Appendix 8.04 – Environmentally Sustainable Design and Services Engineering

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INDOOR COMMUNITY SPORTS CENTRE (ICSC), WELLINGTON

ECOLOGICALLY SUSTAINABLE DESIGN (ESD)

PEER REVIEW REPORT

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eCubed Building Workshop Ltd

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1 INTRODUCTION

This report was commissioned by Wellington City Council and compares the environmentally sustainable design aspects of two proposals for the Wellington Indoor Community Sports Centre (ICSC) as follows.

- The Cobham Drive Park Option
- The Westpac Stadium Concourse Option

It provides a high level comparative review of the two options from the viewpoint of environmental sustainability.

2 BRIEF

2.1 Scope Review

This review has generally included the following:

- Review scope and revised scope of Cobham Drive Park Option that delivered the full brief.
- Review scope of Westpac Stadium Concourse Option against the same brief.
- Highlight and asses the areas of concern that would require attention.

The Cobham Drive Park Option is significantly more developed than the Westpac Stadium option which makes a detailed comparison more difficult in some respects.

2.2 Provide advice and supporting Information to aid decision making

Provide advice and supporting information in conjunction with the other experts to aid in Council decision making. This shall include comment on each schemes functionality, durability, consent issues, whole of life cost inputs exclusions and areas of risk.

2.3 Assessment Criteria

The environmentally sustainable design for both options has been compared against the following broad criteria.

- Energy use
- Indoor environmental quality
- Water conservation
- Materials and durability
- Accessibility and transportation
- Land use

3 COBHAM DRIVE PARK OPTION

3.1 Overview

The Cobham Drive Park option is a fully resolved design solution to the Council's original brief and subsequent amendments. It provides an iconic 'elegant shed' with a high level of design quality based around a very integrated concept. In principle it provides a simple, durable, covered space with high reliance on passive environmental control including no heating, natural ventilation and natural lighting to the bulk of the principal sports spaces. In so doing it has created a very sustainable solution which should result in low life cycle costs due to reduced energy, maintenance and replacement costs as there are very few building systems.

We also recognise that the materials have also been very carefully selected for durability in what is a relatively exposed coastal environment which should again result in a lower life cycle cost. This approach is entirely consistent with

providing good quality covered space for the principal community indoor sports functions of the brief. It is less consistent with other multi-purpose uses such as banquets and other similar non-sporting functions which generally require a higher level of environmental control, containment and flexibility.

We understand that the design team are currently looking at options to reduce the extent and cost of natural ventilation by the use of high level extract fans. Whilst this is to be expected in terms of value management it will detract from the overall sustainability and elegance of the current design solution.

3.2 Energy use

The ICSC will have long operating hours of between 10hours (weekends) and 15 hours (weekdays) per day, 7 days a week, and 365 days per year. The use of the centre will be predominantly concentrated in the early morning and evenings during weekdays and all day at weekends.

The energy use of the Cobham Drive facility will be relatively low due to the passive strategies it has incorporated into its design. The resultant energy use will consist primarily of lighting energy in the early morning and evenings with reliance on daylighting at other times.

We understand that the Cobham Drive park option also has solar water heating which will complement the passive design strategies of the building and further reduce energy use.

We have not considered changing room ventilation or small power energy use as this should be relatively similar for both options. We have also excluded any car park mechanical ventilation as it appears from the latest Beca information that some car park ventilation may have to be retrospectively added to the Westpac Stadium Concourse option. We understand that the Car park ventilation is relatively capital and energy cost efficient and uses a combination of impulse supply fans and larger extract fans with CO/NOX control to vary the ventilation rate at quieter periods during the day.

Based on some manual calculations and assumptions we have estimated the energy use for HVAC, hot water and lighting only to be approximately 55kWh/m^2/yr for this option or approximately \$11/m^2/yr operating cost.

The proposed facility should easily exceed the requirements for energy efficiency (H1 of the New Zealand Building Code).

3.3 Indoor Environmental Quality.

There has been some in depth design work and study of the indoor environment of the centre. This has included predictive thermal modelling, daylight modelling, sun penetration and acoustic modelling.

