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- batteries – contain lead, mercury and acid
- paints, solvents and other hazardous fluids
- asbestos-based materials
- materials with lead-based finishes.

## Deconstruction scheduling

The amount, type and condition of materials salvaged is affected by the time available to do the work and the methodology and sequencing of deconstruction. To maximise recovery rates and avoid contaminating or damaging materials (which then precludes reuse), it is important to:

- ensure adequate time is scheduled for deconstruction methods
- explain to clients that, because deconstruction involves careful planning and preparation and is more labour intensive than demolition, more time is required.
- use plans and working drawings to help determine how to deconstruct using reverse construction sequencing.

## Monitoring and recording procedures

It is important to monitor the deconstruction project to ensure materials are salvaged, recycled and disposed of as specified and to provide valuable lessons for future work.

- Decide what will be recorded, for example:
  - materials salvaged and recycled or otherwise disposed of
  - a summary of amount (volume, quantity, number)
  - destinations, costs etc.
- Give one person the responsibility for recording information on materials recovered.
- Develop forms for recording information or use the REBRI Waste Management Plan (downloadable from [www.rebri.org.nz](http://www.rebri.org.nz)).
- Set up a system to document transfer of the materials from the building site and their destination. Keeping invoices and receipts for all salvage and recycled materials is a good idea or use the REBRI Waste Transfer Form (downloadable from [www.rebri.org.nz](http://www.rebri.org.nz)).

## Tendering and contracts

### Tendering process

Respond to tender requests for waste reduction practices by submitting a detailed deconstruction plan (use the REBRI Waste Management Plan template).

### Contract documentation

Once the tender has been awarded, negotiate the terms of the contract to maximise the benefits of salvage and recycling.

- Agree the deconstruction plan with the principal, main contractor or client and with subcontractors. The deconstruction plan will form the basis for targets, on-site methods, responsibilities and so on.
- Identify a point of responsibility for maintaining materials and waste management. This will ensure that the deconstruction waste management plan is followed. Note it is important that the individuals responsible know who they are!

- Agree which party or parties receive financial benefits of recycling and salvage – this is usually the demolition contractor.
- Agree on any economic incentives for recycling and salvage with staff and subcontractors – this will help keep workers motivated.
- Consider the inclusion of salvage and recycling performance clauses in the contract.

## Setting up a waste management system

Establishing the system for managing waste on site and ensuring adequate site preparation before dismantling begins will make the process smoother and help reduce damage to salvaged materials.

- On-site or off-site waste management? Decide whether you will separate waste types on site for various recycling, reuse and disposal options or haul mixed waste off site for sorting and separation. You could even have a combination of the two. Most deconstruction projects involve a large amount of on-site sorting. Key factors are:
  - space on site for waste and salvage materials storage areas (where space is limited, off-site sorting is usually best)
  - costs
  - availability of recycling services and waste haulers or whether you will transport your own waste, recyclables and salvaged building items from site
  - availability, training and commitment of the labour force on site
  - whether materials will be reused in the new development
  - whether materials will be directly on-sold from site
  - potential for damage or contamination during transportation off site or during storage on site.

When Ward Demolition deconstructed the Blows Building in Auckland in 1996, they salvaged 95% of the building and saved \$153,000 on demolition costs, easily covering additional labour costs.

- Increased space for storage of materials is likely to be needed for deconstruction versus demolition.
- Check with clients, salvaged goods dealers and recycling operators regarding any particular specifications for storage and transportation.
- When designating the storage areas, consider space for loading and unloading containers, need for hoists etc.
- Clearly demarcate storage areas on the ground, for example, by using barriers such as salvaged concrete to create bays.
- Set up separate areas for sorting and storage of reusable and recyclable materials and ensure these areas are clearly marked.
- Contact waste recyclers and arrange containers for waste and suitable times for removing these from site.
- Negotiate recycling paybacks with local resource recovery firms.
- Provide separate bins, pallets or other containers for various materials and ensure these are clearly labelled.
- Use the RONZ symbols (downloadable from [www.wasteminz.org.nz/pubs/ronz-symbols](http://www.wasteminz.org.nz/pubs/ronz-symbols)) or some other type of clear signage on containers.
- Provide and erect barriers and security devices around the site as required to protect the salvaged material from damage, mishandling, theft, vandalism and fire.
- If you undertake or contract for on-site processing of materials such as concrete or wood, see the REBRI resource recovery guidelines at [www.rebri.org.nz](http://www.rebri.org.nz). You will need to consider the opportunities for reuse on site, costs of removal, space for processing and availability of equipment.



