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Residential Construction Waste Reduction: Case Studies and Resources

A report prepared by Beacon Pathway Incorporated

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About This Report

Title

Residential Construction Waste Reduction: Case Studies and Resources

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Abstract

This report brings together existing national case studies of residential construction projects that sought to establish better waste management processes in order to identify existing known barriers and opportunities for better waste management, reuse and recycling.

Reference

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Contents

1 Purpose of this report

This report brings together existing national case studies of residential construction projects that sought to establish better waste management processes in order to identify existing known barriers and opportunities for better waste management, reuse and recycling.

The information gathered from existing research will be used to inform current initiatives being undertaken by Auckland Council and Beacon Pathway to improve waste management processes at the NZ Housing Foundation residential housing development in Waimahia in 2014.

2 What is construction waste?

Construction waste is all non-hazardous solid waste resulting from construction, demolition and land clearing activities. Construction and demolition waste materials that can be salvaged, reused or recycled include, but are not limited to, the following:

Acoustical ceiling tiles	Asphalt
Asphalt shingles	Bricks
Cardboard	Carpet and pad
Concrete	Dirt
Drywall	Fluorescent lights &
Ballasts	Insulation
Land clearing debris	Metals
Paint	Porcelain
Wood	Plastic film from packaging
Window glass	Wood
Field office waste (paper, bottles, cardboard)	Cans, glass & plastic

3 What is the problem?

Construction and demolition waste may represent up to 50% of all waste generated in New Zealand, 20% of all waste going to landfill, and 80% of all waste going to clean-fill.

Considerable research has been conducted into the best methods for reuse and reduction of construction waste to landfill, and has identified substantial benefits with minimal change to site processes. Despite this, uptake of these findings has been slow.

The challenge in reducing the amounts of construction waste being sent to landfill is to develop methodologies to reduce construction waste sent to landfill, which are sustainable, simple to conduct and cost effective for builders in Auckland's current construction environment.

4 Case studies and resources

4.1 Source separation of construction wastes in New Zealand

Author: Sven Hanne & Carol Boyle

Date: 2001

Method: A site trial was undertaken on a large construction site in the Auckland Region, with source separation bins being installed on site

Benefits and Opportunities:

- Approximately 56% of construction waste by weight (50% by volume) was diverted from landfills. The major wastes that were included in this study were timber, steel, cardboard and plasterboard.
- The management costs arising from the set-up and operation of the source separation were minimal and easily compensated by the 19% saving in disposal costs.
- The main factors are availability of space on site, support from site management and operatives, as well as co-operation from the waste contractor. Source separation offers the combination of no risk and the potential to achieve significant financial savings.
- Depending on the technical level of sorting and recovery operation applied, 50-80% (by weight) of the C&D waste materials currently being disposed of in landfills could be diverted from landfills and the materials re-used or recycled
- **Wood**: Wood bins were the fastest filling bins over the course of the construction project and wood waste, by weight, exceeded all other material groups in the waste stream – even the commingled stream of materials not targeted for separation
- **Mixed**: No on-site sorting scheme can eliminate contamination of materials or sort out every type of waste material, as too many different material types and composites are integral to the construction process. That being the case, a mixed bin needed to remain on site and be differentiated from the single material bins
- **Finances**: The source separation trial resulted in a **19%** financial saving over standard disposal practice, which in this trial equalled **NZ$2,140**. This was made possible by the fact that all separated materials were accepted either at reduced rates or free of charge by recyclers and processors.

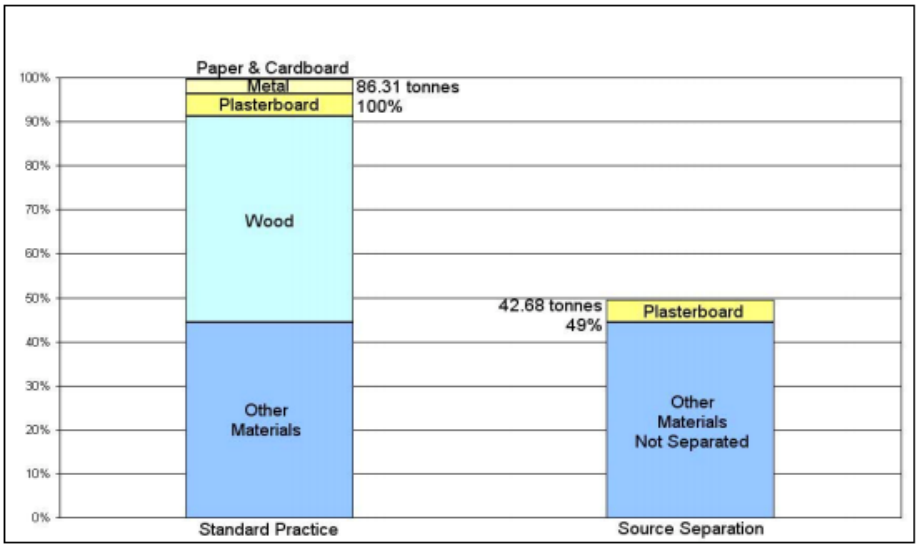

Figure 2: Comparison of Wastes Landfilled (by Weight)

