14% respondents said that the benefits just about covered the cost or exceeded the cost. The weighted average of the results from the Builders Survey indicate that the cost saving benefit of scaffolding offset 41% of the costs.

Our approach means the productivity benefits are estimated as a proportion of the costs of scaffolding. Productivity benefits vary as the estimate of the cost of scaffolding changes.

3.5. Benefits for building inspectors

To get a robust understanding of how scaffolding may be beneficial for improving the quality of construction, BRANZ surveyed building inspectors (n=73) asking them "To what extent does scaffolding on single storey residential houses improve the quality of the inspection by improving access?" Figure 6 shows a majority think it is *"A major improvement".*

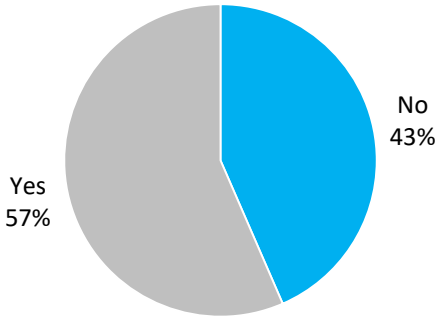
Figure 6 Does scaffolding improve the quality of inspection?



Source: BRANZ Building Inspectors Survey, 2015

To understand why building inspectors think it is a major improvement, they were also asked if it would lead them to identify issues that would have gone otherwise unnoticed. Figure 7 shows that majority of respondents (57%) stated *"Yes"*.

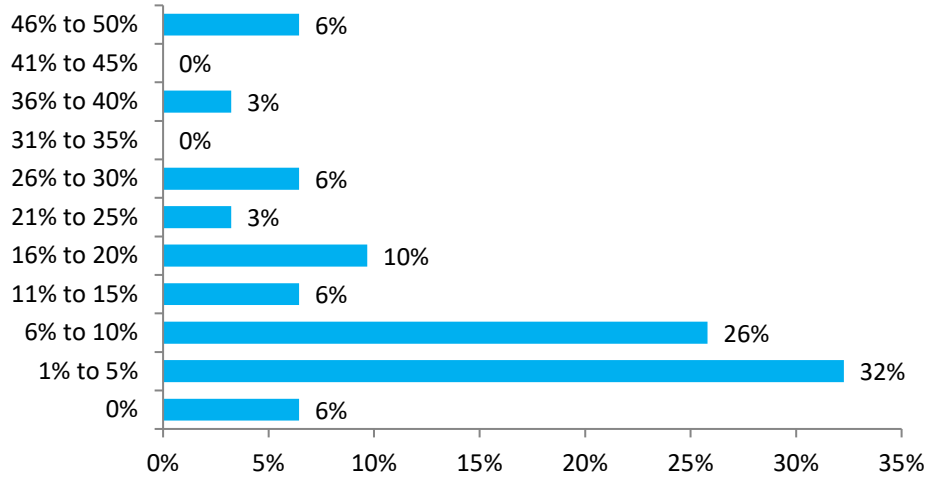
Figure 7 Does scaffolding lead to identification of otherwise unnoticeable issues?



Source: BRANZ Building Inspectors Survey, 2015

Building inspectors were also asked what percentage of houses inspected annually would you have been able to identify major structural problems, which would have been overlooked if scaffolding wasn't used. Figure 8 shows that (32%) of building inspectors only think it would have affected 1% to 5% of houses they inspect. Another 26% of inspector think it would have affected 6% to 10% of houses they inspect.

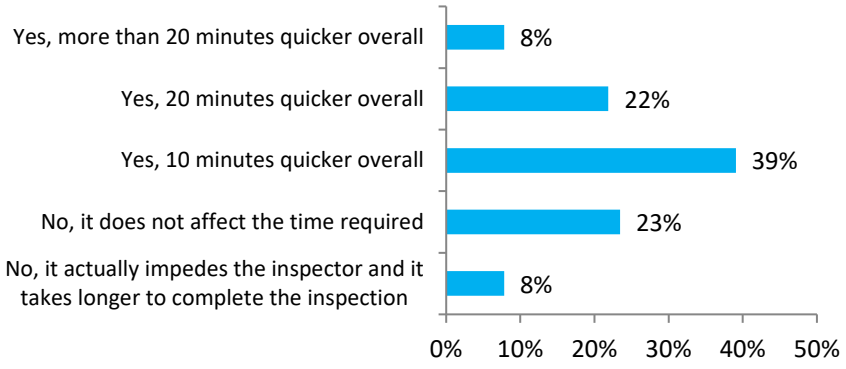
Figure 8 The percentage of houses would benefit from scaffolding at building inspections