The thermal modelling indicates that the building will meet the requirements of the New Zealand Building Code (G4) in terms of ventilation provisions. In our view the sizing of the natural ventilation system has been overly conservative as it ignores any wind effects which will predominate on the site. In so doing this has added significantly to the cost and complexity of the façade. This aspect could be reviewed as part of the value management being undertaken on the natural ventilation design.

The daylight modelling indicates high levels of natural light across the main sports hall and concourse. The modelling uses a relatively basic program which does not take into account internal obstructions. It also uses an optimistic light transmission for the rooflights in our opinion. These aspects should be reviewed.

The sunlight penetration modelling indicates some potential issues in early morning and late afternoon particularly in winter to some of the courts. Note that these are the peak periods of use for the centre. Some mitigation of glare has been afforded by the use of solar control glazing.

We note that detailed acoustic modelling, reports and design have been carried out to satisfy the internal and noise to boundary issues. There may be some concern about aircraft noise ingress for a naturally ventilated solution of this type although sporting uses are quite tolerant.

The indoor environment created is highly variable with changes in external temperature, light levels, sun, wind/air movement and use. As a result it provides a high level of outside awareness in its widest sense which is often lacking in indoor sports centres, sometimes with good reason.. With this variability come some issues such as draughts, extremes of temperature and some glare. We note for instance that the internal air temperature will be below 12 ºC for around 300 to 350 hours per year during operation hours (8am to 10pm). We understand that the infrastructure exists to add some heating in the future if this is found to be desirable.

These possible adverse effects of a fully passive strategy have all been mitigated as far as practicable by the proposed design which should make the venue suitable for indoor community sports use. Some further mitigation of these adverse effects could possibly be achieved, particularly of the glare issues. They do remain as potential issues for more multi- purpose use of the venue when it is used for say banquets or high capacity/high importance regional or international sporting events where a more controlled 'black box' environment is the preferred solution.

Some earlier concerns we had with the natural ventilation aspects of the design via a previous peer review report appear to have been addressed by the designers. We are pleased to see that very robust design solutions have been selected for the natural ventilation devices.

3.4 Water Conservation.

We are unsure of any measures that have been incorporated for water conservation. These should include low water use sanitary fixtures as a minimum and potentially rainwater harvesting for toilet flushing although salt carryover to the roof could be an issue.

We understand that roof water recycling was proposed in earlier concept but deleted in value engineering. Hydraulic services connections (grouping of toilet water supply) have however been designed to allow for future installation. Storm water piping and access to the plant room from a future storm water tank have also been allowed for.

3.5 Materials durability and life cycle analysis

The choice of materials is critical in a windy coastal environment such as Cobham Drive to ensure that the building is durable and maintainable. In response we note that great store has been placed on the durability of the materials solutions. The use of precast concrete panels, the Kalzip roof and a highly specified glazing system from a reputable supplier have all been carefully considered from a whole of life cost rather than a minimum code compliance viewpoint such that their life cycle will be considerably extended albeit for a higher initial capital cost.

The products selected for the external façade have demonstrated on reasonable grounds that their serviceable life expectancy is well in excess of the New Zealand Building Code requirements. The roof system is supported by a 25 year warranty and is reported to have a life expectancy of 40 years. Concrete panels have in service history in excess of 50 years and the glazing system elements will provide 15 years serviceable life if properly maintained. Expected life cycles are as follows:

- Precast Panels >50years
- Glazing Systems>15 years
- Roofing>30 years

Building services systems generally wear out earlier and at more frequent intervals than the structure and building fabric. For the Cobham Drive Park option there are virtually no services in the main hall and concourse as the servicing is entirely passive and integral to the building fabric. In essence the climate technology is embedded rather applied to the building. Life cycle liabilities include the following:

- Re-lamp every 12 years in main hall.
- Window motor replacement – 15years
- Solar water heating system – 18 years

- Annual maintenance cost for the building services within main space is virtually zero other than window maintenance and controls. Allow 1% of capital cost of building services per annum for maintenance.

The building may however need to be cleaned internally on a more regular basis as the outdoor air via the natural ventilation openings is unfiltered. We do not subscribe to the view of additional salt corrosion internally due to ventilation by this means other than local to the windows and window motors. We have some residual concern on the potential ingress of birds through the natural ventilation openings and resultant soiling in the building.

