

2.3.1 Local Economy

The construction and management of buildings can have a major impact on the economy of an area. The economy of an area can be stimulated and sustained by buildings that makes use of and develop local skills and resources.

- Local contractors

Target (4)

80% of the construction must be carried out by contractors based within 40km of the building.

Assessment (5)

The different professions and contractors that will make part out of the erection of the HPC are listed in table.1.

-Local building material supply

Target (4)

80% of the construction materials: cement, sand, bricks etc. must be produced within 200km of the site

Assessment (5)

The site location is central in Gauteng where most of the construction companies and suppliers of building materials are situated. Table.1 shows where some of the building materials will be sourced from.

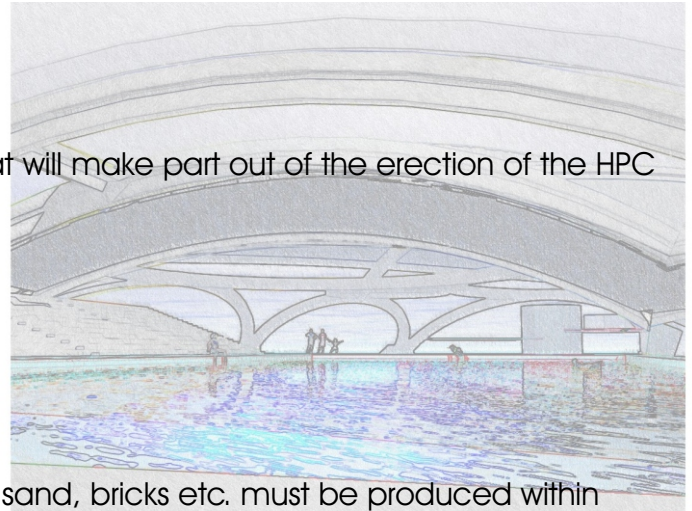
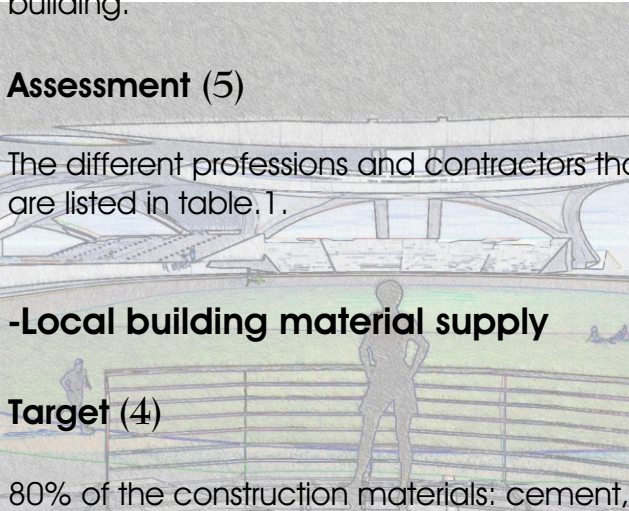
- Local components

Target (5)

80% of the building components, i.e. windows and doors should be produced locally (within 200km). Using locally produced building materials shortens transport distances, thus reducing air pollution produced by vehicles. Often, local materials are better suited to climatic conditions, and these support the area economicall. It is not always possible to use locally available materials, but if materials must be imported they should be used selectively and in as small a volume as possible.

Assessment (5)

The manufacturing of building components are also listed in Fig.81. which shows the manufacturers name and their location, which are within the 200km radius of the HPC.



Contractor/Suppliers	Service	Location
Abe Construction Chemicals	Water proofing	JHB
Aluglass Bautech	Mobile glass partition	PTA
Barloworld Robor Tube	Roof construction	JHB
BPB Gypsum	Drywall and ceilings	JHB
Burocentrum	Auditorium seating	PTA
Clotan Steel (Pty) Ltd Craft-Lock Roofsheets	Roof and cladding	JHB
Concor Technicrete	Retaining walls	JHB
Contract Seating Africa	Stadium seating	JHB
Daikin Air Conditioners	Air conditioner	JHB
EagleWood	Timber Sundecks	JHB
Fintrex	Synthetic sports flooring	JHB
Henderson Sliding Door Gear	Sliding, stacking and folding doors	JHB
ISOBoard	Insulation	PTA
Kaytech	Engineering geotextile	JHB
Kirtech	Window control gear	JHB
Kool Aluminium Luxalon	Roof , wall-cladding and louvers for sun control	JHB
Glass South Africa (PFG) Intruderprufe	Glazing	JHB
South African Landscapers Institute	Landscaping services	JHB
Beka	Lighting	JHB
Taaf Hamman Trading	Sports flooring	JHB
ARUP	Construction and Rock storage	JHB

List of Contractors/Suppliers and the location

Fig.81

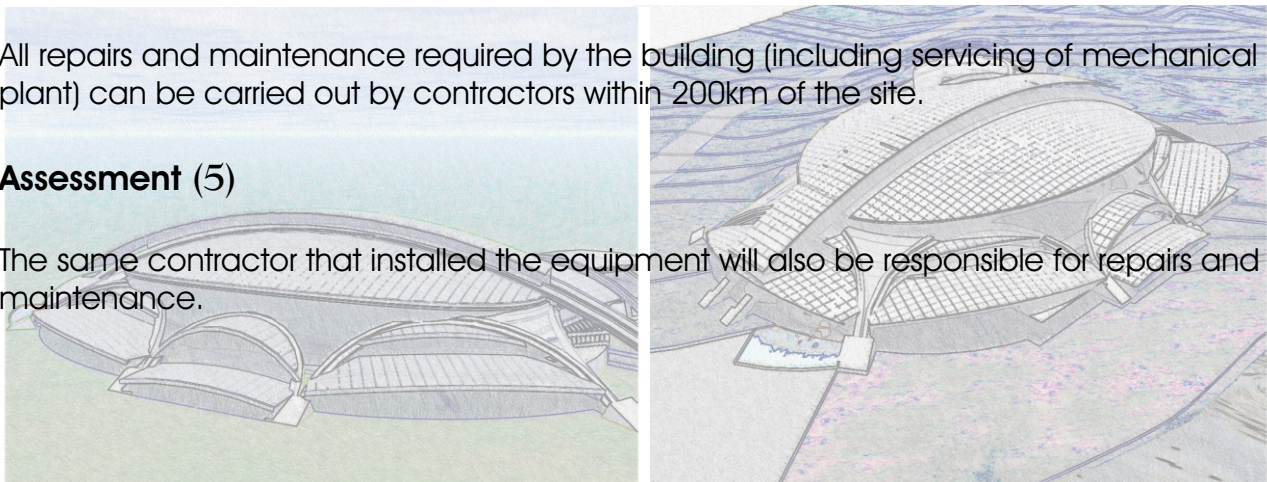
- Repairs and maintenance

Target (4)

All repairs and maintenance required by the building (including servicing of mechanical plant) can be carried out by contractors within 200km of the site.

