

CONSTRUCTION AND DEMOLITION WASTE – BEST PRACTICE AND COST SAVING

MAHARA INGLIS
BCA, BSc

Ministry for the Environment, 23 Kate Sheppard Place, Wellington.

ABSTRACT

Construction and Demolition (C&D) waste is one of the largest global waste streams and makes up an estimated 50 per cent of all waste in New Zealand (WEB 1). Yet for all its environmental impact it is often overlooked in the sustainable building process. This is despite the fact that much of it can be easily reduced, reused and recycled. This presentation will show that by incorporating simple waste minimisation practices during the design, construction and demolition stages, you can save money and increase the sustainability of your building.

The Ministry for the Environment, in collaboration with local government and industry, has developed a set of best practice guides on how to reduce C&D waste. The Resource Efficiency in Building and Related Industries (REBRI) project developed a set of practical guides that reduces waste through improved resource efficiency. The guidelines look at the whole life of a building, from design and construction through to deconstruction/demolition. The guidelines are designed to be practically applicable ranging from two page 'Easy-guides' through to 20-30 page reports.

Once the guidelines were published work began on a number of cases studies. One example is the new Meridian building being built on the Wellington waterfront (expected to be completed by August 2007 in time for the final case study to be presented at the conference). This case study involved the Ministry for the Environment contracting a consultant to provide assistance in implementing the guidelines on the construction site. Results from the project so far include an on-site sorting system, material recycling, waste volume monitoring, staff education and material re-use. All this has led to the diversion so far of 5m³ paper, 4m³ mixed recycling, 2m³ metal and 200m³ of timber². Indeed the project has been so successful that Fletcher Construction is looking to expand the resource efficiency and waste minimisation practices to other sites in Wellington.

KEYWORDS

REBRI; construction and demolition waste; resource efficiency, waste minimisation.

INTRODUCTION

Construction and demolition waste is a major environmental issue and one often overlooked during sustainable building. There are a number of environmental and moral reasons why minimising C&D waste is important. However, this paper will look at the more pragmatic reasons for minimising C&D waste. It can be broken down into two main parts - the business case for reducing C&D waste; and the practical ways in which it can be done.

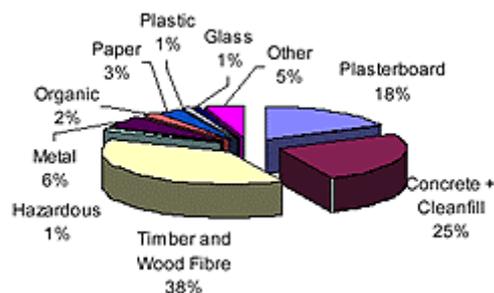
The business case for reducing C&D waste can essentially be broken down to three sections: the first will outline where some costs are incurred during waste minimisation activities. The second section will look at the purely financial benefits. The third section will focus wider business benefits.

The second part covers waste minimisation and resource efficiency. This is broken down into sections on design, construction and demolition. This will examine how each phase of building can implement

simple systems that improve resource efficiency and minimise C&D waste. These sections will include examples of what has been done as well as key lessons.

BACKGROUND

Construction and demolition waste is the largest waste stream in New Zealand. It is estimated to make up 50 per cent of all waste in New Zealand (WEB 1). This can be broken down into approximately 26 per cent, or 820,560 tonnes of waste to landfill every year and the vast majority of the 2.7 – 3.7 million tonnes of waste to cleanfill (Ministry for the Environment, 2007). Construction and demolition waste is a unique waste stream as it is defined by an ‘activity’ rather than any single ‘material’. Efforts to reduce overall C&D waste has so far focused on the ‘Big 3’ waste materials - timber, plasterboard and concrete. It is estimated they make up the majority of C&D waste, including 81 per cent from construction sites (Paterson, 1997).