Source: BRANZ Building Inspectors Survey, 2015

Finally, building inspectors were asked whether scaffolding makes the inspection process any quicker. Figure 9 shows that 69% of building inspectors surveyed found it does make the inspection process quicker. On average, a building inspector saves 10 minutes per housing inspection. By applying an hourly charge out rate of $150 per hour,[4] this time saving translates into $25 per housing inspection. Applying that cost saving across single storey new builds and if two inspections are required in the construction process, it would deliver a net present benefit of between $11.4 million and $14.4 million over 30 years.

Figure 9 Time saving benefits from scaffolding for inspections



Source: BRANZ Building Inspectors Survey, 2015

[4] Based on the average hourly rate reported in Department for Building (2008) and an adjustment for price inflation in professional services.

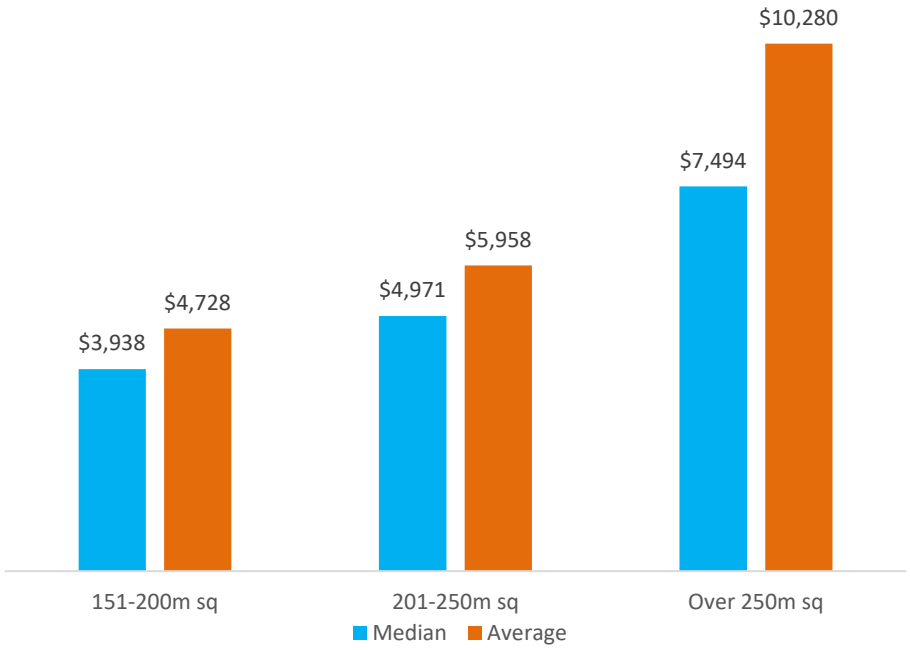
4. Estimating the costs

In this section, we examine the costs of using scaffolding when constructing new single storey residential houses. Nielsen Research surveyed 307 builders and construction specialists about the costs of scaffolding for the client. The responses included the costs of erection and dismantling over the entire duration of the build and excluding GST and overhead costs/margins.

The results of the Nielsen survey reveal a skewed distribution with a median cost response of $4,972 and an average cost of $6,743. The average cost is 35.6% higher than the median.

An examination of the response shows the size and the complexity of the build affected the responses. The graph below shows median cost varies between $3,938 and $7,494 as the floor area increases. The average cost varies between $4,971 and $10,280 as the floor area increases. The average floor area of a new house has increased from 150 sqm to 210 sqm from 1991 to 2016.