Assessment (5)

The same contractor that installed the equipment will also be responsible for repairs and maintenance.



2.3.2 Efficiency of Use

Buildings cost money and make use of resources whether they are used or not. Effective and efficient use of buildings supports sustainability by reducing waste and the need for additional buildings.

- Space Use

Target (4)

Non useable spaces such as airconditioning plants, wc's and circulation should not make up more than 20% of total area

Assessment (5)

The type of structure that is used in the HPC contributes to the useable space of the building. The HPC is designed in such a way that it makes maximum use of natural ventilation and minimal use of air conditioners. Rock storage is used to store warm and cool air that doesn't take up any useable space. The non useable space such as air conditioning plant rooms, wc's and circulation makes up 17.5% of the HPC total area.

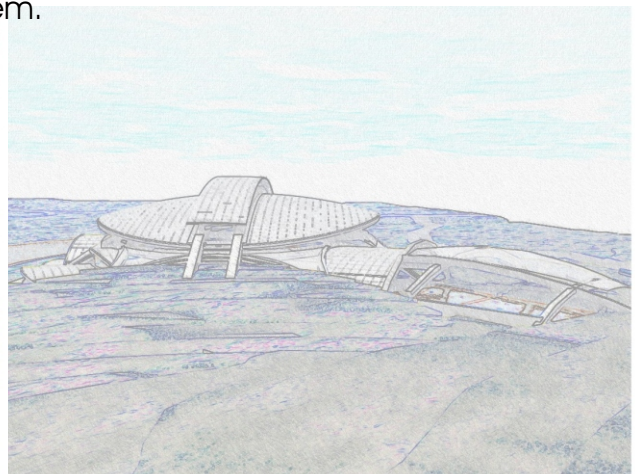
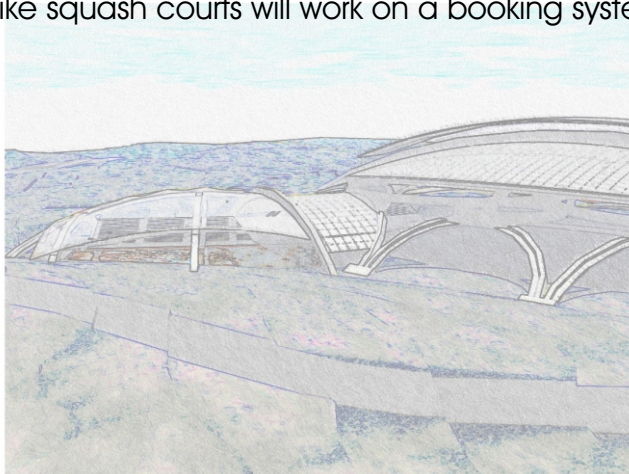
- Occupancy schedule

Target (4)

Building and all working/living spaces are occupied for an average equivalent minimum of 30 hours per week.

Assessment (5)

The HPC is designed to be used by high performance athletes as well as for the public. For this reason all of the facilities of the HPC will be occupied for more than 30 hours per week. Different spaces will be occupied by different people throughout the week. The medical centre has four consultation rooms that will be occupied by different practitioners throughout the week. Approximately twelve different practitioners will use this facility at different scheduled times during the week. An occupancy schedule for spaces like squash courts will work on a booking system.



- Management of space

Target (5)

Spaces must be well used and managed for maximum income. This may include regular audits, or space management system that charge space to cost centres.

Assessment (5)

Much of the literature in sports research is conducted by universities and is based on recreational athletes. Whilst this provides worthwhile information, it does not always apply to the elite athlete. The HPC however, is in a unique position (due to its residential-based athletes) to access the very best of elite athletes for its research and thereby answer the question of how research impacts on elite performance. The indoor open space with its 200m athletic track is a multipurpose space and will be used for cardiac rehabilitation biomechanics laboratory, where experiments and research will be conducted on athletes in action. This open space will also be used by sports groups and athletes for training. It will also be used for indoor athletic championships, or bigger events like concerts. The auditorium will be used together with the medical centre for showing video material of the recordings of the athletes performing to assist them in their performance. The auditorium will also be open for the public to book for events. The swimming pool is there for the athletes training and rehabilitation of sport injuries. This indoor olympic size swimming pool will also be used for swimming galas and training. Spaces like the restaurant, gymnasium, spinning, aerobics, squash courts and the rock climbing are not only for high performance athletes but also open to the general public.