4.2 Waste minimisation in the construction industry

Author: Pene Burns (Sinclair Knight Merz Limited)

Date: 2001

Method: Sinclair Knight Merz Limited conducted a 6-month, four case study, trial of construction waste minimisation opportunities in Christchurch City. The project was funded by Christchurch City Council as part of the "Target Zero" waste minimisation programme. The main emphasis was on training 16 site foremen in identifying and segregating wastes "at the end of the pipe"."

- Workshops were used to:
  - Educate and disseminate information to foremen and management about waste minimisation principles and the pilot study programme
  - Introduce local companies and organisations that transport waste and / or could help divert waste from landfills and clean fills.
- Sinclair Knight Merz visited case study sites once a week to communicate directly with the foreman managing the job, and gain an understanding of issues on a practical level
- It was the site foreman's responsibility to ensure segregation occurred, as this person had responsibility for the work of all staff and sub-contractors.

Benefits and Opportunities:

- All four case studies reduced their waste disposal costs as a result of practical, on-site, waste minimisation procedures. Savings were made because most recycling / reuse opportunities were free, i.e. there was no cost to have the materials removed from site. In the construction

industry, waste costs are directly related to profit margins, and so any cost saving is a direct increase in profit.

- Both companies achieved reductions in waste disposal volumes of 20-40% and costs of 10-80%.
- One case study in particular, the Hagley Community College, saved 84% of the total potential waste bill by salvaging valuable materials to offset the waste disposal costs
- Soft plastic recycling through The Warehouse retail group was successfully implemented half way through the pilot study. A wool sack (provided by The Warehouse) was set up next to the waste skip and labeled.

Barriers & Costs

On all four study sites, there were still significant amounts of recyclable and reusable materials recorded in the waste skips, even with segregation systems in place. This was a result of:

- The recycling industry infrastructure is not well established or integrated and potential participants have difficulty in obtaining information and making contact with recyclers.
- Inadequate staff and subcontractor training exacerbated by high turnover of subcontractors.
- Time pressures meaning that staff and management would not have time to investigate waste minimisation.
- A lack of co-ordinated transport services to the various recycling facilities, unlike the waste disposal industry
- Community groups lacking resources to organise collection and redistribution of firewood and other sought after materials. Groups were often difficult to get hold of and could not make decisions quickly, creating a problem for the foremen who required a reliable service to collect materials on demand.
- Little marketing and advertising in the local recycling industry. Some commercially viable markets such as salvage, metal recycling and cardboard recycling are well known; however, it is difficult to get information on what services are available in industries such as plastic recycling or concrete crushing.
- A lack of information about the savings associated with diverting waste from disposal.

Mainstream implementation of waste minimisation is unlikely to occur until the recycling and reuse industry is more proactive, waste contractors provide essential services that support segregation and information regarding waste minimisation is effectively disseminated through the construction community.

4.3 REBRI and the Easy Guide to Reducing Construction Wastes

Author: Roman Jaques & James Mittermuller

Date: 2001

Methods: Conference paper discussing two new resources for assisting the building industry with waste management: a one stop shop website and a complimentary pocket guide.

Benefits and Opportunities

The paper identifies various methods of reducing the building sector's contribution of C&D waste, for example through:

- Design and procurement practices which allow for resource-efficient methods of construction, such as the use of prefabrication, modular design and the matching of sheet sizes to room sizes to reduce cutting (Jaques, 1999)
- On-site separation to recover reusable and recyclable material and also separation for cleanfill disposal (Patterson, 1997, Park, 1999, and Glucina, 2001)
- Good 'housekeeping', such as having centralised cutting areas, keeping a tidy site etc. (Forrest, 1997 and Mittermuller, 1998)

Barriers & Costs

Jaques and Mittermuller note that getting practitioners within the construction sector to alter their traditional methods and processes can be difficult. There are several reasons for this, including:

- The lack of freely available resources and education on practical methods to reduce waste, which are specifically tailored for the building industry.
- The extra planning that waste management practice involves, whether considering 'start-of-pipe' or 'end-of-pipe' measures.
- The difficulty in easily finding markets/outlets for some recyclable/reusable materials, and the volatility of those markets.
- The nature of the construction industry itself, being relatively conservative and fragmented, making it slower to respond to change and a barrier to improved practices.