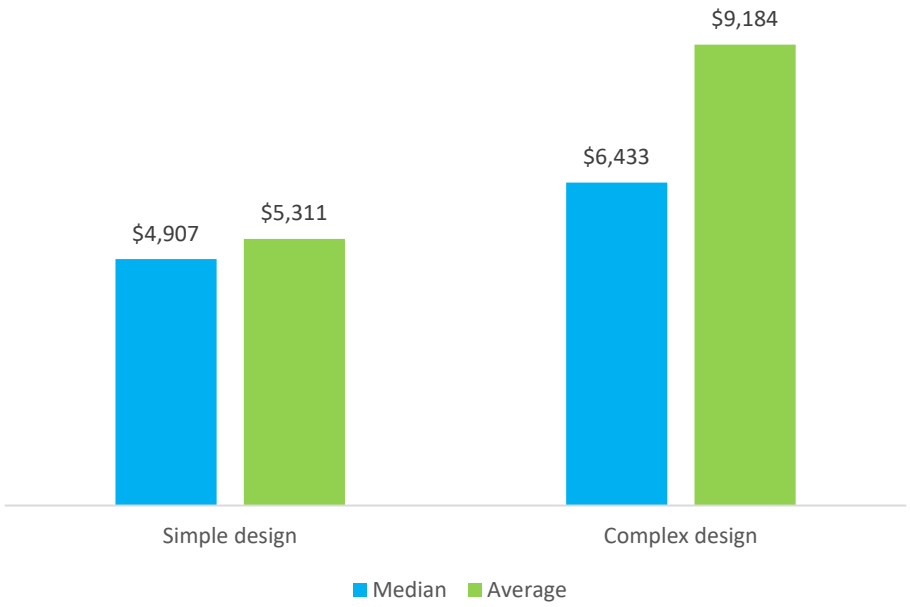
Figure 10 Cost of scaffolding by floor area



Source: Nielsen

The complexity of the design of the house also affects the cost of scaffolding to the client. Simple design in the Nielsen survey was described as largely rectangular. The number of corners and roof lines affects the amount of scaffolding required for a house. This suggests that the cost of scaffolding for low cost affordable houses is likely to be less than that for large bespoke designed houses.

Figure 11 Cost of scaffolding for simple and complex house designs



Source: Nielsen

4.1. Overhead margin

Builder charge and overhead margin covers the costs of administration, depreciation and office rental.[5] We have conservatively assumed the overhead margin charged to consumers is 5% of the cost of scaffolding.

4.2. Hire or own scaffolding

The costs of scaffolding discussed above are the costs for the client and they do not distingush between whether the builder owns or hires the scaffolding. The Nielsen research shows that builders have a perference for hiring scaffolding. The majority (78%) of main contractors said that the scaffolding used on the last single storey residential new build they were involved in was hired/leased only. One in ten said they exclusively use dtheir own only scaffolding and 12% said that scaffolding was both hired/leased and owned.

NZIER asked six builders why they choose to hire scaffolding rather than own it. The following reasons were given:

- Storage costs due to the space needed when it was not in use
- Transport costs
- The need to employ specialist staff with skills to erect and dismantle it
- It is easier to outsource such speciality skills like any other subcontractor.

[5] https://www.xero.com/nz/resources/small-business-guides/accounting/construction-job-costing/

5. Overall results

The benefits and costs discussed in this report were combined in the following equation:

$$Safety\ benefits + Productivity\ benefits + Inspection\ benefits - Costs$$

Table 9 shows the results based on the overall median cost of scaffolding of $4,972 for the period from 2018 to 2037. Present value of the costs was estimated to be $757.5 million. Using scaffolding was projected to reduce the number of fatal, severe and non-severe injuries by 13, 401 and 549 respectively, over 20 years. The estimated present value of the injury reduction benefits was $234.2 million. The present value of productivity and inspector benefits was estimated to be $295.8 million and $7.3 million. The results indicate that use of scaffolding on all single storey new builds would be a net cost to society of $220.2 million, over 20 years. The benefit cost ratio is 0.71.

Table 9 Estimated benefits and costs using the median cost of scaffolding for 2018 to 2037

Median cost of scaffolding $4,972 excl. GST and overhead margin	
Assumptions	
Productivity benefit	41.0%
Cost of scaffolding	$4,972
Overhead margin	5%
Discount rate	6%
Avoided injuries	
Fatalities	13
Severe injuries	401
Non-severe injuries	549
Present value of the discounted benefits and costs ($ million)	
Fatal injury benefits	$31.8
Severe injury benefits	$178.2
Non-severe injury benefits	$24.2
Total injury savings	$234.2
Productivity benefits	$295.8
Inspection benefits	$7.3
Total benefits	$537.3
Total costs	$757.5
Overall result	
Net present value ($ million)	-$220.2
Benefit cost ratio	0.71

Source: NZIER

Unsurprisingly the result worsens if the overall average cost of scaffolding for the client is used instead of the median. Table 10 shows the results, based on the overall average cost of scaffolding $6,743 excl. GST and overhead margin.

