CONCEPT DESIGN STAGE

Tendering/briefing documentation – standard clauses for better buildings

Introduction

Decisions made during the concept design period have a large impact on the environmental performance of the building and may limit the scope for environmentally preferable features later on in the design. The building's layout, location, shape and its relation to the surrounding environment all influence its impact on the environment. It is therefore important to put a high emphasis on environmental considerations at this early design stage. Using less of everything, less materials, less energy and less water, will reduce the buildings impact on the environment.

Standard clauses for all Concept Design Briefs

The following clauses have been developed for inclusion in the tendering/briefing documents for the concept design. Additional to the standard clauses, brief explanations and additional information are provided to be included in the briefs to assist the designers.

It is expected that the designers comply with all relevant legislation and standards and mandatory items are not included here.

The following text (clauses are in ***bold italic***) should be included in all Council briefs for new buildings:

The new building should be energy, water and resource efficient and should be built of materials that do not harm the environment or the people who will use it. A healthy indoor climate should be provided. It is envisaged that the design will reflect environmental and sustainability principles throughout. Simple solutions and passive systems are preferable to high-tech options. The building should be inviting and safely accessible for all people including children, older persons and those with disabilities. The design should result in a building that is adaptable to changing uses, durable and easy to maintain.

At the end of the concept design phase the architect is to produce a design report outlining how compliance with the design clauses is achieved and discussing alternative approaches that were considered in developing the design concept (demonstrate conscious decision making). The proposed building design will undergo an environmental sustainability review before proceeding beyond concept design stage.

In particular the new building must comply with the following guidelines unless approved otherwise by the client:

The building shall have a long design life, and a form and layout that is inherently flexible allowing for a variety of uses.

Reason:

One of the major barriers to building sustainability is the use of designs, construction methods, materials and systems which are inflexible, have short design lives, and are energy intensive both in production and operation.

Possible Solutions:

The building should have an inherently long design life, exceeding the 50 year default design life of the New Zealand Building Code.

The building should be capable of responding flexibly to significant changes in use, function and occupancy requirements without a need for refit, or significant alteration.

Deep plan, internal load dominated building forms require a higher level of inflexible services plant. Flexible open plan solutions are preferred.

Building services systems within the building should be as small and simple as possible. Rather than producing comfort conditions artificially, they should complement passive architectural solutions to comfort.

Cost Implication:

Good design of building form, layout, and systems will always minimise life cycle cost and usually minimise construction costs.

Maximising the energy efficiency of the finished building should be a key factor when determining the form, orientation and materials of the building

Reason:

The decisions made in the first few hours of the design phase about shape, materials and orientation can make or break the overall energy efficiency of the building. A building where there has been no consideration of this in the early design phase has little chance of achieving good efficiencies.

Possible Solutions:

A combination of experience and common sense should help

in determining the orientation and shape of the building. It is helpful to obtain as much climate data from the site as possible. Visiting the site during different weather conditions will help with this. Once a certain shape of building is being considered sun and wind exposure should be modeled and the resulting effects on the building estimated.

It would be beneficial to involve consultants, specializing in passive ventilation, natural lighting and building modelling at this early stage (see also *passive heating, cooling and ventilation*).

Cost Implications:

Spending more time and effort during the design phase will result in extra design costs. However the resulting savings in energy costs generally more than justify this extra spending.

Further Information:

Energy Wise Design for the Sun, D.R. Breuer for the Energy Efficiency and Conservation Authority (EECA). Available from EECA, www.eeca.govt.nz or PO Box 388, Wellington, 04-470 2200. This publication is aimed at residential homes, however the principles can equally be applied to commercial situations. EECA is working on a similar publication specifically for commercial buildings and progress on this should be checked.

The EECA Website (www.eeca.govt.nz/RenewConsSearch/ConsultantSearch.asp) contains a list of consultants that offer energy related services, such as modelling of temperature, airflow and lighting in buildings at the design stage.

Using passive heating, cooling and ventilation systems as much as possible in preference to air conditioning systems. All rooms, which have workstations (areas where people work for long periods), should have windows that open.