4.4 Construction and demolition waste: Best practice and cost saving.

Author: Mahara Inglis - Ministry for the Environment

Method: The Ministry for the Environment and a number of local councils sought to apply the REBRI guidelines to practical construction projects as case studies

Benefits & Opportunities

Financial benefits of construction waste management included:

- Reduced disposal costs.
- Reduced spending on over-ordered materials that are then wasted.
- Revenue from sale of salvaged items. This is available primarily during demolition operations.
- During the NZ Archives construction project, there was a 21% cost saving experienced by monofil bins over mixed waste bins. The sorting system on the site led to a reduction in disposal costs and higher recycling rates of the materials gathered
- Set up a sorting system on-site to make the most of lesser charges incurred by mono-fill bins

Resource efficiency and waste minimisation brings benefits to business including:

- Financial benefits
- Utilising best practice ensures a highly qualified and well trained workforce is maintained
- Improved processes.
- Linkages with 'Green Star'.
- Corporate social responsibility.

The case studies identified that the following opportunities and processes were helpful in encouraging waste minimisation

- Talking to waste contractors about providing mono-fill bins for a lesser charge. This was best done at the tender stage because some waste contractors do not openly advertise their recycling capabilities.
- Involved employees in decisions as they often hold the most practical 'on the ground' knowledge of processes. Encourage involvement not only raises morale but allows them to identify possible gains.
- There is a two-payment principle. You pay to get materials onto the building site and if you do not use them you are also paying to remove them. Essentially you pay twice for materials you do not use. Liaise with your suppliers for 'just in time delivery' and minimise over ordering of materials.
- Meet with the waste contractor to discuss phasing of bins allows for greater fluidity in removal. The arrival of bins can be timed to fit with when specific waste materials are created. For example, a bin for plasterboard only needs to be present during the internal fit out stage of construction.

- Regular ‘site inductions’ which cover waste minimisation practices as well as clearly labelling the different waste bins.

Barriers & Costs

- **Money spent on recycling:** It is a common misconception that recycling services should be essentially free of charge. This is however not the reality and it is very rare that commercial construction recycling will be provided free of charge. Money will still need to be spent on removing ‘waste’ materials from site either to be landfilled or recycled.
- **Time lost**: The most common cost experienced in waste minimisation is lost time. Setting up new systems and communicating them to staff all take time and effort. This is often the first barrier to implementing waste minimisation.
- **Low information** available on what services are available for recycling of C&D wastes.
- **Irregular** removal of bins.
- **Communication**: Waste minimisation practices with a range of different subcontractors that came on and off the site.

4.5 Reducing Waste from Start to Finish (unpublished)

Author: New Zealand Housing Foundation

Date: 2009

Methods: Monitoring ten house constructions, using data to inform future waste management methodologies.

Benefits and Opportunities

- Engagement with a single contractor on site produced efficiency of scale as resources and facilities were shared. Also, having the same subcontractors meant there was consistent knowledge around tidiness and waste processes.
- An on-site labourer was hired to remove waste materials from each house site. The labourer then sorted through the material deciding which could be sent for resource reuse and recovery.
- Two bin system was used one that was sent to waste contractors for sorting, the other bin, owned by Heards (the employer) was for salvageable re-use materials and when the bin was full was sent back to a depot where is was separated.
- The project used modular construction techniques and a small number of designs, this led to wastage reductions due to the ability to standardise materials.
- Materials that are stored under cover are much easier to be re-used as they are less damaged.

Barriers and Costs

- Construction site space can be a limiting factor for effective waste minimisation practices.
- Disposal of treated wood with limited recycling options. There are negative environmental outcomes when people are allowed to burn or compost contaminated material such as this.

- Disposal of cardboard and plastic was more difficult than other waste streams. The report suggests on-site cages to collect cardboard.
- Site tidiness. The study observed that occasionally outside work areas would become cluttered and congested. This led to material damage and wastage.
- Exposed sand and soil would be wasted away into storm water systems unless piled correctly in the right location.

4.6 Reducing waste: Havelock North Best Homes™

Author: Lois Easton, Beacon Pathway Inc

Date: 2012

Methods: Demonstration Project

Horvath Homes focused on both reducing the amount of waste produced and diverting as much waste as possible from landfill. On site, the construction manager was designated to be in charge of waste management. In this study the construction manager produced a short waste minimisation plan before the project began and briefed all subcontractors on their responsibilities. One point of difference in this study was the absence of a conventional skip. The only bin on-site was for wood; all other waste was collected and dealt with immediately.