## Principles for deconstruction and dismantling

### General principles for dismantling and deconstructing buildings

- Deconstruction is the reverse of construction – remove building parts in the reverse order to construction. Start with the soft strip of interior fittings, doors and linings, then remove the roofing, cladding, windows and finally framing and foundations.
- Multi-storey buildings are deconstructed floor by floor, beginning with the roof and upper floor.
- Undertake the soft strip manually with hand tools to minimise damage caused by large machinery.
- During the hard strip, preparation of materials may be required prior to removal, such as soaking wooden floors and fittings with water to avoid splitting.
- During the hard strip, dismantling of major components may be done in stages. Large scale removal of building parts such as flooring or roofing may be done initially, with excavators or cranes, followed by more detailed separation of components and contamination by hand (on-site or off-site).
- Photograph joinery and other building components in place prior to removal to indicate potential reuse and to give purchasers a better idea of how the joinery would look in place.
- Keep all hardware (hinges, screws, rollers, guides, keys etc.) together with the building component such as doors, windows, joinery, HVAC etc.
- Keep building components together for reuse, such as doors attached to frames.
- Label separated components as they are removed for easy reinstallation.
- Asbestos should only be removed by approved contractors.
- Storage and handling of recyclable and reusable materials should be done in a manner to reduce contamination and damage (see below).



Dismantling the Northern Roller Mills building, Auckland floor by floor (Ward Demolition).



After removing the roofing and bituminous and wire netting underlay from a 1970s commercial building in downtown Auckland, Ward Demolition then cut the 190 x 45 mm rafters into manageable lengths using a chainsaw (for speed), before stacking and transporting them to their used goods saleyard.

By soaking dry rimu strip flooring for 3 days, Ward Demolition were able to ensure that flooring from a 1970s house in Auckland could be removed intact and without splitting. The flooring was then cut into sections in preparation for hoisting by digger to a clear working space where the floor joists were then separated from the strip flooring manually, with both being salvaged.

## On-site sorting and storage of materials

When sorting materials and components removed from buildings and preparing them for removal:

- obtain the specifications for materials from recycling operators or second-hand dealers prior to starting
- ensure different material types, sizes, grades, reusable and recyclable materials are kept separate
- sort materials according to dimensions and length
- do not mix treated and untreated wood
- sort directly into the containers that will be used for storage or removal to avoid rehandling
- remove contamination as you sort.

Appropriate storage of salvaged items and materials will reduce damage and contamination that could preclude reuse or devalue the materials. In general, salvaged materials should be stored and handled in the same manner as for similar new materials.

- Store easily damaged materials indoors or under cover to protect from weather where possible, otherwise cover with canvas, plastic or other material to protect from sun and rain.
- Store materials to avoid cross-contamination and damage and to allow easy movement around the site.
- Stack and palletise masonry, roofing, cladding, tiles etc. for easy removal.
- Use clear signage for all storage areas and containers to avoid cross-contamination. Signage should include the type and grade of material and any instructions for product protection (for example, keep dry). Use the RONZ symbols (downloadable from [www.wasteminz.org.nz/pubs/ronz-symbols](http://www.wasteminz.org.nz/pubs/ronz-symbols)).



Stacking timber according to dimensions at Northern Roller Mills deconstruction.



Brick stacked for easy resale (Ward Demolition).

Refer to the specific REBRI guides for C&D resource recovery for more detailed information on how to best store concrete, timber and plasterboard.

Weatherboards and rafters removed from a house deconstructed by Ward Demolition were stacked according to type and size before being transported to their saleyard. At the saleyard, they were dewatered and restacked ready for sale.

## Residual waste disposal

Once you have followed up all possible avenues for reuse and recycling, you will need to ensure that residual waste is disposed of responsibly.