Reason:

Air conditioning systems consume large amounts of energy. They can also contribute to indoor air quality problems and are expensive to maintain. Well-designed buildings can often operate adequately without air conditioning systems and naturally ventilated buildings are often perceived to be more comfortable by occupants than air-conditioned buildings.

Possible Solution:

Utilizing vents and opening windows at different heights can make use of natural airflows to ensure adequate air exchange and cooling. For larger buildings it is probably necessary to engage an engineer to model airflow and ventilation. The building will maintain a much more constant temperature (warmer in winter and cooler in summer) if it has high thermal

mass. The shape of the building and the location and shading of windows will also have a large influence over internal temperatures. Light coloured roofs will result in lower solar gain. Any building over 300m² floor area must be optimised for minimum energy use by a modelling system complying with the requirements of NZS 4243:1996 section 4.7.

If passive methods cannot meet ventilation and cooling requirements a mechanical ventilation system may be used. Only when this approach cannot meet ventilation and cooling requirements can an air conditioning system be considered. It must be proven that there is the need for an air conditioning system.

If it is decided that air-conditioning is necessary to some parts of the building this should not result in a comprehensive air-conditioning system that runs all year. It is preferable to have air conditioning that switches on only when needed and only in those parts of the building were natural ventilation is not sufficient. One option is to have a “dead” temperature band during which the HVAC system stays switched off. This would typically be $19^{O}C$ – $23^{O}C$. The rest of the time ventilation would be via opening windows.

The aim should be to ensure that adequate air exchange, reasonable equivalent temperatures (18-24^{o}C, WBGT index measurement) and humidity levels between 40 and 70% are maintained for most days of the year no matter what system is chosen (passive, mechanical or air-conditioned). However it is acknowledged that this will not be possible for every day of the year, especially when using passive systems, and that there will be a few days a year when the maximum temperatures will be exceeded. Consideration should be given to the heat generated by lighting and computer equipment as well as other equipment used for special tasks, such as photocopying.

Cost Implications:

While there will be a higher cost during the design process (time and money to model temperature and air flows) the cost of the air conditioning system will be saved. The electrical running costs and maintenance costs of a building without air conditioning will be lower than those of a building with air conditioning.

Overall experience has generally shown that reducing the need for air conditioning saves money.

Further Information:

The EECA Website (www.eeca.govt.nz/RenewConsSearch/ConsultantSearch.asp) contains a list of consultants that offer energy related services, such as modelling of temperature, airflow and lighting in buildings at the design stage.

Reason:

A high level of energy efficiency reduces the running costs of the building and reduces environmental impact.

Possible Solutions:

The standard describes solutions, however these are generally aimed at buildings with comprehensive air conditioning systems. For buildings without air conditioning systems modelling can show compliance with the standard and will give an indication of kWh per m^2. A report giving calculations of energy use is expected with the concept drawings.

Where extensive glazing is used double-glazing can help achieve the standard.

The following summarises the requirements in the standard, however the standard must be consulted to ensure compliance:

- Minimum insulation values for the Auckland area of: Roof R 1.9 and Wall R 0.3 (no requirement for floors unless floors are heated).
- Maximum lighting power density limits: 11W/m^2 for assembly spaces (community halls), 18 W/m^2 for educational and office facilities (libraries).
- Window to wall ratio should be less than or equal to 50% (twice as much walls as windows) or the building should behave as if this was achieved (shown through modelling).

It is however likely that these standards have to be exceeded to achieve the target of 100 kW/h per m^2 per year. It is noted that this is total energy consumption including fuels such as gas as well as electricity.

Cost Implications:

Higher up-front cost but reduced running costs.

Further Information:

New Zealand Standard NZS 4243:1996 Energy Efficiency – Large Buildings, available from Standards New Zealand.

Maximising the use of natural light and designing artificial light to complement natural light. All workstations should have access to natural light.