(Paterson, 1997)

In an effort to address this issue, a number of stakeholders including central and local government, research institutes and product suppliers, got together to develop a series of guidelines for minimising C&D waste. The Resource Efficiency in Building and Related Industries (REBRI) project worked closely with the construction and waste industries to develop a series of practical guidelines aimed at reducing C&D waste by improving resource efficiency. Resource efficiency is essentially about using materials, energy, time, money and labour more efficiently to reduce the waste generated (WEB 2). Once the project was completed the guidelines were published on the internet at www.rebri.org.nz.

REBRI Case Studies

Since the publishing of the guidelines the Ministry for the Environment and a number of local councils have sought to apply the guidelines to practical construction projects. The Ministry’s process is to identify possible and interested projects. The Ministry then engages with the project coordinators and develops a memorandum of understanding regarding resource efficiency and waste minimisation during the project. The Ministry then contracts a consulting firm to provide expert advice on the REBRI guidelines, resource efficiency and waste minimisation practices to project contractors. The main objectives for these case studies are:

- Test the validity of the guidelines on a practical project.
- Build capacity within project contractors (e.g. designers, construction companies) for resource efficiency and waste minimisation.
- Raise awareness and build momentum for resource efficiency amongst construction companies, waste contractors and the wider community.
- Build a business case for resource efficiency.
- Minimise waste coming off a significant construction project.

The Ministry is currently engaged in four REBRI case studies:

1. The Meridian Energy Building on the Wellington Waterfront.

2. The New Zealand Archives Building in Auckland.
3. The Wellington Zoo Animal Hospital.
4. The Housing New Zealand development in Northcote.

The final reports of both the Meridian and New Zealand Archives projects are due to be published in the third quarter of 2007.

COSTS

Experience has shown that overall C&D waste minimisation can lead to a decrease in costs (WEB 3). However implementing waste minimisation practices often this involves changes in processes which can add or incur some costs. The sections below outline the primary cost issues that have been experienced as well as how they can be overcome.

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.

Meridian Energy

During the Meridian project the change in processes necessitated a change in the site design as well as time spent on developing a waste minimisation plan. Feedback from the contractor has indicated that they believe this process will become much faster as the new process become imbedded (Personal Comms, Marta Karlik-Neale).

NZ Archives

The NZ Archives project also required a change in processes and redesign of the site. Many of their comments were similar to those on the Meridian Site in that things would become much easier at the next project and once practices were imbedded (Personal Comms, Brain Robinson).

Key Lesson

- Establish the systems to start with and this will aid in implementing them at a later date on other sites.
- Make sure they are well communicated to staff.

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. The benefits arise when there is a cost differential between materials going for recycling and those going to landfill. An outline of benefits of the cost difference can be found in the section below on 'Financial Benefits'.

FINANCIAL BENEFITS

A significant part of the Ministry's REBRI project has been establishing the business case for waste minimisation. Experience has shown that resource efficiency and waste minimisation can lead to financial benefits for C&D contractors (WEB 3). This section will outline the primary ways in which financial benefits occur:

1. Reduced disposal costs.
2. Reduced spending on over ordered materials that are then wasted.
3. Revenue from sale of salvaged items. This is available primarily during demolition operations.

Reduced disposal costs

This comes about from reduced volumes of mixed waste being sent to landfill. Mono-fill bins which are sent for recycling often incur a lesser charge than mixed bins.

NZ Archives

During the NZ Archives construction project there was a 21 per cent 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 (Personal comms, Amy Clore).

Meridian Building

Precise figures on what has been saved during this project are yet to become available. However all are sure that there has been a financial saving. The only issue is that some recycling services were provided free of charge by the Wellington City Council. In order for an accurate analysis of on-going cost savings there will need to be a removal of waste cost included in the accounting.

Key Lesson

- Talk to your waste contractor about providing mono-fill bins for a lesser charge. This is best done at the tender stage because some waste contractors do not openly advertise their recycling capabilities.
- Set up a sorting system on-site to make the most of lesser charges incurred by mono-fill bins (details on setting up a system are included in the 'Construction' section).

Reduced spending on over ordered materials

REBRI case studies have shown that a large amount of C&D waste generated comes from over-ordered stock.