- Only use disposal facilities that are consented by the regional council or have met the 'permitted activity' status in regional plans. These records should be available from the disposal facilities or regional councils for you to view. Otherwise you risk fines or prosecution under the Resource Management Act (1991).
- Obtain waste acceptance criteria from disposal facilities and operate according to these criteria.
- Treated timber not separated for reuse should be disposed of to a municipal solid waste landfill.
- Asbestos should be disposed at a licensed municipal solid waste landfill.

## When deconstruction is complete

Summarise the amount (volume, quantity, number) of materials reused and recycled or otherwise disposed of. Use the REBRI Waste Management Plan (downloadable from [www.rebri.org.nz](http://www.rebri.org.nz)).

Evaluate the success of the deconstruction project by assessing:

- whether you recovered as much material as you expected (compare your estimates in the plan to the actual data from monitoring)
- how you could have recovered more
- whether deconstruction was more financially rewarding than demolition
- how much material was diverted from landfill and cleanfill
- ability to use the project for marketing purposes.



## Marketing and external accreditation

Market your services and publicise your successes in deconstruction. The biggest barrier to salvage is a lack of knowledge in the design and building industry. Encourage the building industry to support the recycling market through your marketing.

- Emphasise your experience and success in deconstruction when marketing your services at [www.nothrow.co.nz](http://www.nothrow.co.nz), buy recycled website ([www.zerowaste.co.nz](http://www.zerowaste.co.nz)) and in the Yellow Pages ([www.yellowpages.co.nz](http://www.yellowpages.co.nz)).
- Advertise in trade newspapers and websites, including [www.trademe.co.nz](http://www.trademe.co.nz) and [www.nothrow.co.nz](http://www.nothrow.co.nz).
- Provide information on your successes for articles in design and construction newsletters and magazines.
- Provide information to REBRI that can be used as case studies on the REBRI website ([rebri@rebri.org.nz](mailto:rebri@rebri.org.nz)).
- Join the Enviro-Mark® NZ programme for external accreditation of your environmental management.
- Join industry organisations such as the Waste Management Institute of New Zealand, New Zealand Demolition and Asbestos Association or Sustainable Business Network to network with peers (see Links, resources and information).

Fletcher Construction and Hawkins Construction in Christchurch found that the Roof Shout, a monthly newsletter put out by the Canterbury Master Builders branch, was a good way to promote good waste reduction practice to construction companies.

## Training staff and subcontractors

Training demolition staff and subcontractors is a key success factor for high recovery of building components. By understanding the process of transforming demolition materials into valuable products, workers take more care in recovering as much material as possible while ensuring minimal contamination. Most training in the industry is done on the job, so your training programme should reflect this.

- Ensure employees and subcontractors are aware of what they need to do and how they should do it. Consider providing documentation on resource recovery requirements, deconstruction techniques and sorting and storage requirements.
- Formalise the roles of senior staff as trainers and provide any training to enable them to be more effective on-the-job trainers.

- Emphasise the benefits of deconstruction and maximising resource recovery.
- Ensure accurate identification and planning for hazardous substances – the increased manual nature of deconstruction means that this is even more important. Occupational health and safety advisers may be able to assist.
- Consider using a formal job training programme through industry training organisations and/or apprenticeships.
- Consider the mix of staff experience on any project to ensure less experienced staff are mentored and managed by more experienced staff.
- Check documentation regularly and keep a record of training.

## Links, resources and information

- ConsumerBuild – information about building and renovating homes in New Zealand [www.consumerbuild.org.nz](http://www.consumerbuild.org.nz)
- Enviro-Mark<sup>®</sup>NZ [www.enviro-mark.co.nz](http://www.enviro-mark.co.nz)
- New Zealand Demolition and Asbestos Association [www.demolition-asbestos.co.nz](http://www.demolition-asbestos.co.nz)
- New Zealand Waste Strategy [www.mfe.govt.nz/publications/waste/waste-strategy](http://www.mfe.govt.nz/publications/waste/waste-strategy)
- Resource Efficiency in the Building and Related Industries (REBRI) [www.rebri.org.nz](http://www.rebri.org.nz)
- Site Safe. [www.sitesafe.org.nz](http://www.sitesafe.org.nz)
- Sustainable Business Network [www.sustainable.org.nz](http://www.sustainable.org.nz)
- The Waste Exchange [www.nothrow.co.nz](http://www.nothrow.co.nz)
- Waste Management Institute of New Zealand – WasteMINZ [www.wasteminz.org.nz](http://www.wasteminz.org.nz)
- Yellow Pages [www.yellowpages.co.nz](http://www.yellowpages.co.nz)
- Zero Waste Buy It Back Guide [www.zerowaste.co.nz/resources-education/buy-it-back-guide](http://www.zerowaste.co.nz/resources-education/buy-it-back-guide)