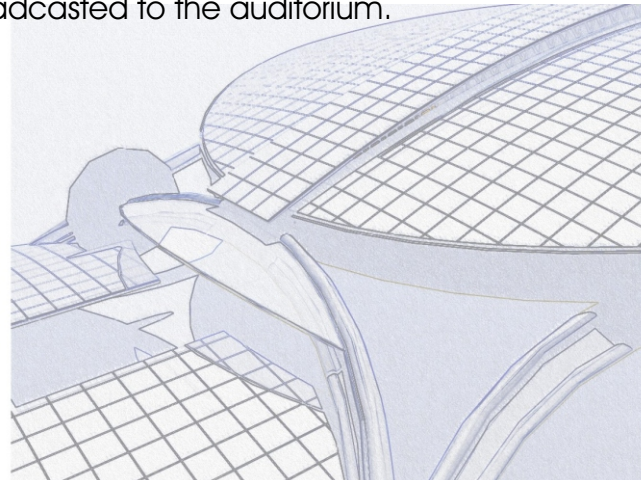
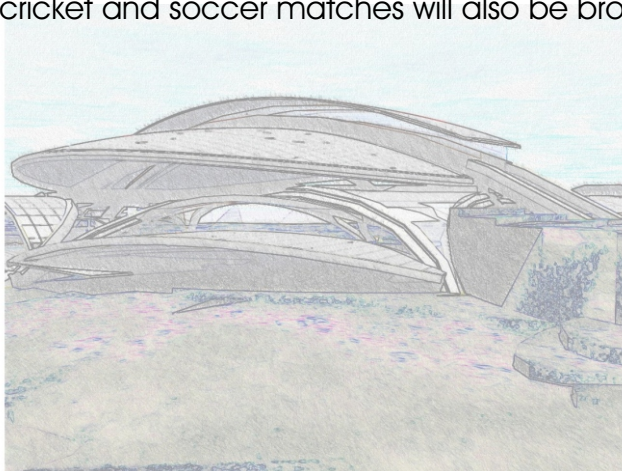
- Use of Technology

Target (3)

Communications and information technologies should be used to reduce space requirements, i.e. video conferences, teleworking etc.

Assessment (4)

The auditorium will be used for broadcasting events like a swimming gala or athletic championships if there aren't enough seats. Broadcasting of bigger events like rugby, cricket and soccer matches will also be broadcasted to the auditorium.



2.3.3 Adaptability & Flexibility

Most buildings can have a life-span of at least 50 years. It is likely that within this time that the use of the building will change, or be reinvestigated. Buildings which can accommodate change easily support sustainability by reducing the requirement for change (energy, costs etc.) and the need for new buildings.

- Vertical dimension

Target (4)

A structural dimension (floor to the underside of roof, or slab of the floor above) of more than 3m.

Assessment(5)

The floor to ceiling height is not lower than 3m, except in the toilets where it is 2.4m.

- Internal partitions

Target (3)

Internal partitions between living/work spaces are non-load bearing (i.e. non-load bearing brick / block or plasterboard partitions) and can be moved relatively easily.

Assessment (4)

The HPC is an open plan design with minimum internal walls. The only area which is divided is the medical centre and the office space that have internal partitions for flexibility and adaptability. The sports shop and gymnasium has a glass curtain wall that can easily be removed for adaptability.

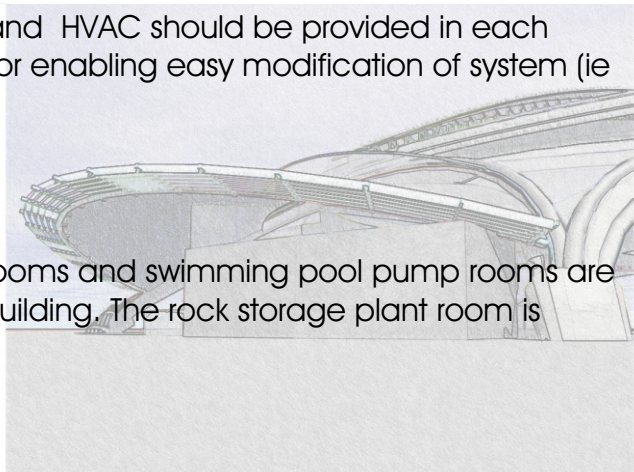
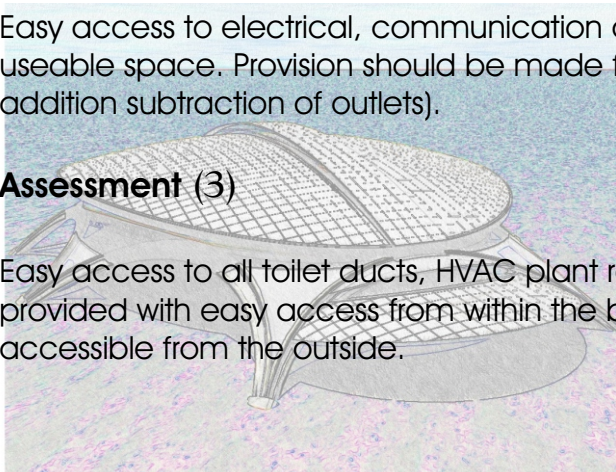
- Services

Target (3)

Easy access to electrical, communication and HVAC should be provided in each useable space. Provision should be made for enabling easy modification of system (ie addition subtraction of outlets).

Assessment (3)

Easy access to all toilet ducts, HVAC plant rooms and swimming pool pump rooms are provided with easy access from within the building. The rock storage plant room is accessible from the outside.



- Structure and circulation

Target (3)

The building structure and circulation roads must be designed in such away that it contributes to adaptability and flexibility of spaces.

Precedents

Santiago Calatrava



Fig.82

Milwaukee art museum, Las Vegas, USA.

Calatrava marries sculpture and structure, and models a new identity. The structure becomes visible and appears to be living. The concrete structure is sculptured in an elegant way to complement the architecture and identity of the building. The tensile concrete structure shapes itself to comply with the different forces that keep the structure in equilibrium.



Fig.83

CARE DE SATOLAS TGV, Lyon , France !989-94

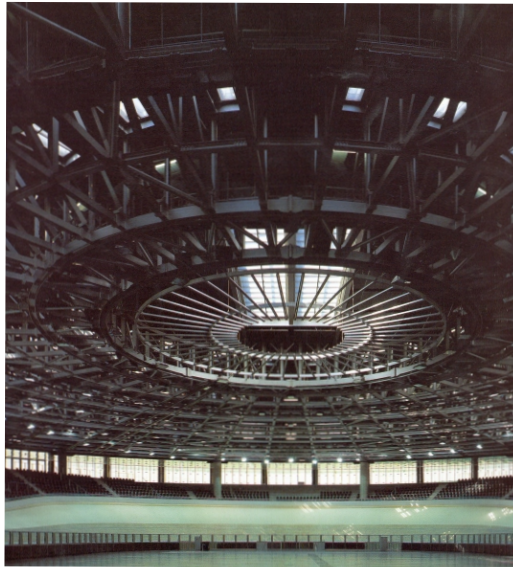
Another example of Calatrava's concrete sculptures is the Lyon-Satolas Airport in France.