Maddren Homes

During a waste audit on a Maddren Homes construction site, they estimated that 2.3 per cent approximately (\$1700) of the total construction costs were wasted by over ordered materials being sent to landfill. (WEB 3)

Key lesson

- Always remember the 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.

Revenue from salvaged items

This is often generated from high value fittings and hardwoods that are recovered. Revenue can also be generated by recovering steel reinforcing from concrete and crushing the concrete into aggregate (Personal comms, Peter Ward). This can be done either on a separate processing site, or on-site crushing for re-use as aggregate on any new construction.

Blows Building

During the deconstruction and demolition of Blows Building in Auckland, 95 per cent of materials were recovered. This contributed to an estimated \$153,000 in savings on demolition costs. Extra labour costs were more than covered by reduced dumping costs and on-sold materials. (WEB 5)

Key lesson

- Liaise with the client to try and allow more time for recovery of fittings.
- Determine whether there is any need for aggregate on a new construction project and whether there is sufficient volumes/zoning for concrete to be crushed.

WIDER BUSINESS BENEFITS

Along with financial benefits there are a number of ways resource efficiency and waste minimisation can be beneficial to your business. They are:

- Current best practice.
- Improved processes.
- Linkages with 'Green Star'.
- Corporate Social Responsibility.

Current best practice

The REBRI guidelines can be considered best practice in resource efficiency and waste minimisation within New Zealand. By implementing the guidelines in the operation of your business you can maintain a highly qualified and well trained workforce.

Improved processes

Implementing resource efficiency allows site managers to examine their processes. Experience has shown that this can lead to greater dialogue with general workers and improved processes.

Meridian building

On the Meridian site 'Tool Box' sessions were held where site workers were brought up to speed on waste minimisation activities and encouraged to put forward ideas for improved waste minimisation practices (Personal comms – Marta Karlik-Neale).

There have also been examples of resource efficiency and waste minimisation contributing to a rise in morale amongst the site workers. On both the Meridian and NZ Archives sites workers felt positive that they were both engaged in the processes and to be contributing to something that was good for the environment.

Key lesson

- [Employees like to feel involved in decisions and often hold the most practical 'on the ground' knowledge of processes. Encourage involvement and you will not only raise morale but allow them to identify possible gains.](#)

Linkages with certification schemes

Sustainable building certification schemes often allocate 'points' for those who have minimised the waste during construction. For example the 'Green Star' rating scheme currently has three points directly linked to waste minimisation practices, as well as additional points available in the 'Materials' subsection. These points can not only be easily achieved but as mentioned earlier can cut costs during construction.

Meridian Building

This project is one of the first case studies that will use the 'Green Star' rating scheme. It is currently reducing its waste by approximately 64% (as of May). This is enough to be eligible for 2 points within the 'Green Star' system and only 6% away from being eligible for 3 points.

NZ Archives

While this is not using any sustainable building rating scheme, it is easily achieving a minimisation rate of approximately 50%. This would achieve two points within a 'Green Star' rating scheme on waste management.

Corporate social responsibility

Around the world there is a huge emphasis being put on sustainability and corporate social responsibility. Consumers such as the LOHAS demographic, estimated to represent 32 per cent of the adult US population (WEB 6), are beginning to demand sustainable products. The New Zealand government is also beginning to both drive and mandate sustainable practices. For example the Govt³

programme, which looks to improve sustainable practices and increase sustainable procurement, currently has 49 government and wider state sector agencies signed up. Resource efficiency and waste minimisation are factors that can contribute to a company's sustainability profile.

DESIGN STAGE

This section incorporates the roles at the beginning of a project, including project managers and architects. It is often the phase where the biggest impact can be made in minimising waste, by developing and implementing efficient systems.

Project managers

During the initial stages of a project a lot can be done to minimise waste, in particular during the tender stage. This can ensure resource efficiency and waste minimisation principles are adopted throughout the different phases of a project. Experience has indicated that this does not lead to any significant increase in costs as it is still part of a competitive process (Personal comms, Kevin Crutchley).