Reason:

Using natural light instead of electric lighting saves energy. Lighting is one of the largest energy costs

in commercial buildings (typically about 30%). Natural light is also healthier than artificial light and most employees perceive it to raise comfort levels by increasing their association with the outside world.

Possible Solutions:

Natural light is provided by appropriately placing windows to bring light into the building. There are also other techniques available, such as light-shelves, to bring light into the inner areas of the building. These reflect light from the outside against the ceiling to bring it further into the building. Care should be taken to avoid glare and over heating or excessive heat loss. Large west-facing windows are commonly associated with overheating during the afternoon. Shading provided by roof overhangs or external blinds can work well. There are several special glass types that can be used to avoid glare and heat gain and loss (low-e glass).

The use of clerestories to bring light into the inner parts of the building is preferable to skylights, because horizontal glazed areas are associated with a high rate of heat loss in winter and over heating in summer. Overhangs over the clerestory windows will provide shading similar to ordinary windows.

Artificial light needs to be designed to complement natural light. It needs to be arranged in practical banks to allow surplus lights to be switched off or dimmed when sufficient natural light is available. Automatic systems, utilising light sensors, can work well. It needs to be kept in mind that it is generally the lights in the periphery of the building (near windows) that will require dimming, and that lighting circuits need to be designed accordingly. Any artificial light should have good colour-rendering characteristics. Consideration should also be given, where required, to lighting for special tasks.

High efficiency lighting systems are essential to minimise cooling costs.

Cost Implications:

The use of natural light results in reduced running costs of the building and increased comfort for the users of the building.

Further Information:

There is extensive information available about

lighting issues on the EECA Website: www.eeca.govt.nz or from EECA, PO Box 388, Wellington, 04-470 2200.

EECA can also be contacted for advice.

Compliance with NZS 4243:1996 as a minimum, the standard should generally be exceeded. Overall the building must not consume more than 100 kWh per m^2 per year (total energy use, including gas and any other fuels, but excluding passive solar energy).

Reason:

A reduction in water use reduces the running costs of the building through lower water and power bills (hot water). Water resources in the Auckland region are under pressure, it is therefore important that public buildings set a good example of conserving water.

Possible Solutions:

The following will achieve compliance with the standard:

Showers and Taps: No more than 9 litres per minute
Toilets:
Urinals:
Dishwashers:

Cost Implications:

Water saving fixtures are generally no more expensive than standard fixtures and the running costs of the building are reduced.

Further Information:

Further information on water saving devices can be found in the *Sustainable Home Guidelines*, Waitakere City Council, 1998, available in full at www.waitakere.govt.nz or from Waitakere City Council, Private Bag 93109, Henderson, Waitakere City, 09-8390400

It is advisable to consult a competent plumber.

Compliance with the AAA rating criteria for water efficiency in Australian Standard SAA MP 64-1995.

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It is advisable to consult a competent plumber.

The overall lifecycle costs (environmental and financial) should be considered when choosing materials.

Reason:

Materials have environmental and financial costs throughout their lifecycle, which includes extraction of the raw material, transport, processing, use and disposal or re-use/recycling.

By using resources that are replenished through natural processes and that are used at a rate that lets renewal occur, global resources are protected. This ensures that future generations can meet their needs.

Avoiding harmful substances will improve the indoor air quality of the building and therefore increase the comfort level of the building users. It will also reduce the overall environmental impact of the building.

Possible Solutions:

A preference should be given for materials that are sustainable and renewable and for those made from recycled materials. Substances that are harmful to people or the environment, including those that have high embodied energy should be avoided. However this should not be at the cost of good performance and durability and the running costs of the building has to be weighed up against the energy used to produce the materials used.

The re-use of recovered building materials is encouraged, as is the use of recycled materials. The Auckland Regional Council is in the process of publishing a directory of recycled building materials.

The least harmful substance should be chosen for each application. In general local products are preferable because less energy is consumed during their transport. Independent labels, such as Environmental Choice New Zealand, provide confidence in choosing a less harmful product. At present there are Environmental Choice paints and carpets available.

Paints and adhesives are often associated with adverse environmental and health impacts. Choosing water passed products wherever possible is desirable.