In spite of appearance, the great dynamism of the superstructure obeys to a simple geometry. A central spine is generated by two cones, with axes parallel to the platforms, they intersect at the transversal axis of the station. Each wing is ribbed by a series of "wing-tips" formed by the composite profiles of varying height. Each "wing-tip" is supported at three points. The lower part is supported by the tubular arches of the spine. The central section rests on vertical columns which carry the lateral glazing. The column-heads are linked by an arch formed from a curved triangular lattice beam elegantly spanning the width of the building.



The form follows function structure with its sculptural column beam construction that spans a hundred metres evokes the theme of flight.

Photos of Calatrava's work Fig.84



OLYMPIC VELODROME AND SWIMMING HALL, Berlin Germany, Designed 1992-96 Dominique Perrault

The ring structure used in the Olympic velodrome and swimming hall are a good example of compression rings working together, forming a large span roof structure. The steel construction spans over the indoor cycling track without any vertical support in between. All the steel rings press together to keep the roof structure in equilibrium.

OLYMPIC VELODROME AND SWIMMING HALL Fig.85



GREAT GLASSHOUSE, Camarthen, Wales Designed Foster and Partners.

The distinctive shape and size of the structure grew directly out of the existing site conditions, notably a shallow oval platter of land that had been created. The visual horizontality and simplicity of the structure interact with the surrounding landscape, rather than dominating it. But there is still an undeniable spectacular element to both the structure and landscape.

GREAT GLASSHOUSE

Fig.86

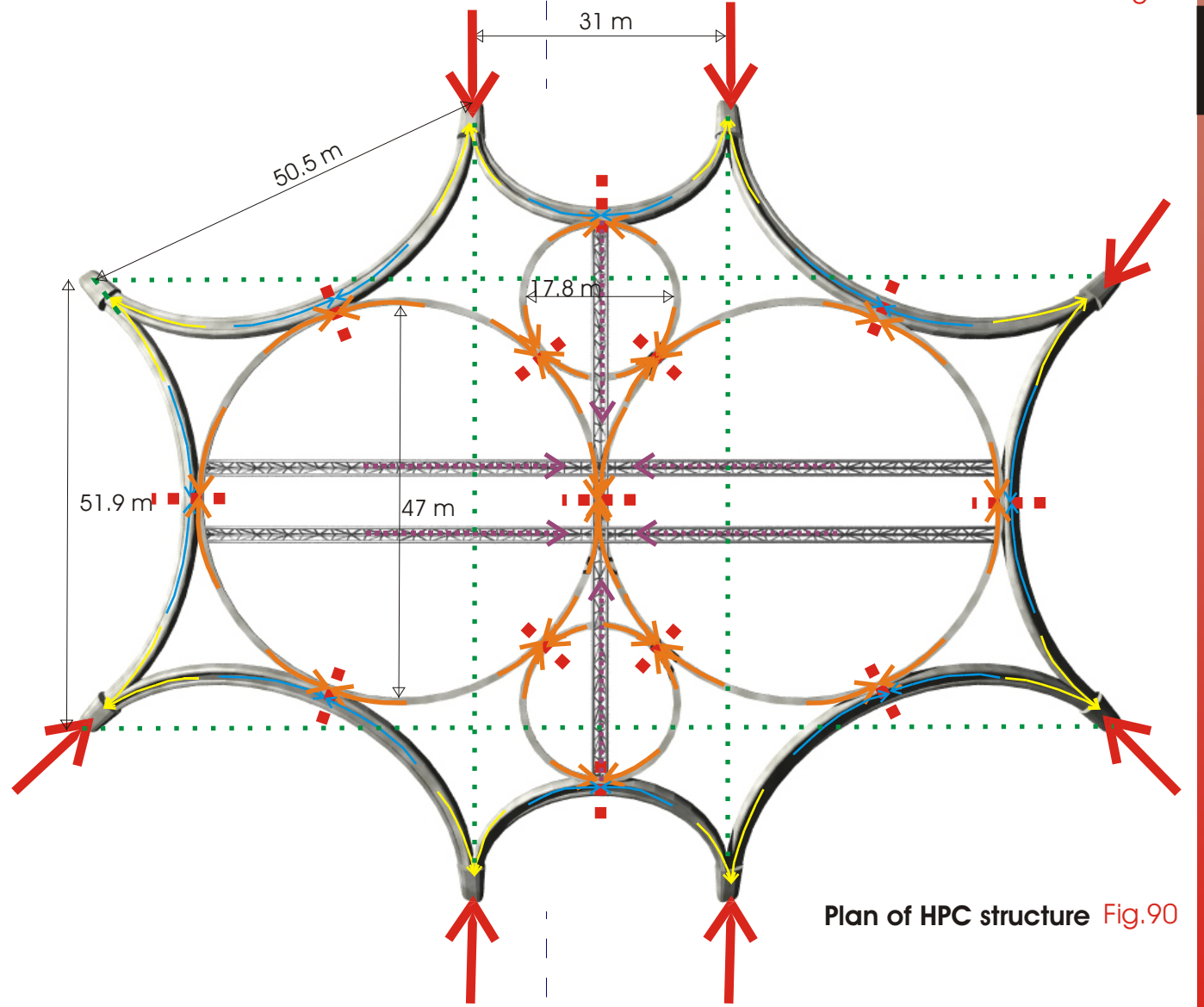
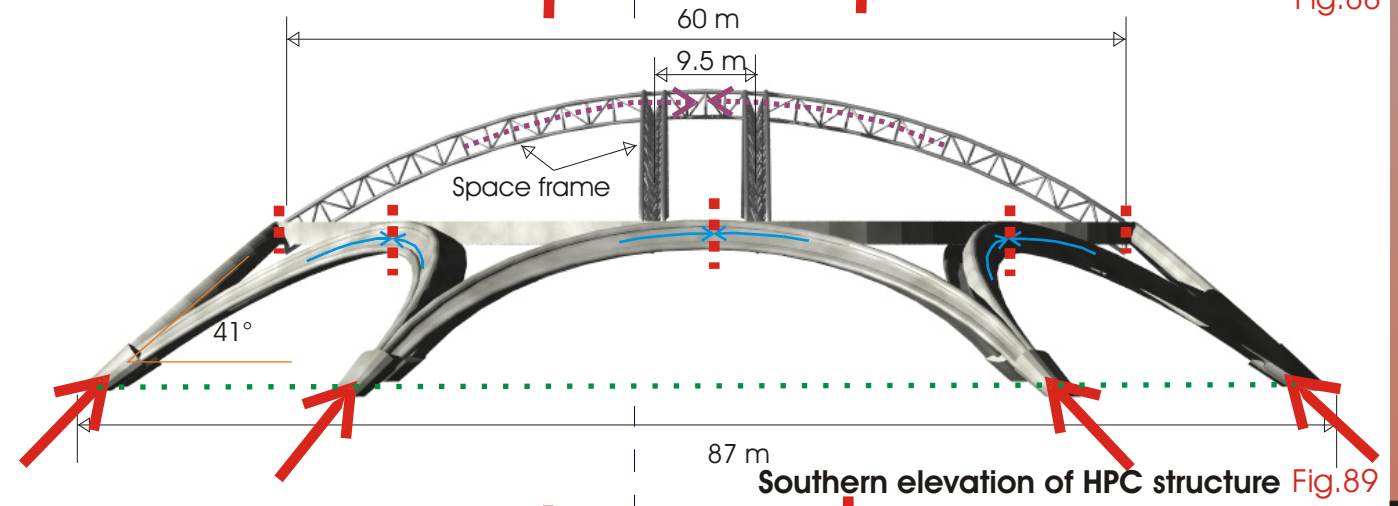
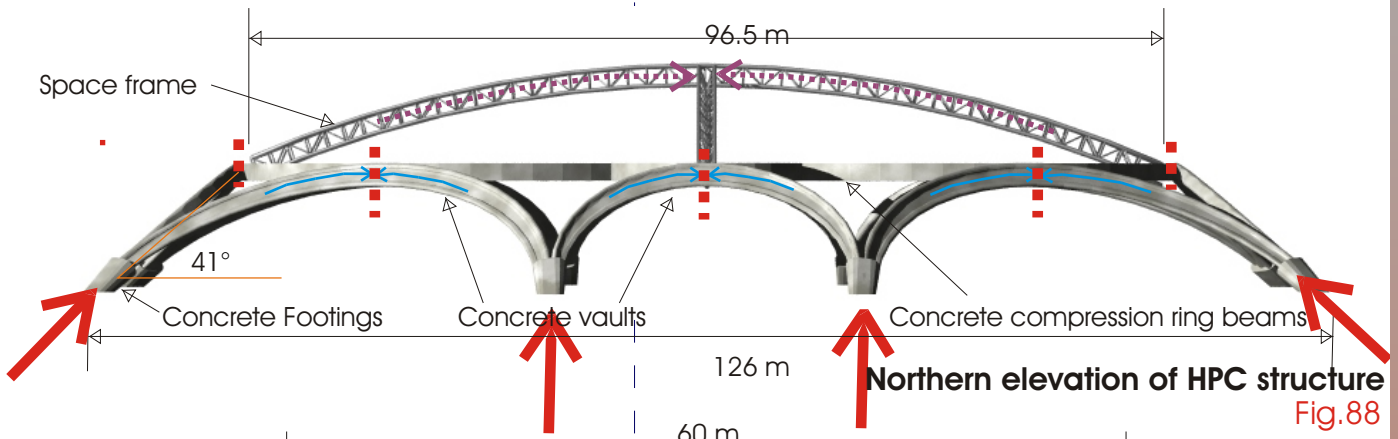
Assessment (4)

