Influence the client brief

The initial consultation also provides an opportunity to influence the client brief.

This can reduce waste by potentially avoiding full-scale demolition and overdesign by using materials that reduce waste and by incorporating features that reduce waste during the life cycle of the building. Issues to discuss include:

- repair and refurbishment in preference to demolition and reconstruction or specify deconstruction to recover a high proportion of materials
- use of salvaged building materials
- use of materials that last longer and require less maintenance
- including space for waste sorting and storage during occupancy
- building smaller buildings that are better designed for your client's needs
- designing the building to be flexible for future uses.

Moving or renovating a building may be better for the client than demolition and rebuilding.

Team building

A team approach by the owner, builder, designer and others involved in the building process is the most effective way to implement waste reduction. A team that communicates well from the beginning of the project will help in the identification of ways to reduce waste and is also likely to reduce delays and cost over-runs.

When building a team, it is important to:

- seek out other design professionals who express an interest in waste minimisation
- ensure design professionals can evaluate the environmental impacts of the building materials and systems they specify over their full life cycle or consider hiring a consultant to help with this task
- include the constructor and key subcontractors in the design team if possible or include a team member with expertise in construction methods and planning
- if possible, include suppliers in the team – their involvement can help ensure specified materials save unnecessary waste, cost and labour during construction
- establish roles and responsibilities for minimising waste
- encourage ongoing communication about waste minimisation by, for example, establishing waste minimisation issues as a regular item on the agenda for design progress meetings
- educate the team about the impact of construction on the environment
- ensure the team understands the opportunities for improvement.

Establish goals and objectives

- Explore goals and objectives that reduce waste/waste streams at different stages of the building's life from design through to post-occupancy. Goals and objectives should be as specific as possible (see Influence the client brief).
- Obtain agreement and commitment from the entire design team on waste goals and objectives.

Gather information/research

- If using second-hand materials, find out what is available – contact salvage dealers and your city or district council for the nearest material exchange database (see Building material and product selection).

- Review the impact of using salvaged material on project costs.
- Research new building practices and materials that reduce wastage.
- Identify local infrastructure for recycling of construction and demolition waste – contact your city or district council for further information.

Site investigation and development

The importance of a thorough site investigation can never be underestimated. Awareness of existing site conditions reduces waste by preventing design variations and overspecification that result in unnecessary and additional landfill waste. There are additional factors to consider if there are existing buildings on the site.

Clear greenfield site

- Design to reduce removal of vegetation (which often then becomes solid waste) and soil.
- Identify composting opportunities and indicate the potential volumes and types of materials generated by the project.
- Maintain the integrity of the site by designing to minimise cut and fill.
- Design according to the contours of the land to ensure minimal impact upon soil excavation. For example, sloping sites may lend themselves to split level design while level sites are appropriate for slab floors.
- Ensure topsoil is retained and replaced after construction so that existing nutrients can be returned back to the site. This will reduce the need for transporting excess soil away from the site and disposing of this valuable resource.

Redevelopment site

- Factor in waste generation and costs when advising clients as to most appropriate options (alterations and additions, demolition and deconstruction).
- If renovating, consider reusing buildings and components.
- Consider deconstruction rather than demolition.
- If deconstructing and/or demolishing, identify reuse and recycling opportunities and indicate the potential volumes and types of materials generated by the project.
- Maximise the use of reclaimed materials from the old building(s) in the new building(s).

Concept design

To minimise waste when defining the building type, function, core materials and core design, consider the following:

- Plan for end use and deconstruction so that, when future modifications or decommissioning occurs, the entire structure can be taken apart and reused or recycled with ease and minimal waste (see Designing for deconstruction).
- Check the design concept matches the actual needs required from the building owner or occupier to avoid overdesign and use of excess materials.
- Keep the design simple so that it will be easier to build and hence less likely to have things go wrong during construction. Simple designs also tend to require less maintenance.
- Design the building so that it can be easily adapted for other uses over time. Ensure spaces are flexible to allow for changes in usage and future-proofed against advances in technology and trends.
- Select materials that reduce waste and that have recycled content. Factors to consider include durability and reuse and recycling options (see Building material and product selection).
- Dimension to suit standard modular construction sizes, which will reduce unusable off-cuts and make the most efficient use of materials.
- Investigate reusing existing buildings and materials to reduce demand for resources, lower waste volumes and save money. Renovating a structurally sound building is usually more material efficient than starting from scratch.
- Use prefabricated and pre-cut components where ever possible. Off-site fabrication can reduce waste, facilitate separation of waste streams and improve recovery rates.