Timber treatment is another problem area. Often untreated timbers can be used, such as untreated kiln dried pine for above floor framing. Some species, such as Macrocarpa and the Eucalypt species, are naturally more durable than pine. These are often suitable substitutes for treated timber. Alternative timber treatments to CCA are becoming available, these are still toxic but less so than CCA. The alternative methods available at present are copper based, but do not contain arsenic or chromium, they do tend to be slightly more expensive.

In New Zealand plantation grown timber is readily and

cheaply available. Because timber is a renewable resource, has low embodied energy and is a well-proven construction material, it is generally a good choice, when evaluation between timber and another material.

Cost Implication:

Cost Implications vary depending on the materials used. Water based paint for example is generally no more expensive than oil based paint. There is however extra time needed to source alternative products and to evaluate the manufacturers or suppliers information. Many low toxicity products are also more expensive. Overall it is therefore likely that using the least harmful product will cost more. However when looking at the overall building cost this difference is likely to be small.

Further Information:

The Materials Section of the *Sustainable Home Guidelines*, Waitakere City Council, 1998, available in full at www.waitakere.govt.nz or from Waitakere City Council, Private Bag 93109, Henderson, Waitakere City, 09-8390400

The Auckland Regional Council is producing a list of recycled building materials, ph.: 09-366 2000

All timber, including any composite wood products, is from New Zealand plantation grown timber or from an independently certified sustainable source.

The building should be designed to reduce waste generation during construction, operation and demolition.

Reason:

A waste-full design inevitably results in strain on the environment, through unnecessary resource use and pollution through disposal and transport of waste. Using less of everything will reduce the environmental impact of new buildings.

Possible Solutions:

Sizing building elements to be multiples of material sizes can reduce waste. Using a 600mm grid, for example, will reduce off-cuts from wall panels. Choosing materials that allow for re-use or recycling and do not require packaging will also help to reduce waste. (See Waste Reduction by Design – Sustainable Home Guidelines)

Use of materials that will not last or will go out of fashion results in unnecessary waste.

The building should be designed so that it can be easily disassembled into re-useable components.

It will be expected that the construction company produce a waste management plan at the construction stage. However the designers have a responsibility to aid this process through good initial design.

Cost Implication:

Careful design takes time and there may therefore be additional costs during the design phase. However it can be expected that the resulting savings will outweigh this.

Further Information:

Further information on waste reduction can be found in the *Sustainable Home Guidelines*, Waitakere City Council, 1998, available in full at www.waitakere.govt.nz or from Waitakere City Council, Private Bag 93109, Henderson, Waitakere City, 09-8390400

REBRI

The Resource Efficiency in the Building and Related Industries (REBRI) membership programme aims to reduce resource use and waste by sharing information and experiences New Zealand wide. Member companies commit to reducing resource use and environmental impact. To find out more (or to join) call the Auckland Regional Council on 366 2000

Landscaping plans should be developed in consultation with Council's parks department.

Reason:

Landscaping around Council buildings plays an important role in educating the public about appropriate planting for local conditions. Especially the use of native plants for decorative purposes in the urban environment is to be encouraged. Council's parks department also has extensive experience in creating low maintenance gardens and this should be utilised.

Possible Solutions:

The parks department should be contacted early on to discuss any planned landscaping. In general the use of plants native to the area is encouraged, as is the use of plants that will require minimal watering and maintenance. Native plants should be eco-sourced where possible.

Plants, which are known to cause problems with

allergic reactions and asthma and plants that are environmental weeds, should be avoided.

Landscaping can influence the performance of the building. Deciduous trees for example can help shade the building in summer, while letting light and warmth through in winter. Planting can also help to make car parking areas more attractive, shade cars and help with stormwater management.

Cost Implications:

Council's parks department has extensive experience in landscape development and maintenance. Their preferred solutions will generally be cost effective.

Further Information:

Waitakere City Council's Code of Practice for City Infrastructure and Land Development, Parks and Reserves Section. Available from Waitakere City Council or at the Henderson library.