The HPC structure

The sculptural structure of the HPC with its curved geometry symbolises the motion of an athlete. The vaults with its elegant form and function portray a sense of athletics and sport. The structure contributes to the Hi-performance image of the HPC.



HPC Structure Fig.87



The structure of the HPC consists of eight concrete vaults that are in compression with four concrete ring beams which obey simple geometry. The structure is a combination of compression forces working against each other to achieve state of equilibrium.

The light weight space frame construction on top of the concrete structure is to transfer the roof dead load and live loads to the concrete structure. The three space frames are all under compression. A light weight steel structure will be fixed to the space frame that will make part out of the rest of the dome construction.

The concrete compression rings are 1600 x 800 mm in section. It is precast in 5m lengths that are pulled together with cables on the site. There are two main rings with a diameter of 47m and two smaller rings with a diameter of 17.8m. These four compression rings are held up by the compression of the eight vaults.

The vaults are angled at 41° to transfer the compression forces of the rings straight into the ground. The vaults have a high pressure point where the vaults meet the rings. At this point the bending moment of the vaults will be at its highest. The vaults are a sculptured structural element that will take on two different functions, one of a beam and one of a column. At the connection between the vault and ring it has the same character and function of a beam. The depth of the vaults is 2.5m at the high pressure point. The size reduces as it enter the ground.

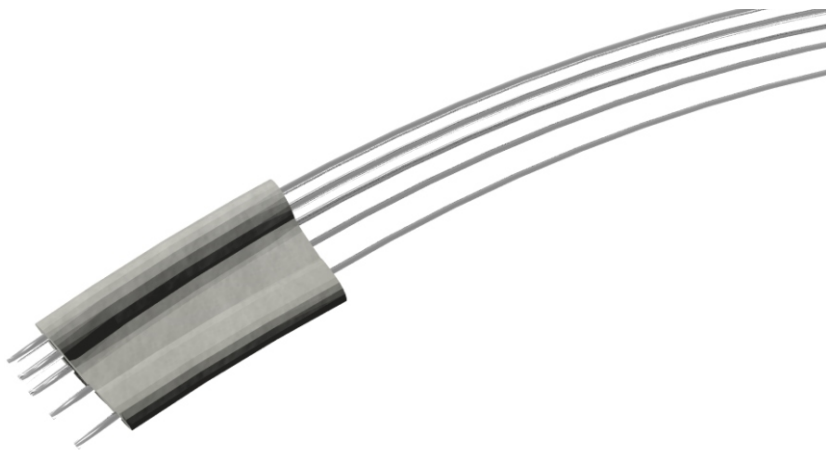
The vaults function and character change closer to the footings because the bending moments become direct compression forces. At this point the vaults take on the function of a column and don't need that depth anymore. Therefore the vault depth is only 1.28m where the vault connects with the footing. The vaults' compression forces are transferred directly onto the footings.