Key lessons

- Stipulate in the 'Request for Proposals' (RFP) for designers that they must provide complete drawings and specify recycled content in materials.
 - Studies have shown that incomplete drawings are a contributor to waste generation (SKM, 2004).
- Stipulate in the RFP for construction/demolition contractors that they must have and implement a waste minimisation plan for the site.
 - Include specific targets for recycling (examples of easily achieved recycling rates can be found in the 'Construction' section).

Architects/Engineers

A study conducted by Sinclair Knight Merz (2004) as part of the REBRI project identified designers, architects and engineers as having a great deal of influence and control over resource efficiency during various stages of construction and demolition. There are a number of ways in which this can be carried out.

There are a number of simple ways in which waste can be minimised during design, in particular by making sure that designs are comprehensive and complete. Industry representatives have identified that incomplete design specifications are often presented to tradespeople and can lead to over ordering of materials, ordering the wrong materials or making mistakes in construction. All of which contribute to greater waste (SKM, 2004).

Warren and Mahoney

Warren and Mahoney used a number of methods to drive C&D waste minimisation through better design. One way of doing this is by selecting materials with high amounts of recycled content, which in turn helps develop markets for recovered materials. Warren and Mahoney have found this can be done with little or no impact on cost or time. They contend that designing for modularisation, while it does not work on every building, has been successful in office buildings. For example, Warren and Mahoney, in the NZI3 Information Technology building that they designed for Canterbury University (Personal comms – Graeme Finlay).

Key lessons

- Select materials with high recycled content.
- Ensure designs are accurate, detailed and complete.
- If carrying out deconstruction/demolition liaise with the contractor to decide on an appropriate time period that will allow for increased recovery rates.

CONSTRUCTION STAGE

There is much that can be done during the construction stage to minimise and recover waste materials. Outlined below are basic outlines of REBRI cases studies that were carried out and the lessons learned.

NZ Archives – Manukau

Background

During this project the Ministry for the Environment contracted MWH consultants to provide expert advice on resource efficiency and waste minimisation to Mainzeal (the contractor). This project had support from senior managers within Mainzeal and was viewed as a ‘bridge-head’ project.

What was done

During the construction of this building Mainzeal implemented a waste management system which included a centralised sorting system. Waste Management provided mono-fill bins which were sent off for recycling. These bins were also charged at a lower rate than mixed bins.

Mainzeal also worked with Full Circle for recycling facilities near the kitchen and on-site office. The kitchen and office recycling was seen as important because it not only recovers materials but imbeds the practice of recycling with the site workers.

Mainzeal also implemented a practice of requiring subcontractors to remove their own waste (such as packaging) when they leave the site. This was seen as particularly successful as subcontractors often have established relationships with suppliers who can take back their product or have in-house recycling systems of their own.

Issues

Mainzeal encountered some issues with provision of adequate recycling services. These included:

- Little information available on what services are available for recycling of C&D wastes.
- At times irregular removal of bins.
- Communicating the waste minimisation practices with a range of different subcontractors that came on and off the site.

How to overcome

- 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.

Result

These simple steps have allowed Mainzeal to divert an estimated 50 per cent of materials from the site. Comments have also been positive and the Mainzeal site coordinator believes that even better results can be achieved on future projects by better phasing at the start. A ministerial visit to the site also brought C&D waste issues to the attention of senior management within Mainzeal.

Meridian Energy Building – Wellington Waterfront

Background

The Ministry for the Environment contracted URS to provide expert advice on resource efficiency and waste minimisation to Fletcher Construction (the contractors). This project received support from senior managers within Fletcher Construction and was known as ‘bridge-head’ project.

What was done

Fletcher Construction developed a site waste management plan that included waste sorting and reuse, recycling programme, suppliers and trades management and awareness and training activities.