A list of environmentally damaging plants can be found in the District Plan.

A Guide for Planting & Restoring the Nature of Waitakere City, available for Waitakere City Council.

The *Gardening with Water* chapter of the *Sustainable Home Guidelines*, Waitakere City Council, 1998, available in full at www.waitakere.govt.nz or from Waitakere City Council, Private Bag 93109, Henderson, Waitakere City, 09-8390400.

Minimise stormwater run-off from the site by reducing impermeable surfaces and by providing innovative stormwater retention and treatment.

Reason:

Stormwater run-off from hard surfaces can cause problems with flooding and will affect the quality of receiving aquatic environments. In many areas of the city the infrastructure is insufficient to deal with increased run-off.

Possible Solutions:

Providing densely planted areas will increase water absorption into the soil as well as evaporation from the plants. Providing large lawn areas is of limited benefit. Paved surfaces can be sloped to drain into landscaped areas (swales), however care needs to be taken not to cause localised flooding.

Permeable paving can be used in car parks with low traffic flows. Council can provide further information on this.

Roof water collection can double as stormwater detention if the tanks have extra capacity that acts as a buffer in storm events and which slowly drains into the stormwater sewer.

Cost Implications:

The cost for these measures is often lower than the provision of more traditional stormwater infrastructure (pipes). However the maintenance costs can be higher and any proposed solutions should be discussed with Council in detail.

Good stormwater measures should be an integral part of the development and become parts of elements such as car parks, roof water tanks or landscaped areas. This consequently reduces the need for conventional stormwater infrastructure and the cost associated with it.

Further Information:

Guidelines for Best Practice – Water Management, Eco Water, Waitakere City Council, ph. 09-835 0290

Any proposed stormwater treatment should be discussed with EcoWater staff.

The amount of earth works and vegetation clearance should be minimised as far as practicable.

Reason:

Vegetation clearance and earth works cause erosion and siltation of receiving streams and harbours.

Possible Solutions:

The building should be designed to fit with the natural contours of the land. Important vegetation should be maintained, however it needs to be weighed up if the benefit of retaining the vegetation outweighs the benefits of having fewer restrictions in the design of the new building. If in doubt this should be discussed with Council.

It is expected that all Waitakere City Council and Auckland Regional Council guidelines for earthworks be complied with (see below).

Cost Implications:

Fewer earthworks will generally result in lower costs, however the resulting changes to the design might cause an increase in costs.

Further Information:

The *Site Earthworks* chapter of the *Sustainable Home Guidelines*, Waitakere City Council, 1998, available in full at www.waitakere.govt.nz or from Waitakere City Council, Private Bag 93109, Henderson, Waitakere City, 09-8390400

Erosion and Sediment Control Guidelines for Earthworks – Technical Publication No. 90, Auckland Regional Council.

Environmental Impacts of Accelerated Erosion & Sedimentation – Technical Publication No. 69, Auckland Regional Council.

Ensure safe and appropriate access for all people to all facilities in the building. This includes providing a safe access route from disabled car parks to all public facilities in the building and providing appropriate toilet and changing facilities. It is expected that the recommendations in the Resource Handbook for Barrier Free Environments be followed.

Reason:

There is a large proportion of the community that have mobility issues due to their age, disabilities or medical conditions. People with limited eyesight or hearing also have special needs. It is therefore vital that any public buildings are accessible to these people.

Possible Solutions:

Providing a safe access route means ensuring that there are no obstacles that can't easily be overcome by a person in a wheel chair, someone with other mobility problems, such as a person who has suffered a stroke, or someone with limited eyesight. Generally it involves providing low gradient ramps, non-slip floor surfaces and doors that are highly visible and can be easily opened (aren't too heavy). The documents listed below should be consulted for guidance. Access must be provided to all public facilities and should be clearly marked (colour contrasts as well as signage can be very effective).

Guidelines for toilet and changing room design are provided in the Resource Handbook for Barrier Free Environments. It is important that changing facilities are large enough to change older children as well as infants.