We are not aware that a conscious effort has been made to select environmentally friendly materials other than the durability considerations described above, which are obviously paramount. For instance consideration could also be given to selection of materials with Environmental Choice New Zealand certification where available and suitable. We note that hydraulic services have been designed without the use of PVC. Electrical services do however use PVC material due to costs and availability which appears a little inconsistent.

3.6 Transportation

The Cobham Drive Park option is in a less accessible suburban location with and fewer modal options (e.g. trains) than the Westpac Stadium Concourse option. However a sporting facility of this nature might be expected to be located within the community and to suit it's demographic rather than in the CBD which would involve travel and congestion into the city.

3.7 Land Use

The Cobham Drive Park option obviously displaces some external amenity and green space in comparison with the Westpac Stadium Concourse option. It is also a stand alone facility so there are fewer opportunities for using the facility for other city focused events other than indoor sports. It will be reliant on new infrastructure connections with upgrading as required to satisfy the building demands.

4 WESTPAC STADIUM COUNCOURSE OPTION

4.1 Overview

The Westpac Stadium Concourse option is at a much earlier stage of design development than the Cobham Drive Park option and is therefore not fully resolved at the time of this review. This includes the design development period which would normally be used to explore more sustainable options. It appears at this stage however that sustainability and life cycle analysis does not form any part of the Westpac Stadium Concourse option.

In contrast to the Cobham Drive Park option the Westpac Stadium Concourse option envisages a sealed and more controlled black box solution. Daylighting is largely limited to a high level clerestory and the environment is controlled more closely by mechanical ventilation and direct gas fired radiant heaters. Some initial consideration has been given to the use of natural ventilation for air supply however this has been qualified by Becas adding a recommendation for salt filters on the air inlets which would not be feasible in our view. They also maintain the need for space heating.

We believe a more controlled environment is appropriate for this location given the more frequent demand for multi-purpose uses other than just sports. We are aware of the option being considered to upgrade the services for concert use with up-grading of the air supply and the addition of cooling. This upgrade has not been considered further by this report however we would suggest that it would be re-evaluated if the Council proceed with this option.

4.2 Energy Use

Again the ICSC will nominally have long operating hours of between 10hours (weekends) and 15 hours (weekdays) per day, 7 days a week, and 365 days per year. Similarly the use of the centre will be predominantly concentrated in the early morning and evenings during weekdays and all day at weekends. Additional multi purpose use may also increase energy use but has not been allowed for in this assessment

The energy use for the Westpac Stadium Concourse option will be considerably more than that of the Cobham Drive facility due to the current design of the facility and the apparent lack of any energy efficiency features. Energy consuming services will consist of heating, tempered mechanical ventilation hot water supply and lighting. Given the lack of daylighting we believe that a considerable proportion of the lighting will be on all the time. We also understand that no solar water heating is proposed for this option.

Again we have not considered changing room ventilation or small power energy use as this should be relatively similar for both options. We have also excluded any car park mechanical ventilation as it appears from the latest Beca information that some car park ventilation may have to be retrospectively added to the Westpac Stadium Concourse option so it is on a like for like basis with the Cobham Dive Park option.

Whilst details of the proposed building services are vague an assessment has been made of the likely energy use again based on some manual calculations and assumptions. We have estimated the energy use for HVAC, hot water and lighting only to be approximately 155kWh/m²/yr for this option or approximately $31/m²/yr operating cost.

When fully and properly designed the proposed facility should meet the requirements for energy efficiency (H1 of the New Zealand Building Code). The mechanical system will also need to comply with the new HVAC section of H1.

4.3 Indoor Environmental Quality

There has been very little if any design work and study of the indoor environment of the proposed centre. No predictive thermal modelling, daylight modelling, sun penetration and acoustic modelling have been provided. Being mechanically ventilated it is safe to assume that the building will meet the requirements of the New Zealand Building Code (G4) in terms of ventilation provisions.