The results indicate that the use of scaffolding is a net cost to society of $384.7 million, over 20 years. The benefit cost ratio is 0.63. The costs are disproportionate to the benefits.

Table 10 Estimated benefits and costs based on the average cost of scaffolding

2018-2037

Average cost of scaffolding $$6,743 excl. GST and overhead margin	
Assumptions	
Productivity benefit	41.0%
Cost of scaffolding	$6,743.40
Overhead margin	5%
Discount rate	6%
Avoided injuries	
Fatalities	13
Severe injuries	401
Non-severe injuries	549
Present value of the discounted benefits and costs ($ million)	
Fatal injury benefits	$31.8
Severe injury benefits	$178.2
Non-severe injury benefits	$24.2
Total injury savings	$234.2
Productivity benefits	$401.2
Inspection benefits	$7.3
Total benefits	$642.7
Costs	$1,027.4
Overall result	
Net present value ($ million)	-$384.7
Benefit cost ratio	0.63

Source: NZIER

6. Sensitivity analysis

Due to the uncertainty involved in the proceeding analysis, sensitivity analysis was warranted. Two sensitivity scenarios were considered:

- Higher productivity benefits
- Including an estimate of a reduction injuries from falling objects.

What increase in productivity would be needed for the CBA to breakeven?

The most uncertain component of the analysis was the level of the productivity benefits relative to the costs. Our estimate of productivity benefits is that they are 41% of the costs. The productivity benefits would need to be 80% of the costs for the benefits to equal the costs (using the median cost of scaffolding).

Quantifying the additional benefits of fewer injuries from being hit by objects falling from above

The table below shows the number of injuries prior to any adjustment for attribution, based incident descriptions. The total number of injuries is less than the injuries from falling from heights.

Table 11 Overall changes in the number of injuries from being hit by falling objects

Difference in injuries between 2009-2011 and 2012-2014, prior to adjustments for attribution

Injury severity	2009-2011	2012-2014
Fatal	5	1
Severe	259	231
Non-severe	1,647	1,942

Source: NZIER based on Worksafe data

This category of injuries included other injuries than those being hit by objects falling from one level to another. For example, a significant share of the incident descriptions appeared to be about people dropping objects and injuring their lower body or hands. We were only able identify and attribute a small proportion of the injuries from the construction subsectors (see Table 12.) None of the fatalities from 2009 to 2011 were related to the situations where scaffolding would have prevented the person being stuck by the objects because they did not occur at the building perimeter.

As a result of the data limitation only a small additional benefit from a decrease in this type of injury was able to be estimated. The estimated present value of additional safety benefits was $2.19 million over 20 years.

Further research is required have a better understanding of the extent of benefit from a decrease in injuries from falling objects.

Table 12 Attributable injuries from falling objects

Sub-sector	%
House Construction	1%
Air Conditioning and Heating Services	3%
Bricklaying Services	7%
Carpentry Services	0%
Concreting Services	0%
Electrical Services	3%
Glazing Services	6%
Painting and Decorating Services	6%
Plastering and Ceiling Services	5%
Plumbing Services	0%
Roofing Services	2%
Structural Steel Erection Services	8%

Source: NZIER

7. Improving the guidance

The second research question is aimed at understanding whether there are ways to improve the guidance. We reviewed the guidance used in Australia and compared it to the New Zealand approach to understand the differences in the guidelines and consider if there are aspects that could be adopted in New Zealand.

The Nielsen survey included questions about the guidance. The main results were:

- 61% off respondents said the guidance is easy to understand (one third did not agree or disagree).
- 56% of respondents agreed the guidance provided different options for the work they do (34% neither agreed or disagreed).
- 62% of respondents said the guidelines helped them better assess hazards and risks associated with working at heights (29% neither agreed or disagreed).
- 43% respondents agree that, according to the guidelines, all single-storey new builds need scaffolding (19% neither agreed nor disagreed and 21% disagreed.)

These results show that the guidance could be clearer about the options for working at heights and using of scaffolding for single storey houses.