Benefits and Opportunities

- The only bin on site was for timber; all other wastes were piled up and removed quickly when produced. This meant that the site remained tidy, and the temptation to stick recyclables in the bin destined for landfill was eliminated.
- Timber off-cuts were taken back by PlaceMakers, used for noggins, jack studs and blocking, and any remaining timber waste was used as fuel in the nearby Whirinaki Power Station
- Paint containers were taken back by the supplier for recycling, and waste water from paintbrushes was cleaned in a paint cleaning system.
- Plumbing and drainage offcuts were taken by the supplier.
- Polystyrene offcuts from the cladding were taken back by the supplier who returned them to the manufacturer for recycling.
- Good practice in terms of planning – construction schedule, tracked and updating, ordering materials ahead – meant not doing things in a rush, but in a planned and coordinated manner.
- Regular site reporting – the construction manager visited the site everyday, documented what was going on (taking photos and a couple of lines of notes) – this identified issues/problems as arose, not later on.
- The Havelock North Best Home™ has a total floor area of 186.68m2. In total, 15.15kg/m2 of floor area (2829.15kg) of waste was generated from the house's construction. Of this, 95% (2696.15kg) of waste materials was diverted from landfill.

Barriers and Costs

- Errors and rework generated substantial extra waste, even in this well-project managed house. Over 58% of the waste produced was concrete/masonry. This was reflected an error in the installation of a concrete thermal wall in the house, which then had to be completely reworked – creating an extra 900kg waste (31.8% of total waste generated).

5 Opportunities for better waste management

Consensus in these case studies was that, with little disruption to business-as-usual, waste management plans could lead to considerable diversion of waste from landfill, resulting in noticeable savings. Savings came from decreased disposal costs, reduced spending ordering material and salvage of valuable materials.

On-site sorting was the preferred method of waste diversion from landfill and often resulted in significant percentages of waste being recycled. The New Zealand Archives construction project showed a 21% cost saving by the use of mono-fill bins rather than conventional mixed waste bins.

Hanne and Boyle showed that it was possible to divert approximately 56% of construction wastes by weight from landfills. This included the main waste streams of timber, steel, cardboard and plasterboard. The key factors they identified that encouraged better waste management were: availability of space on site; support from site management; and co-operation from waste contractors. Sinclair Knight Merz's Hagley Community College case study showed an even greater saving of 84% of the total potential waste bill by salvaging valuable materials to offset the waste disposal costs.

On-site waste processes were enhanced by regular site reporting and management. During the construction of the Havelock North Best Home™ the construction manager visited the site every day to document waste processes. This allowed for the identification of issues/problems as they arose, not later on.

Financial benefits from this diverted waste was significant, with some studies showing that source separation methods could result in a 19% financial saving over standard disposal practice, savings on a large construction site were shown to save NZ$2,140 over the length of the project. Diversion is made possible by the fact that all separated materials were accepted either at reduced rates or free of charge by recyclers and processors, however this free-rate was not seen in all case studies.

Along with financial benefits there are a number of side benefits of resource efficiency were observed including improved processes, linkages sustainability accreditations positive Corporate Social Responsibility outcomes, and employee empowerment, when they were involved in developing processes.

Establishing C&D waste minimisation processes has been shown to greatly benefit organisations both financially and in other areas of their business such as CSR. There has been a significant amount of research supporting these benefits, but, as yet, practical, sustainable methods of implementing site waste methodologies have failed to change the quantities of C&D waste being disposed at both clean fill and landfill around the country. The next section elaborates on some of the barriers to waste management processes being established and sustained.

6 Barriers to better waste management

These New Zealand case studies also share consensus of the barriers to achieving good waste management. Primarily, the case studies identified a lack of practical information available to site managers and staff for the successful implementation of good processes. Lack of training in these processes, exacerbated by a high turnover of subcontractors, appears to impede the implementation of long-term, sustainable waste management.

Capacity and organisation of the recycling industry appears to lag behind that of conventional waste to landfill organisations. Added to this was the lack of resources available by groups to collect and redistribute usable leftover construction resources. Having materials accumulating on site can become a hazard if not effectively managed and claimed efficiently. The case studies also found a common misconception was that recycling services were free of charge. Removal from site was sometimes costly and some studies suggested it was rare to find organisations who would remove waste free of charge.

Even though on-site sorting processes did not diverge greatly from business as usual, modifying behaviour represented an increase in short term costs, and even with the promise of long term savings, still appeared to hinder waste management. Tight time pressures also meant that contractors did not have time to investigate and implement better waste minimisation practices. Setting up new systems and communicating them to staff took time and effort;, this was observed by Inglis to be one of the greatest barriers for implementing waste minimisation processes.

It was observed in the Havelock North Best Homes™ case study that, even when significant effort was put into the better waste management processes, errors and rework could still generate substantial extra waste.

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