The concrete footings are pilled into the ground according to the engineer's specification. The footings will be connected to one another with underground cables to make sure the structure will be kept together.

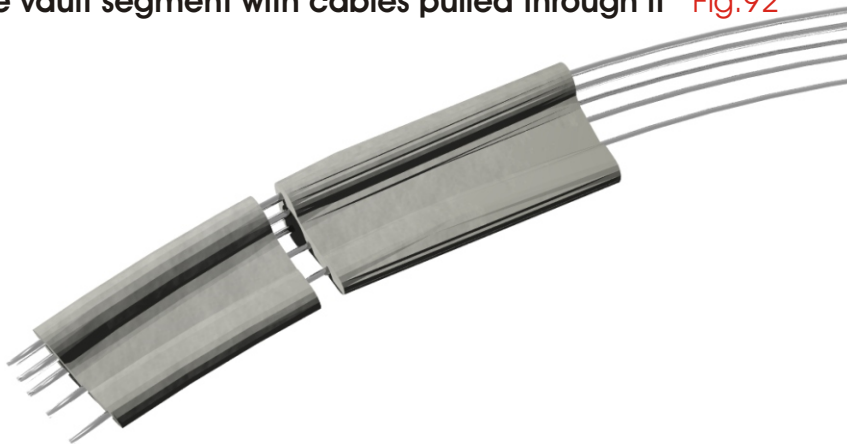
The underground cables are mainly to make sure that in case of any ground movement or natural cause that the structure will not move apart. These cables will be connected to the underground pilers. The cables are the only tensile element in the HPC structure and will ensure to the equilibrium of the building.



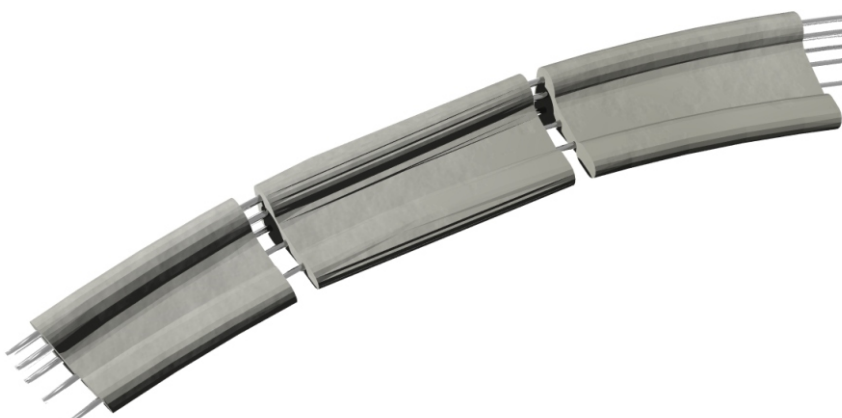
HPC structure Fig.91



One vault segment with cables pulled through it Fig.92



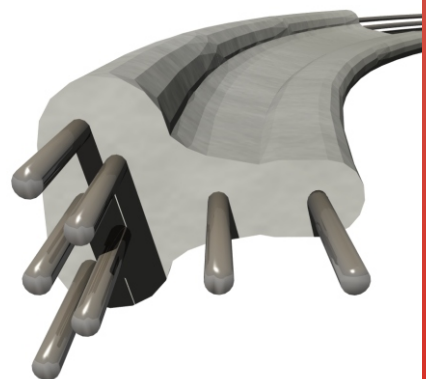
Two vault segments with cables pulled through it Fig.93



Three vault segments with cables pulled through it Fig.94



Three vault segments pulled together with cables Fig.95



Vault section Fig.96

The whole concrete structure is precast in 5m lengths. These segments are then transported to site where they will be pulled together. The precast segments are cast with seven 80mm holes through segments where the cables will fit through. All the segments are then pulled together with the cables. These cables are then cast into the footings to keep them tight. A rubberised cushioning specified by the engineer will be placed between the segments to protect them from one another and to assure water proofing. This rubberised cushioning will also allow for thermal expansion.

The ring beams will also be precast in 5m lengths and pulled together with cables. When the structure is pulled up and all the vaults and rings are set into position all elements will be in compression.

2.3.4 Ongoing Cost

- Maintenance

Materials with a longer life relative to other materials designed for the same purpose need to be replaced less often. This reduces the natural resources required for manufacturing and the amount of money spent on installation and the associated labour. Durable materials that require less frequent replacement will require fewer raw materials and will produce less landfill waste over the building's lifetime.

Target (4)

Material specification must be low maintenance and low-cost. All airconditioning plants and fabric must have a maintenance cycle of at least two years. Low or no maintenance components (i.e. windows, doors, plant, etc.) must be selected. Maintenance can be carried out cost effectively (i.e. replaceable items such as light bulbs can be easily reached and replaced).

Assessment (5)

The material selection of the HPC is considered to be low in maintenance. The aluminium composite roof panels that are power coated and oven baked, produce a low maintenance finish. The transparent membrane has a life span of 20 years. The concrete structure will keep its natural texture and colour, and will have no maintenance. No walls will be painted, most of the walls are concrete or foamed concrete that does not need any finishes. The only areas that will need servicing are the airconditioning plants. The rock storage will have no or little maintenance. Fluorescent light bulbs and tubes will be used that are low in energy and have a longer life span.

- Cleaning

Target (4)

Measures must be taken to limit the requirement for cleaning. Hard wearing solid flooring (limited or no carpeting) must be specified. Windows must be easily accessible for cleaning.