- Plan the building to reduce vegetation clearing and earthworks. Consider piles, especially on sloping sites, to avoid excess excavations. Reducing disturbances to the land reduces waste and resource use.
- Consider design to minimise temporary works – early consultation with constructors can provide valuable insights into alternative methods and materials to achieve this.

This building was designed on piles to protect tree roots. It also reduced earthworks and the need to remove soil from the site.

Detailed design

When developing and finalising the design, consider the following issues.

Building services

- Obtain a good understanding of and, where possible, discuss with relevant trade subcontractors and subconsultants the potential to design in more efficient distribution routes for building services.
- The coordination of the services content of a project is important in that services account for around 30% of the total building cost.
- A simple example of ascertaining whether various service runs can go into the one trench has a favourable impact upon waste minimisation. Such strategies will lead to more efficient use of materials and generate less waste.
- Reduce pipework lengths and gulley traps by grouping wet areas such as kitchens, laundries and bathrooms close together and placing the hot water cylinder centrally in this group.

Footings and slabs

- For pre-cast concrete slabs, instead of using bars along each edge, bent at the corners to create an overlap, use straight bars with off-cuts bent and overlapped at corners.
- Use crushed concrete or crush suitable waste materials on site. (Concrete crushing operators should be familiar with specifications for concrete that incorporates waste material.)
- Break up concrete off-cuts or waste concrete and incorporate into hard stand.

Concrete off-cuts can be incorporated into driveways and hard stand

Masonry

- For masonry design, ensure that the structure's dimensions suit the precise sizing of the masonry units. To maintain standard brick courses, consider increasing the wall cavity to suit.

Framing

- Design for standard product dimensions.
- In the use of steelwork, ensure that spans and bays are dimensioned to the full working length in order to maximise the value of steel members.
- Prefabricated and pre-cut components that can be used include wall framing and roof trusses.

Use prefabricated framing to reduce timber off-cuts during the early stages of construction.

Roof and wall cladding

- When determining eave widths, check the standard sheet sizes for linings and design accordingly. If eaves are not horizontal, allow for angling in sizing.
- Wherever possible, roof pitches should be designed to rafter lengths that use the exact number of tiles. This eliminates the cutting of tiles. However, this suggestion is dependent on the client brief, as it may impact on the integrity of a complex project.
- Where the design involves a concrete tilt-up slab construction, check the standard reinforcement steel fabric length. The panels should be designed to suit the fabric dimensions. Where possible, span the panels horizontally instead of vertically, which reduces requirements for excavation and concrete.

Glass and glazing framing

- Design custom glazing panels to suit modular glass sizes wherever possible.

Access

- If a wider than normal staircase is required, before determining the actual width, consult a professional staircase manufacturer who will be able to advise you on the most economical widths in relation to length and size of standard materials that are required and available for your design.
- Before designing balustrades, consider the materials to be used, and once these have been established, investigate the standard sizes available in order to minimise waste.
- For handrails constructed of steel with perspex inserts, design according to the standard size of perspex sheets.

Linings and finishes

- Design passage and doorways to suit architrave and door sizes.
- Design ceiling heights to conform with plasterboard sheet sizes and a combination of cornice and skirting sizes.
- Consider designing bathroom dimensions to suit floor and wall tile sizes.
- Where a suspended ceiling is employed, run the walls to the ceiling, rather than the ceiling between the walls, to create a continuous ceiling grid. This allows flexibility to move partition walls without incurring damage to the ceiling.