7.1. Comparison of the guidelines

Purpose and background

We have reviewed and compared the following guidelines for working at heights:

- *Best practice guidelines of working on roofs.* June 2012. Published by the Ministry of Business, Innovation and Employment, New Zealand
- *Best practice guidelines for working at height in New Zealand.* April 2012. Ministry of Business, Innovation and Employment, New Zealand
- *Preventing falls in housing construction: code of practice.* July 2012. Published by Safe Work Australia.

The aims of the review were to:

- Review the quality and clarity of documents from the users' perspective
- Explore if there are lessons for New Zealand from the Australian approach
- Consider if adopting aspects or features of Australian code of practice would enhance the guidance in New Zealand.

Since this comparison was completed an updated Australian code of practice has been published. An assessment of the updated code of practice is not in the scope of this report.

We note the Australian code of practice sits under a different set of regulatory requirements for managing the risk of injuries. The Australian regulation in this area is more detailed than in New Zealand. Whether a similar regulatory approach would be

beneficial in New Zealand has not been considered in this comparison. The focus of this comparison is solely how the guidelines could be improved.

Evaluation criteria

The review covered best practice principles and communication characteristics. The framework and criteria for the review were adapted from two sources. The communication, format and structure where drawn NZIER's policy advice benchmarking criteria. The best practice principles were adapted from the best practice regulatory principles in the Transport Regulatory Policy Statement 2012. Table 13 describes each of the evaluation criteria.

Table 13 Factors for evaluation

Best practice principles	
Proportionality	Recognises that the recommended or required methods should be proportionate to the expected risks.
Flexibility and durability	Guidelines should be able to evolve in response to changing circumstances – practitioners should be provided sufficient scope to adopt innovative and least costly approaches to meet the requirements.
Accountability	Accountability should be clear – guidelines should be consistent with the underpinning regulation. Accountability means a clear definition of who is responsible.
Certainty	The scope of the guidelines is upfront and clearly defined. Guidelines should provide consistent and pragmatic solutions or logic to provide certainty for practitioners. The guidelines should give users clarity about want they are expected to do in both principle and practice.
Culture and compliance	Encourages and reinforces positive behaviour as a first action — the guidelines promote a culture that encourages active risk awareness and mitigation. The requirements for compliance are clear and logical.
Clear and concise communication	
Language	Uses plain English and minimises jargon. Uses short sentences and paragraphs to make the reading task easier. Is uncluttered, and has no typos, grammatical errors, or other slips.
Structure	Is concise, and avoids duplication or unnecessary clutter. Uses meaningful subheadings as sign-posts and to tell a logical story. Summarises the key points, preferably in well under a page.
Format	The medium that best fits the situation. Uses diagrams and illustrations that are easy to understand and read.

Adapted from Ministry of Transport 2012 and NZIER 2015

Summary of key findings

Proportionality and risk-based approach

- All three documents encourage risk awareness and in-principle responses that are proportional to the risk assessment
- The definition and discussion of 'reasonably practicable' should be shifted to the beginning in both sets of the New Zealand guidelines
- Core words and phrases which are intended to shape work practices and culture should be concisely defined at the beginning of the document.

Flexibility and durability

- The Australian code of practice prescribes the conditions when certain fall prevention systems must be used. Practitioners retain some scope for discretion and innovation, which allows practitioners to tailor their fall prevention strategy to the specific form and scale of the risk
- In the New Zealand guidelines, the difference between a required, as opposed to a recommended approach is not always clear, which makes them appear more prescriptive and less flexible.

Accountability

- All three documents describe the duty care for suppliers, employers, and employees
- Both of the New Zealand guidelines could be improved by including a section on the responsibilities of duty holders at the beginning of the document like Section 1.1 of the Australian Code.

Certainty

Australian code of practice

- The scope is tightly defined
- The physical fall prevention systems are described in detail in the code and are specifically linked to the 5 levels of the hierarchy of control.

New Zealand's guidelines

- It is frequently unclear whether the guidance is a recommendation or a requirement.

Culture and compliance

- The Australian code of practice has a clearly defined risk management process, which will support a culture of active risk assessment and expected behaviour within the construction sector
- The New Zealand guidelines also promote a culture of risk awareness and fall prevention

- References to “the Ministry’s expectations” may not be helpful because they do not have clear standing for practitioners who are seeking to understand the requirements for compliance.

Language

- There is scope to improve the language around requirements and recommendations in the New Zealand guidelines
- Key terms should be defined at the beginning of the document. For example, in the *Best practice guidelines for working on roofs* some defined phrases (e.g. major roofing works) are used in the body of the document without any signal that they have a specific meaning and are described in the glossary at the end of the document.