The building has no cooling and we would expect that the internal temperature in summer with this option will be warmer given the ability to economically move a similar volume of air mechanically compared to the very extensive natural ventilation system. Conversely gas fired radiant heating is proposed so the incidence of temperatures below 12ºC highlighted for the Cobham Drive Park option will be avoided. Air movement in winter will also be much more controlled with this option. The indoor environment created will therefore be less variable with this option. This option provides very little outside awareness and natural light.

The proposed building services if properly designed are more suited to multi- purpose use when the venue is used for say banquets or high capacity/high importance regional or international events where a more controlled ‘black box’ environment is the preferred solution. They could also allow for the provision of cooling for a concert use with some upgrading.

We note that detailed acoustic modelling, reports and design have not yet been carried out to satisfy the internal and noise to boundary issues. Consideration also needs to be given to noise ingress from train and road traffic noise which again makes the mechanical ventilation option more appropriate for this location and the potentially wider range of uses.

4.4 Water Conservation

We are unsure of any measures that are intended to be incorporated for water conservation. These should include low water use sanitary fixtures as a minimum and potentially rainwater harvesting for toilet flushing although salt carryover to the roof could be an issue.

4.5 Materials and durability

The choice of materials is just as critical if not more so in the elevated and potentially more exposed location of the Westpac Stadium. We note that the materials selections, although preliminary appear to be less durable than the Cobham Drive Park option. Expected life cycles are as follows:

- Metal Cladding >15years
- Glazing Systems>15-20 years
- Roofing>25 years

Building services systems generally wear out earlier and at more frequent intervals than the structure and building fabric. Their life will also be shortened due to the long operating hours of the Centre. The Westpac Stadium option relies on mechanical services systems for environmental control and is therefore more exposed to life cycle cost concerns than the passive Cobham Drive option. The lack of daylighting for this option will also require more regular re-lamping of light fittings.

- Re-lamp every 4 years in main hall.
- Air handling and ventilation ducting replacement after 25 years
- Replacement of gas fired heaters replacement after 10 years
- Annual maintenance cost for mechanical within main space is virtually zero other than window maintenance Allow 1% of capital cost of mechanical services capital cost per annum for annual maintenance.

The air supply to the building will be filtered and should result in less cleaning being required internally. The potential ingress of birds through the natural ventilation openings and resultant fouling in the building of the Cobham Drive Park option is also avoided.

4.6 Accessibility and transportation

The Westpac Stadium Concourse option is in a more accessible fringe CBD location with complete transport modal options.

The entry to the centre for this option is less than desirable and may require more lift energy use.

4.7 Land Use

The centres location and use may conflict with its role as a community sporting facility both in terms of its co-location with the stadium, when in use, and the probable desire for more multi-purpose activities associated with city centre events. Conversely the possibility of multi purpose use may be seen as a net benefit by the wider community who do not necessarily participate in sport.

5 CONCLUSIONS

Environmental Sustainability largely centres on the ‘tale of two sites’, one urban and the other suburban. Also the resulting opportunities for the use of the centre, be they more multi-purpose or singularly focused on sporting activities.

In response to these two contexts two fundamentally different design approaches have emerged – one open and passive and the other sealed and black box. Both could be considered appropriate to their context. But as a result the Cobham Drive Park option is significantly more environmentally sustainable than the Westpac Stadium Concourse option. And consequent to this the Westpac Stadium Concourse option will cost about 3 times as much in terms of energy to run every year for the duration of its life. Given the issue of climate change and the impact of rapidly increasing energy costs this is a relatively profound difference between the two options.

The simplicity and durability of the Cobham Drive Park option will also result in lower life cycle costs in terms of ongoing maintenance and replacement. Again this also has relatively profound sustainability effects in terms of embodied energy and ongoing construction/demolition waste management.

The Cobham Drive Park option is obviously the more thought through in terms of incorporating sustainable features. The Westpac Stadium Concourse option is relatively unresolved in design terms and currently pays no attention to issues of sustainability. This may however be a function of where the thinking is currently at rather than where it may end up. Any comparison of costs therefore needs to make an allowance for a comparable sustainable agenda. This is normally in the order of 5% of the construction costs.

Wider sustainability issues include the accessibility of each of the centres to their targeted demographic. Is the centre better located in the community for predominantly sporting uses or in a more central location that offers a greater range of potential uses to a wider community? However this is essentially a briefing and political decision.