Practical examples of how the plan was implemented included:

- Meetings held with Wellington City Council and Full Circle to provide recycling services.
- An onsite sorting system was established. Untreated timber and plasterboard were separated for composting. Shrink wrap and plastic packaging were sent for recycling. Treated timber was still sent for disposal at landfill. Metal scraps were recovered for recycling.
 - A recycling system was also established at the lunch room. This encouraged recycling behaviour throughout the site.
- 'Toolbox' meetings were held with site workers to communicate recycling systems and also gather input into where additional gains could be made.
- Data register was established to monitor waste flows

Issues

- Reorganising the way the site works to accommodate a sorting system. This was found to require effort up front but was efficient once implemented.
- Urgent one-off wastes generated tended to be sent to landfill as there was insufficient time to organise recycling. For example, asphalt that needed to be removed.
- Time spent working on documents such as the waste minimisation plan.

How to overcome

- Designing the site to include a sorting system, at the beginning of a project makes it easier to implement.
- Detailed planning up front means that one-off wastes can be predicted and dealt with.
- Developing company guidelines on how to set up a site and waste minimisation plan can reduce time spent. They will need to be tailored to the individual site but guides will reduce time spent developing them.

Result

This project has recycled approximately 64 per cent of materials. Fletcher Construction has seen the project as beneficial and has implemented waste minimisation practices on other construction sites. It even led to Fletcher's carrying out a waste audit of their office building (Personal comms, Marta Karlik-Neale).

Ebert Construction – Takapuna

Background

North Shore City Council initiated a REBRI project with Ebert construction. This project began at the construction phase. The project is currently being managed by Bruce Middleton from Waste Not consulting.

What was done

Ebert have set aside space for a separate waste sorting area. Due to the size of the site wheeli-bins have been used occasionally to put sorted materials into before transporting them to the larger mono-fill bins.

Issues

- Strict contamination criteria for recovered plasterboard has been an issue.

How to overcome

- Ingraining the sorting practices amongst site workers will remove this as an issue.

Key Lessons

1. The earlier you get involved the greater the ability to reduce waste.

2. Stipulate in the RFP for waste contractors that they will provide separate bins for recycled materials.
 - a. Note that not all waste companies advertise their recycling options. If you require it as a part of the tender then they will go about meeting their obligations.
3. Develop a waste management plan. Examples of these are available on the REBRI website (www.rebri.org.nz).
 - a. Allocate a centralised waste location (with the different bins).
 - b. A key success factor is having a 'champion' on the site. Someone who will make sure the waste minimisation plan is implemented.
4. Meet with the waste contractor to determine phasing for different bins.
 - a. Also note that many waste companies can carry out waste removal services based upon weight. This can be particularly useful if removing a material that is unlikely to fill an entire standard bin, thus still allowing incremental savings. However this information is not widely advertised so is best stipulated at the RFP stage.
5. Stipulate in agreements with subcontractors for them to remove their own waste from the building site.
6. Develop company guides on waste minimisation practices, including template waste minimisation plans and site organisation.

DEMOLITION

A significant proportion of C&D waste is generated at the demolition stage. However this too can be reduced through a number of methods:

- Best practice waste minimisation.
- Closer links between demolition and other stages in a buildings design and construction.
- Lateral thinking by large developers.

Best practice waste minimisation

Ward Demolition has a number of methods for recovering large percentages of materials during the deconstruction and demolition of buildings. His practices have led to recovery rates of up to 95 per cent (by weight).

Key lessons

- Source separation of materials as much as possible as it is much easier (and cost effective) than separating commingled materials.
- Onsite reuse. Ward demolition and resource recovery have successfully reused large quantities of materials during new construction. At Sylvia Park approximately 20,000m³ of concrete was crushed and reused as aggregate.
- Team meetings. At the outset, everyone involved in a demolition project, right from the Bobcat operators through to the project manager, will get together to discuss how the project will go ahead. This gives everyone the opportunity to be involved, share their own relative area of expertise and give clarity on how the project will proceed.

Closer links

By getting people at all stages of the process, from designers and construction companies through to demolition contractors and waste collectors, links can be built that aid in waste minimisation.