Design for deconstruction

Designing for deconstruction means considering the durability or recyclability of building components and the ability for components to be separated during deconstruction for recycling or reuse. Simple things can make a big difference to wastage at the demolition phase.

For detailed information regarding designing for deconstruction, see www.seda.uk.net/assets/files/guides/dfd.pdf.

- Design entrances wide enough for deconstruction machinery to reach the inner building and upper floors.
- Specify fixing mechanisms that can be reversed without causing damage – screws, clips, bolts and gaskets in preference to rivets, mastics, adhesives and tapes.

Easy deconstruction of buildings allows the reuse of parts at the end of its useful life (Ward Demolition).

- Use components and equipment that have a long life and are easily maintained so that they can be reconditioned for reuse.
- Specify materials that can be easily recycled.
- Use reversible construction and assembly sequences.

Design for flexibility

Over a building's life, it may change ownership several times and be used for many different purposes.

The original design dictates how easy it is to retrofit the building and how much waste is created during each renovation. Some detailed design considerations:

- Maximise the distance between loadbearing components or design the loadbearing components to the edge of the building to allow flexibility with the internal arrangement of partitions or temporary walls.
- Modular design techniques so that adding on to or altering the building is easier in future.
- Design for a greater load on the foundations and lower-storey supports to allow for upper storeys to be added in future.
- Allow good access to wall and ceiling spaces to allow for service upgrades and modifications.
- Allow flexibility with lighting, heating and ventilation wiring and controls for changing building uses.

Reuse of second-hand buildings and building parts in design

Second-hand building parts can be used for structural, functional or decorative purposes in new buildings. Parts of buildings can be reused, or entire buildings can be relocated and re-erected.

Relocating buildings

Relocating a building requires the same design checks as building a new building:

- Check the Building Code and Building Act 2004, as the relocated building must comply with all new standards and codes, regardless of whether it complied with standards at the time it was first designed.
- Recalculate all relevant loadbearing.
- Design foundations and civil works to suit the building.
- Check the consent requirements for the Resource Management Act 1991 and make sure the building complies in the new location.

Renovating existing buildings

Renovation is a very common alternative to demolition and reconstruction. At the detailed design stage, it is important to consider all of the options for making additions or alterations.

In the example below, the client required more office space but had limited room to expand. Because the existing building could not support a second storey, engineers chose to remove the wooden building and construct a new first storey using concrete brick.

This allowed the foundations and structure to be designed to support a second storey. The wooden building was then relocated and renovated.

Lyttelton Port Company, Christchurch

Reusing second-hand building materials

For information on how to source second-hand building materials, see Building material and product selection. When reusing building materials, check that they are still fit for purpose. This may require simple visual inspections or laboratory testing depending on the product.

Suggestions for using second-hand building materials for functional purposes:

- Reuse cladding such as roofing tiles, roofing iron, insulation panel and fibrous cement panel.
- Use concrete tilt slab pieces for retaining walls.
- Reuse insulation, doors, windows and other building components.
- Use native and hardwood timbers from weatherboards or framing for flooring.
- Reuse steel purlins or beams for bracing.

Insulation can be salvaged and reused in new or renovated buildings

It is possible to reuse components such as concrete tilt slab or steel beams for structural purposes:

- Make a list of the quantity, dimensions and types of materials available for reuse. Have them stacked in order on site ready for reuse.
- Check the quality of the materials and, if required, have a sample of the materials tested for loadings or stress.
- Discuss the testing requirements with your local city or district council building inspectors.
- Structural design is similar to using new products except in reverse, where you have the dimensions of your components and design the loadings to suit.

Space for operational recycling

- Obtain information from the client on the projected waste stream including type and quantity of recyclable materials generated by building users.
- Incorporate bins into the kitchen/cafeteria and design for separating organic, recyclable and non-recyclable items.

- Position compost bins, organics collection bins or worm farm areas so that they are easily accessible from the kitchen/cafeteria.
- Incorporate loading, storage and pick-up areas for industrial quantities of waste for recycling.