There is a benefit in supplying a unisex disabled toilet, because the caregiver of a disabled person might be a different sex than the disabled person and this can make it awkward to use designated male or female toilets.

It can often be beneficial to discuss the concept design with local disability groups. Contacts for the Waitakere area are listed below.

Further Information:

Resource Handbook for Barrier Free Environments, Barrier Free New Zealand Trust, 1997, PO Box 10455, Hamilton, 07-8396545

NZS 4121:1985 Design for Access by Disabled Persons, Standards New Zealand

Disability Information Waitakere Network, Po Box 21 931, Henderson, Waitakere City, ph: 836 1609, fax: 838 7206

Additional Clauses

These are clauses that do not have to be included, but that are desirable. A decision about their inclusion has to be made on a case-by-case basis, with special consideration given to the cost implication. However it should also be considered that public buildings can play an important role in educating the public and can set a valuable example for private developers to follow. This benefit can often outweigh the cost of the described measures.

Roof water should be collected and used for non-potable purposes, such as toilet flushing and irrigation.

Reason:

Water is a valuable resource and by collecting roof water less pressure is put on the public supply. Over the past years water issues have been a high priority for Council and including this measure will demonstrate to the public that Council is in fact doing what it preaches.

Space for the tanks and infrastructure needs to be planned for at the concept design stage. Even if roof water collection is not part of the initial design it can be beneficial to design the building to allow for the future installation of these facilities.

Possible Solutions:

Water can be collected in above or under ground tanks and then pumped to toilet cisterns and outdoor taps. Roof water could also be used for showers and other non-drinking purposes, such as fountains or other water features.

It would be desirable to include educational features, such as see through pipes or water features to draw people's attention to the use of rainwater.

Cost Implications:

The payback period for the installation of a roof water collection system is likely to be long (10 years or longer). However there is a considerable benefit in providing a demonstration site and in raising awareness of water issues.

The installation of the water collection system at the Massey Community Centre cost about $20 000 and it was estimated that annual savings would be just under $2 000.

Further Information:

It is likely that a professional engineer will need to be engaged to design the system. However some basic information can be found in the Using Rainwater chapter of the *Sustainable Home Guidelines*, Waitakere City Council, 1998, available in full at www.waitakere.govt.nz or from Waitakere City Council, Private Bag 93109, Henderson, Waitakere City, 09-8390400

Allow for solar hot water systems and/or photovoltaic cells in the roof design. This generally means having some north facing roof space.

Reason:

If it is decided to install solar hot water systems or photovoltaic cells the availability of north facing roof space is crucial.

Additional space under the roof and access to the roof may also be required. This applies whether these systems are planned in the initial design or might become options in the future.

Possible Solutions:

Ensure that an area of the roof faces north that is large enough to accommodate the chosen systems. It also needs to be ensured that the roof is strong enough to support the systems as well as allowing easy access for installation and maintenance.

It would also be desirable to plan for some public access to the roof space to allow the public to look at the systems (under supervision).

There are now photovoltaic cells available that are incorporated into the roof membrane (the solar panel is the roof) and this might be an attractive option. Windows that double as solar panels are also becoming available.

Cost Implications:

At present these technologies are quite expensive. Solar hot water heating has a payback period of about 7 years in a domestic situation and this might be faster in a public building with high hot water use.

Electricity can now be sold back to the supplier from buildings with photovoltaic cells and this has reduced the cost (batteries are no longer required), however the resulting financial savings alone still do not justify the high initial cost. For a Council building the demonstration and education value as well as the environmental benefit would be the main reason to install photovoltaic panels.

Further Information:

The *Heating Water* chapter of the *Sustainable Home Guidelines*, Waitakere City Council, 1998, available in full at www.waitakere.govt.nz or from Waitakere City Council, Private Bag 93109, Henderson, Waitakere City, 09-8390400

EECA can be contacted for advice and their Website (www.eeca.govt.nz/RenewConsSearch/ConsultantSearch.asp) contains a list of consultants that offer energy related services, such as the design of photovoltaic systems.