Key lessons

- By working with clients and project coordinators, additional time can sometimes be set aside to increase recovery of materials. This can lead to a decrease in disposal costs and increase in revenue from materials recovered.

- This practice successfully at the tender stage and has led to increased recovery of materials (personal comms Graeme Finlay).
- Best practice design and construction techniques can be used to maximise the materials recovered at the deconstruction/demolition stage.
- Work with waste collectors at the start of a project to identify what materials can be separated and recovered. This can be done effectively when designing a RFP for waste collectors.

Lateral Thinking

A lot of construction and demolition being carried out is by large developers with a number of projects going on. Thinking laterally and coordinating waste minimisation efforts between the projects can often have benefits. For example, recovered material from one site can be crushed and reused on another site (Personal comms, Peter Ward).

Key lesson

- Coordinate between projects on what materials will be needed and where recovered materials may be beneficial.
 - During the demolition and redevelopment of Sylvia Park, Ward Demolition reused approximately 20,000m³ of recycled aggregate (Personal comms, Peter Ward).

REBRI deconstruction/demolition case studies

The REBRI project carried out a number of deconstruction/demolition case studies. The results of these can be found on the website, but a breakdown of the information is contained below.

Blows Building – Auckland

Ward Demolition were contracted to demolish the Blows Building in Auckland. This project recovered approximately 95 per cent of materials, including bricks, Kauri flooring, iron roofing and Kauri beams. The key to this project was the sufficient time allocated for materials to be recovered, in this case approximately six weeks. An estimated \$153,000 was saved in demolition costs, with extra labour costs easily covered by reduced disposal costs and revenue from on-sold materials (WEB 7).

Ridings Road House, Auckland

Ward Demolition were contracted to deconstruct/demolish a 185m² 1940's bungalow-style house, over a two week period. The objective was to salvage the higher value items - of which there were many, due to the quality of the building. Initially, a 'walk through' was done, to establish which materials/components were worth salvaging - depending on the likely markets/ease of access/time constraints/labour skill at the time. The items that were considered to be worth salvaging included Rimu flooring and roofing, various joinery, fittings and flashings. Other large volume materials, such as the bricks and concrete tiles were crushed and used for fill (WEB 8).

LOCAL GOVERNMENT

Local government are often large purchasers of buildings and can have a major influence on the amount of C&D waste generated. Benefits for the local council include reduced C&D waste in their area and encouraging best practice techniques amongst construction companies.

Key Lessons

- Get in at tender stage.
 - Adding waste minimisation requirements at the tender stage can have a large impact with little if any increase in costs. This is primarily due to it still being a competitive process (Personal comms, Kevin Crutchley).
- Requiring waste minimisation techniques via contracts also builds capacity within construction companies. This can then be translated to other building sites.

- This experience of techniques being transferred to other building sites has been seen in a number of REBRI case studies, including those involving Mainzeal and Fletcher Construction.
- Informing builders through workshops. Holding capacity building workshops is also a way that councils can influence the builders within their area.
 - Workshops are being planned by Tasman District Council for builders (Personal comms, David Stephenson).

CONCLUSION

Construction and demolition waste is a major environmental issue. Unfortunately when it comes to sustainable building it is often overlooked in favour of more high profile issues such as energy efficiency. Improving resource efficiency and minimising waste can have a number of benefits for your business including cost reductions, profile raising, implementing best practice and linking with certification schemes.

There are a number of procedures that can be practically implemented at design, construction and demolition stages that will drastically reduce C&D waste. Most of them are simple and practical principles that are easily implemented. The primary requirement is a bit of thinking early on in the project and all the benefits will flow.

ACKNOWLEDGEMENTS

Amy Clore – MWH
Annabelle Ellis – North Shore City Council
Brian Robinson – Mainzeal Construction
David Stephenson – Tasman District Council
Graeme Finlay – Warren and Mahoney
Kevin Crutchley – Christchurch City Council
Kelly Taylor – Waitakere City Council
Marta Karlik-Neale – URS New Zealand Ltd
Peter Ward – Ward Group

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