Design documentation

- Prepare accurate drawings – clear, comprehensive, accurate documentation will reduce the likelihood of design variations.
- Document your design, including the location of all services, and leave it with the building's owners or occupiers – this will ensure that alterations, maintenance and deconstruction are easier and less wasteful.
- Provide a deconstruction plan that includes a list of building materials and components as well as their design or service life and the best options for reuse, refurbishment or recycling and instructions on how to deconstruct elements.

Building material and product selection

Building materials are often selected based on lowest cost, aesthetics and short-term needs. However, to identify the most effective materials to use in order to reduce waste, it is important to use a broader set of criteria when choosing materials such as:

- recyclability – whether the product or material can be easily reprocessed back into a useful product or material
- resource efficiency – less materials have been used to produce the same product
- salvage and reuse – second-hand building parts and ensuring a useful life for the product/material following its original use
- durability – how quickly a product or material will need to be replaced – the more durable, the less wasteful.

Product suppliers can tell you this sort of information, or check the information on product labels.

Product and material selection should still be done within the context of New Zealand building standards and regulations.

Specify materials that achieve waste reduction

- Materials and components that are reusable or can be recycled after their useful life in the building.
- Materials with known recycled content – this reduces the use of raw materials and helps boost the market for recyclables.
- Second-hand or salvaged materials – using materials where durability is consistent with the building's anticipated life will reduce the frequency of replacement.
- Materials that don't need finishes (natural timber ceilings, bricks and tiles, pigmented concrete or plaster or roofing steel with a colour baked on at the mill) – reduces waste associated with finishing products.
- Avoid overspecifying (for example, specifying 9 mm plasterboard when 6mm is appropriate) – this reduces the amount of materials going into a building.
- Prefabricated materials supplied to the specifications of your project – means no resizing on site.
- Materials that have recyclable or reusable packaging.
- Refer to the Environmental Choice New Zealand website for a range of lower-impact materials (www.environmentalchoice.org.nz).

Polystyrene off-cuts can be recycled in some cities – either by the manufacturers or a recycling operator.

Finding recycled or second-hand materials

Use local waste-recycling directories (www.branz.co.nz/REBRI_Recycling_Directory), Yellow Pages (www.yellowpages.co.nz), the Waste Exchange (www.nothrow.nz) and buy recycled directories (www.zerowaste.org.nz) to know what materials have markets for reuse or recycling. These change often, so it pays to keep checking.

Suggestions for recycled product use

The availability of recycled products will change around New Zealand. Suggested recycled products are:

- waste plasterboard gypsum as a soil conditioner in landscaping
- waste wood mulch in landscaping
- recycled concrete aggregate as base course in driveways, foundation slabs and other civil works
- insulation with recycled content (batts with recycled glass or recycled textiles)
- claddings, interior linings and floor coverings with recycled content.

Waste wood chip can be used as landscaping mulch (Crusader's Landscaping).

Consider supplier practices

Your choice of suppliers can influence the amount of waste generated during manufacture and retailing of the product as well as during construction. Develop a preference for materials from suppliers that have investigated how their product characteristics, manufacturing processes and product packaging can reduce waste. Some of the more obvious things you may like to look for include suppliers that:

- have waste minimisation/environmental plans or credentials
- reduce packaging waste, for example, by using minimal types and amounts of materials and avoiding unnecessary packaging.

For more information on what you can expect from manufacturers and retailers who reduce waste, see the REBRI Waste Reduction - Building Products guide.

Develop and maintain product information

- Ensure that you keep up to date on product information and changes in materials standards. This can be achieved by keeping your libraries of manufacturers' product literature and specifications current and by the attendance at trade information briefing sessions presented by manufacturers and industry associations. Reading building trades publications promoting resource efficient building is also recommended.
- Develop a preferred specification list that includes materials and components that use recycled or reused constituents, utilise recyclable or reusable packaging.
- Develop a set of standard details for use on projects.

Specifying just enough product will help to make sure that it is not wasted on site.

Tighten up on estimating and purchasing

- Plan for 1% wastage or less! By doing this, you reduce your product orders and will give staff an incentive to use resources more efficiently, since there is not a plentiful amount of supplies available.
- Avoid overspecifying.