Structure

- The structure of the Australian code of practice is better. It is clear about important key terms. The risk management process and responsibility is in the first section. New Zealand’s guidelines are not as well organised.

Format

- The Australian code of practice has an excellent layout, with clear and informative diagrams to assist busy practitioners.

General observations:

The Australian code of practice for preventing falls from heights in construction has the following key features.

1. An emphasis on a culture of safety by making it clear that both managers and employees have a duty to consider safety and identify risks
2. A framework for making trade-offs in the approach is applied when considering mitigating the risk of a fall from heights that is similar to the one in New Zealand. Duty holders are advised to take steps that are ‘reasonably practical’ which is defined by the weighing up four factors:
    a. severity of the risk or hazard
    b. the state of knowledge about controlling the risk
    c. availability and suitably of ways to eliminate or minimise risk
    d. the cost of elimination or mitigation the hazard or risk
3. A clearly defined hierarchy of control for considering the level of risk mitigation. The five levels of the hierarchy of control are summarised in Table 14. The hierarchy improves clarity about the expected approach to preventing falls from heights.

Table 14 Australian hierarchy of control

Level of control	Description of response	Examples
Level 1	Work on the ground or on a solid construction.	A deck area with stairs and guardrails.
Level 2	A raised temporary work platform where it is reasonably practical.	Trestle or scaffolding.
Level 3	A work positioning system where it is reasonably practical.	A travel restraint system the limits movement to only safe areas.
Level 4	A fall prevention system where it is reasonably practical.	Safety nets, scissor lifts or a full body harness.
Level 5	If none the above options above are reasonably practical apply administrative controls for working at heights including using ladders.	Limiting movement or exposure time through 'safe work statements' that define the guidelines for safety practice for working at heights.

Source: NZIER summary of Safe Work Australia, (2012)

A new regulatory environment

New Zealand's health and safety regulatory environment has changed in recent years. The Health and Safety at Work Act 2015 introduced a change in emphasis given to benefits and costs of safety interventions, in comparison to the Health and Safety in Employment Act 1992 (HSE Act).

The HSWA 2015 requires the person conducting a business or undertaking (PCBU) to take a reasonably practical approach to eliminate or mitigate health and safety risks in the workplace. Worksafe has recently published guidelines on the reasonably practical test in the Act.[6] PCBU's are required to consider and weigh up the following:

- The likelihood of risk occurring
- The degree of harm if associated with the risk
- What is reasonably known about the risk and the way of either eliminating or mitigating it
- The availability and suitability of options to eliminate or mitigate the risk
- Only consider the costs after the safety risks and potential interventions have been thought through
- Only consider an alternative approach if the cost of elimination or mitigation is grossly disproportionate to the risk.

Reducing the risk of injury is the primary focus of the HWSA 2015. The costs of interventions to reduce or eliminate the risk of injury are only to be considered after safety risks and options have been fully considered. The legal test is whether the cost of weighting the risk is grossly disproportionate to the level of the risk. This change in emphasis means that conventional balancing of benefits and costs, where a benefit cost ratio of one is used as a decision criteria does not apply for the legal test here.

[6] http://www.worksafe.govt.nz/worksafe/information-guidance/all-guidance-items/hswa-fact-sheets/reasonably-practicable/reasonably-practicable.pdf

The point or range that the costs are grossly disproportionate to risk has not been defined in terms of a benefit cost ratio. Policy makers and operators are required to make a judgement on what this definition might be.

Overtime, case law may establish a clearer definition. Waiting for case law is not the only option. Further research to define when the costs are grossly disproportionate to the benefits would reduce the ambiguity for PCBUs and policy makers alike. Both are both required to make decisions that influence safety, require the allocation of scarce resources and are subject to scrutiny.

A review of international definitions of grossly disproportionate would be a logical next step. It would inform the decisions of businesses and government agencies when they seek to comply with the HSWA Act. Indeed, if there was accepted definition of when costs are grossly disproportionate to the benefits it could have used to inform and enrich the guidelines discussed in this report. Looking forward, an evidence-based definition of 'grossly disproportionate costs' would add value and provide greater clarity in the development of any subsequent guidance on working at heights.