## REBRI guidelines and tools

- Waste Reduction – Design and Planning
- Waste Reduction – Construction
- Waste Reduction – Demolition
- Waste Reduction – Building Products
- Waste Reduction – Home Renovation
- Easy Guide to Waste Reduction – Construction
- Easy Guide to Waste Reduction – Building Products
- Contract Specifications for Waste Management
- Waste Management Plan
- Waste Transfer Form

## Glossary

- **C&D:** Construction and demolition – refers to the process of building or demolishing domestic or commercial buildings, excluding infrastructure.
- **Cleanfill:** Area for disposal of inert material that does not require the high containment standards of an engineered landfill. Also used to refer to such material. The material deposited in a cleanfill will typically be from construction and demolition activities and will generally comprise soil, rock, concrete, bricks and similar inert material so does not include compostable materials, hazardous or toxic materials.

- **Construction and demolition (C&D) waste:** Solid waste typically including building materials, packaging, metal, plasterboard, timber, concrete and rubble resulting from construction, renovation and demolition of buildings.
- **Demolition:** Rapid destruction of a building with little removal of salvageable items.
- **Deconstruction:** The process of taking a building apart, storing and handling materials in a manner that achieves maximum salvage and recycling of materials and safe removal and disposal of hazardous materials.
- **Dismantling:** Taking a building or building components apart in a manner that achieves maximum salvage and recycling of materials
- **Engineered wood products (EWP):** Timber products that have been manufactured from wood pulp, fibre or veneer, for example, fibreboard or plywood.
- **Hazardous:** Explosive, corrosive, toxic or reactive.
- **HVAC:** Heating, ventilation and air-conditioning.
- **Landfill:** A site for the disposal of waste materials by burial. Historically, landfills have been the most common methods of organised waste disposal and remain so in many places around the world.
- **Non-hazardous:** Exhibiting none of the characteristics of hazardous substances.
- **PPE:** Personal protective equipment.
- **Renovation:** Changes made to a building including structural alterations, additions and redecorating.
- **Reuse:** Repeated use of a product in the same form but not necessarily for the same purpose.
- **Recycle:** Any process by which waste and recyclable materials are transformed or collected for the purpose of being transferred into new products.
- **Salvage:** Removal of structural and non-structural building materials from residential, industrial, commercial and institutional buildings deconstruction projects for the purpose of reuse or recycling.
- **Source separation:** The act of keeping different types of waste materials separate from other wastes from the moment they become waste,
- **Triple bottom line:** An assessment method that incorporates financial, environmental and social factors rather than just economic factors to make a decision.
- **Waste:** Any product or material resulting from the construction or demolition process that is surplus to or not included in the finished building

## What is REBRI?

The REBRI waste reduction guidelines have been developed to encourage and assist everyone involved in the construction and demolition industry to reduce waste. REBRI stands for Resource Efficiency in the Building and Related Industries and started in 1995 as a collaborative effort between Auckland councils and BRANZ to undertake research and raise awareness of the issues of waste and the efficient use of resources in C&D projects. A consortium of councils, BRANZ, Recycling Operators of New Zealand and the Ministry for the Environment, with assistance from Winstone Wallboards Limited and industry representatives, extended the initiative in 2003 to undertake more research and develop national waste reduction guidelines.

Our thanks goes to the numerous individuals and organisations in the building and resource recovery industry, research organisations and in local and central government that have helped to develop these guides through participation at workshops, review of drafts and otherwise providing advice and time to the project.