- Develop a procurement/purchasing policy so that manufacturers and suppliers are aware of your exact requirements. In particular, this can assist in avoiding overpackaging goods or unnecessary packaging.
- Consider whether lower standards or performance specifications may be appropriate if waste can be reduced as a result.

Project management

Managing the design, construction and tendering processes provides further opportunities to ensure waste is reduced during the construction or demolition process.

Programming for waste reduction

- Allow sufficient time for accurate and detailed design.
- Ensure that regular design reviews include assessments of potential waste generation.
- Be aware that a short construction programme may require more temporary works than a longer one.
- Allow time for deconstruction, which generally takes longer than demolition.
- Before the tender process, negotiate room on or near the site for recycling and waste containers. This may involve discussing possible requirements with property owners, neighbours or the city or district council.

Tendering and contracts

Contract documentation

- Refer to the REBRI Contract Specifications for Waste Management for standard contract wording.
- Agree which party or parties receive financial benefits of salvaged and recycled material from demolition or construction.
- Provide economic incentives for recycling or for reaching a target of waste reduction.
- Include waste minimisation and recycling performance clauses in the contract (refer to standard clause documentation).
- Clearly identify in tender information that waste minimisation techniques have been adopted in the design and request that tenderers respond to these in their submissions.
- Nominate waste streams to be recycled.

Tendering period

- Promote economic benefits of waste minimisation and recycling to tenderers.
- Familiarise tenderers with recycling, waste management and minimisation strategies.
- Answer questions and allay concerns (including costs).
- Engender a spirit of co-operation to achieve waste minimisation objectives (team building).

Awarding tenders

- Check that waste reduction requirements have not been tagged out. If so, consider whether the contractor has offered an acceptable alternative method or solution. Some contractors may have different waste management systems that achieve the same targets or goals.
- Evaluate the waste reduction approach alongside other tender variables.
- Review the supply chain interfaces to reduce waste (such as contractor purchasing policies and procedures) and contracts between the main contractor and the subcontractors.
- Agree the waste management plan with the main contractor and with subcontractors. The waste management plan will form the basis for targets, on-site methods, responsibilities and so on.
- Identify a point of responsibility for maintaining waste management. This will ensure that a waste management plan is followed. It is important that the individuals responsible know who they are!
- Agree which party or parties receive financial benefits of recycling.

- Provide economic incentives for recycling – this will help keep contractors motivated.
- Consider the inclusion of waste minimisation and recycling performance clauses in the contract.

Managing the contract

- Ensure the necessary training is given by the contractor so that everyone understands the requirements needed to minimise waste.
- Supervise the contractor's workmanship, making sure it is of a high standard. This will prevent work having to be repeated, thus utilising more materials and products.
- Verify contractor performance to ensure they are doing what they have said they would.

After the project is finished

- Evaluate contractor performance against the waste reduction targets of the project.
- Evaluate the success of the project and get feedback from the client and occupants.
- Apply lessons learnt to your next design job.
- Leave a copy of the design diary with the client and occupants.
- Consider disseminating practical experience and promoting the success of this project to current and potential customers, for example, through writing articles and papers and attending seminars. This may help give you a marketing edge in a market that is becoming increasingly conscious of environmental issues.

Links, resources and information

- ConsumerBuild – information about building and renovating homes in New Zealand www.consumerbuild.org.nz
- Enviro-Mark®NZ www.enviro-mark.co.nz
- New Zealand Waste Strategy www.mfe.govt.nz/publications/waste/waste-strategy
- Resource Efficiency in the Building and Related Industries (REBRI) www.rebri.org.nz
- Scottish Ecological Design Association – SEDA. Design for Deconstruction Guide www.seda.uk.net/assets/files/guides/dfd.pdf
- Site Safe. www.sitesafe.org.nz
- Sustainable Business Network www.sustainable.org.nz
- The Waste Exchange www.nothrow.co.nz
- Yellow Pages www.yellowpages.co.nz
- Zero Waste Buy It Back Guide 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.