Table 15 Evaluation of the guidelines

	Australian Code of Practice – Preventing Falls in Housing Construction (July 2012)	MBIE Best Practice Guidelines for Working on Roofs (June 2012)	MBIE Best Practice Guidelines for Working at Height in New Zealand (April 2012)
Best practice principles			
Proportionality and risk-based approach	Encourages risk awareness and in-principle responses that are proportional to the risk assessment. The structure of the Code indicates a clear focus on assessing the risks and encouraging proportional responses. Useful subheadings encourage practitioners to think about for factors: risk severity, what is known, availability and suitability of mitigation options, the cost-risk trade-off. What is 'reasonably practicable' is described in a clear and concise section (2.2) at the beginning of the document.	Encourages risk awareness and in-principle responses that are proportional to the risk assessment. Guidance encourages practitioners to act in a reasonable and practicable manner. However, the section that most clearly communicates an approach that is proportionate and risk-based is at the back of the document, nested in the glossary of terms. It would be better to define and discuss the concepts of a risk-based and reasonably practicable approach at the beginning of the document to set the context for the reader.	Identical guidance to the Best Practice Guidelines for Working on Roofs but the guidance appears in the middle of the document rather than at the end.
Flexibility and durability	Within some conditions, practitioners retain some scope for discretion and innovation. This allows practitioners to tailor their fall prevention strategy to the specific form and scale of the risk. The code of practice prescribes the conditions when certain fall prevention systems must be used, but practitioners retain some scope for choosing the safety technology within defined thresholds. This creates space tailoring solutions to the situation and a degree of innovation, which will support cost management.	Fairly prescriptive. Scaffolding is the preferred means of access to temporary access, where practical. When the work constitutes 'major roofing work' (a defined term in the glossary) scaffolding is required (p.4). This suggests to practitioners that scaffolding is required or expected, but there may be some circumstances where it is not practical.	These are general best practice guidelines for working at heights. Scaffolding is one of several recommended options to reduce or eliminate the risk of falls from height. The guidelines reference a long list of industry specific standards and procedures for further reference.

	Australian Code of Practice – Preventing Falls in Housing Construction (July 2012)	MBIE Best Practice Guidelines for Working on Roofs (June 2012)	MBIE Best Practice Guidelines for Working at Height in New Zealand (April 2012)
Accountability	*"A person conducting a business or undertaking has the primary duty under the WHS Act to ensure, so far as is reasonably practicable, that workers and other persons are not exposed to health and safety risks arising from the business or undertaking"* (p.4). In addition to this, the responsibilities of designers, manufacturers, suppliers, importers, installers, company officers and workers are described briefly. The caveat of reasonably practicable is applied in each case (p. 5).	The guidelines could be improved by moving the sections on the responsibilities of duty holders to the beginning of the document like the Australian Code (section 1.1). It is made clear that adherence to the guidelines may be the subject of legal proceedings. *"The guidelines and adherence to them may be relevant as evidence in court"* (p.1).	Very clear section on 'Duty holder responsibilities' (section 8, pp.38-40). The guidelines could be improved by moving the sections on the responsibilities of duty holders to the beginning of the document like the Australian Code (section 1.1).
Certainty	The scope is tightly defined. The Code indicates that some level of physical fall prevention system is 'usually necessary' when working at a height of 2m or above. The physical fall prevention systems are described in detail in the code and are specifically linked to the 5 levels of the hierarchy of control. The Code indicates that trestle scaffolding has a trestle plank height limits of 2m for safety reasons. This would cover the task requirements for single storey residential buildings in New Zealand. Practitioners are also expected to consider the risks when working at heights of less than 2m and respond with responsible practical measures that reflect the risks. Scaffolding must be used above 4m and must be erected by a licensed scaffolder.	There is a lack of clarity around key terms, recommended approaches or required approaches which could confuse the industry. The prescribed terms 'shall', 'must', 'may' or 'should' do not appear in the section on access to roof areas (p.4). This could lead to confusion.	The distinction between recommendations and requirements is not consistently clear. This could be partly to the general nature of these guidelines. More use of the defined terms 'should, 'may', 'shall' and 'must' would improve clarity and certainty.

	Australian Code of Practice – Preventing Falls in Housing Construction (July 2012)	MBIE Best Practice Guidelines for Working on Roofs (June 2012)	MBIE Best Practice Guidelines for Working at Height in New Zealand (April 2012)
Culture and compliance	The Code of Practice outlines a risk management process, with includes risk identification, assessment, implementation of control measures, and consultation with all parties involved. This promotes a culture of risk awareness and collaboration to prevent injuries.	The guidelines promote a culture of risk awareness and proactive behaviour at all points in the organisational structure. There is evidence of this throughout the document, but it is most visible in section 12 on the responsibilities of duty holders. The second paragraph of the introduction emphasises a culture of risk awareness and management at all levels of an organisation working on roofs. *"The Ministry expects principals, employers, and contractors with staff working on roofs to actively manage any potential for falls"* (p.1). It would better to clearly communicate the regulatory requirements and obligations.	The 'hierarchy of control' promotes a culture of forward planning and risk reduction.
Clear and concise communication			
Language	Clear distinction between requirements and options. In providing guidance, the word 'should' is used in this Code to indicate a recommended course of action, while 'may' is used to indicate an optional course of action.	There is scope to improve the clarity of the document.	Emphasis on the expectations of the Ministry. "*In these guidelines, the terms "shall" and "should" are used. "Shall" is used where there is a requirement to meet legal obligations. "Should" is used as a way of indicating the practicable steps the Ministry expects to be taken on a particular matter"* (p. 8).

	Australian Code of Practice – Preventing Falls in Housing Construction (July 2012)	MBIE Best Practice Guidelines for Working on Roofs (June 2012)	MBIE Best Practice Guidelines for Working at Height in New Zealand (April 2012)
Structure	The document is well structured with meaningful subheadings that guide the reader. Definitions of key terms are defined in a glossary at the beginning of the document (p.5), which removes potential ambiguity around the meaning of key terms, before the reader gets in the body of the guidelines. Accountability and the responsibilities of duty holders are discussed before launching into the discussion of practice.	The structure of the document can be substantially improved. There is limited use of subheadings to guide and inform the reader. The definitions of key terms are defined in a glossary, which is at the end of the document.	Well structured, but it could be improved by moving the glossary of key terms to the front of the document.
Format	Excellent layout. Good balance between text and white space. Great of diagrams – simple, concise and informative. Specifications are shown in the diagrams when required.	An improved layout would assist the readers. It is currently text heavy. More diagrams are needed and some specifications that are in the text should also be in the diagrams to be more effective. Feels busy.	Excellent layout – good balance of text images and white space. Meaningful subheadings.

Source: NZIER

8. References

Boardman A. E., Greenberg D. H., Vining A. R., & Weimer D. L. (2005). Cost Benefit Analysis: Concepts and Practice. 4th ed. Prentice Hall.BRANZ (2015). *Physical characteristics of new houses 2014.*

Department of Building and Housing. (2008) *Identification and analysis of building consent, inspection and approval costs.*

Health and Safety in Employment Act 1992 (repealed)
http://www.legislation.govt.nz/act/public/1992/0096/latest/DLM278829.html

Health and Safety at Work Act 2015.
http://legislation.govt.nz/act/public/2015/0070/37.0/DLM5976660.html

Ministry for Business, Innovation and Employment. (2012). *Best practice guidelines for working on roofs*. Wellington: Ministry of Business, Innovation and Employment.

Ministry of Business, Innovation and Employment. (2012) *Best practice guidelines for working at height in New Zealand.* April 2012.

Ministry of Transport. (2012) *Transport Regulatory Policy Statement.*
http://www.transport.govt.nz/assets/Import/Documents/Transport-Regulatory-Policy-Statement-2012-Edition-Issued-4-May-2012.pdf Accessed on 28 July 2015

Nielsen. (2017) Worksafe New Zealand: Single-storey residential new builds survey.

Norman, D., Curtis, M., & Page, I. (2014) *A cost-benefit analysis of improved working at heights regulation*. Wellington: BRANZ.

NZIER. (2015) NZIER Policy Advice Criteria.

Safe Work Australia. (2012) *Preventing falls in housing construction: code of practice*. Australia: Safe Work Australia.

The Treasury. (2015) *Guide to social cost benefit analysis.*
http://www.treasury.govt.nz/publications/guidance/planning/costbenefitanalysis/guide/cba-guide-jul15.pdf

Worksafe New Zealand. (2017) *Reasonably Practical HWSA fact sheet.*
http://www.worksafe.govt.nz/worksafe/information-guidance/all-guidance-items/hswa-fact-sheets/reasonably-practicable/reasonably-practicable.pdf