Assessment (3)

There are three different floor finishes in the HPC:

- Tartan in the indoor open space

- Toilets and kitchens will be tiled

- 6mm epoxy screed floor finish for the rest of the HPC

Access to the windows will be from the outside of the building. Access to the roof is provided on the western side of the building where the site is filled up to roof. Cleaning and staff rooms are provided next to the swimming pool's pavilion.

- Disruption & downtime

Target (3)

Electrical and communication services, HVAC and plant located where they can be easily accessed with a minimum of disruption to occupants of the building. This should maximize access to this from circulation areas (rather than work/living areas) and lift off panels at regular intervals to vertical and horizontal ducts.

Assessment (3)

The rock storage is situated under the auditorium and is accessed from the outside. The other airconditioning systems are on the first floor with easy access from the inside that will not disturb the occupants. The swimming pool pump has also easy access from the inside and will not disturb the occupants.

- Insurance / water / energy / sewerage

Target (2)

Costs of insurance, water, energy and sewerage must be monitored. Consumption and costs must be regularly reported to management and users. Policy and management to reduce consumption (ie switching off lights on leaving building spaces) must be implemented.

Assessment (3)

The HPC will be controlled by a Building Management System(BMS) that will control lighting, louvers, window openings and airconditioning plants for optimal use. BMS is also capable of calculating the water usage of the building according to the amount of water catchment, municipal water, reusable water and sewage water. The BMS will save on money and will make the report to management much easier. Insurance cost must be calculated by financial advisers and reported to management.

2.3.5 Capital Cost

Buildings are generally one of the most valuable assets that people, and often organisations and governments own. Money spent on buildings is not available for other uses such as health and education. Often too, the high cost of buildings results in the services (i.e. health and education) and the accommodation (for work and living) that is beyond the reach of people with the lowest incomes. Buildings that are cost-effective support sustainability by helping provide access to accommodation and services for low income areas and by enabling money to be spent on other areas that support sustainability.

- Construction

Target (4)

Construction approach designed to reduce initial capital cost of building. A building must be constructed in a series of phases. Building built as shell first with finishes to be added later.

Assessment (2)

The HPC has different construction phases. The first is the structure that is discussed in section 2.3.4. The second phase is the aluminum composite roof panel together with all the walls. The third phase is all interior finishes. The school and hostels are the fourth phase. The indoor open space with its long span makes the construction of the structure quite expensive. The aluminum composite roof panels, off shutter concrete walls and transparent membrane roofs finishes have a high capital cost but have very low maintenance.

- Plate efficiency

Target (4)

Building must be designed to maximize usable areas of the building to make it a feasible design.

Assessment (5)

Gross floor area	11 218 m ²
Usable area	9 487m ²
Usable factor	84 %

2.4.1 Water

Water is required for many activities. However, the large-scale provision of conventional water supply has many environmental implications. Water needs to be stored (sometimes taking up large areas of valuable land and disturbing natural drainage patterns with associated problems from erosion etc.), it also needs to be pumped (using energy) through a large network of pipes (that need to be maintained and repaired). Having delivered the water, parallel efforts are required to dispose of this after it is used, ie sewerage systems. Reducing water consumption supports sustainability by reducing the environmental impact required to deliver water, and dispose of this after use in a conventional system.

- Rainwater

Target (5)

Rainwater is harvested, stored and used. Rainwater collected from roofs or paved parking lots can be used for flushing toilets and landscape irrigation. The building itself can be designed to act as a collector of rainwater, to be stored in a cistern for later use. For health reasons, current building codes prohibit the use of this gathered water for human consumption, but it is possible that future water purification devices will make onsite water safe to drink at a lower cost than current municipal water treatment.

Assessment (4)

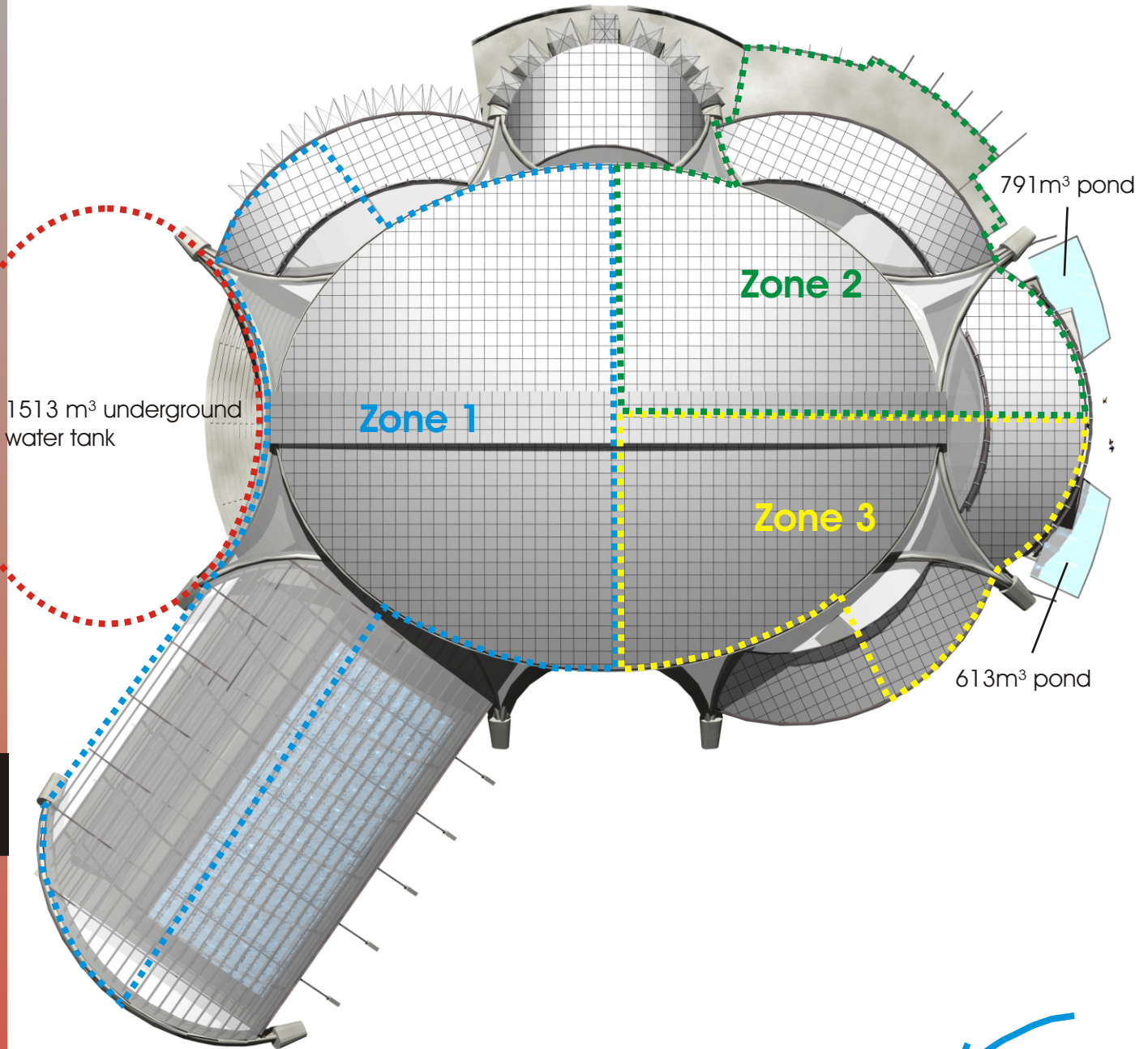
According to Fig.31 Centurion's average annual rainfall is 850mm. The roof area is divided into three areas that will fill the three different rainwater harvesting tanks:

A 1513 m³ underground water tank on the western side of the HPC for domestic use, storing three months rainwater. This water will run through a sand filter to purify it. This tank will harvest its water from zone 1 that covers an area of 4812 m² (fig.97)

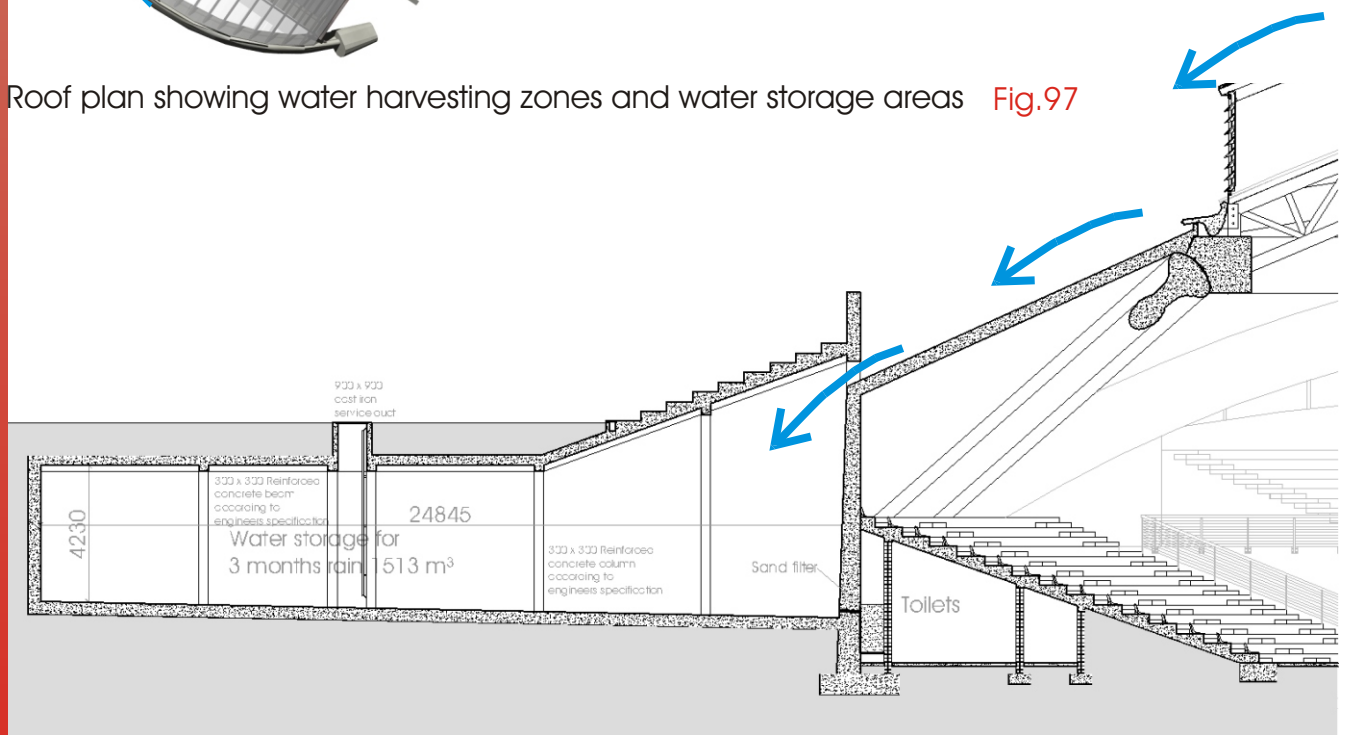
A 791m³ pond on the eastern side of the HPC for irrigation, storing four months rainwater. This tank will harvest its water from zone 2 that covers an area of 2790 m² (fig.97)

A 613m³ pond on the eastern side of the HPC for irrigation, storing four months rainwater. This tank will harvest its water from zone 3 that covers an area of 2162 m²(fig.97)

A total of 9764m² roof area will harvest 8300 Kℓ annually. The current water cost per Kℓ is R 4,62. An amount of R 2,2 million will be saved over a period of twenty years.



Roof plan showing water harvesting zones and water storage areas Fig.97



Section through underground water tank

Fig.98

- Water use

Target (4)

Water conservation issues address efficient use of water as well as an overall reduction in the volume consumed. Water efficient devices must be used to save water.

Assessment (4)

Water-saving showerheads and toilets will be used. The underground rainwater tank's water is filtered through a sand filter to purify the water for domestic use. The water in the two ponds that is used for irrigation will not be treated.

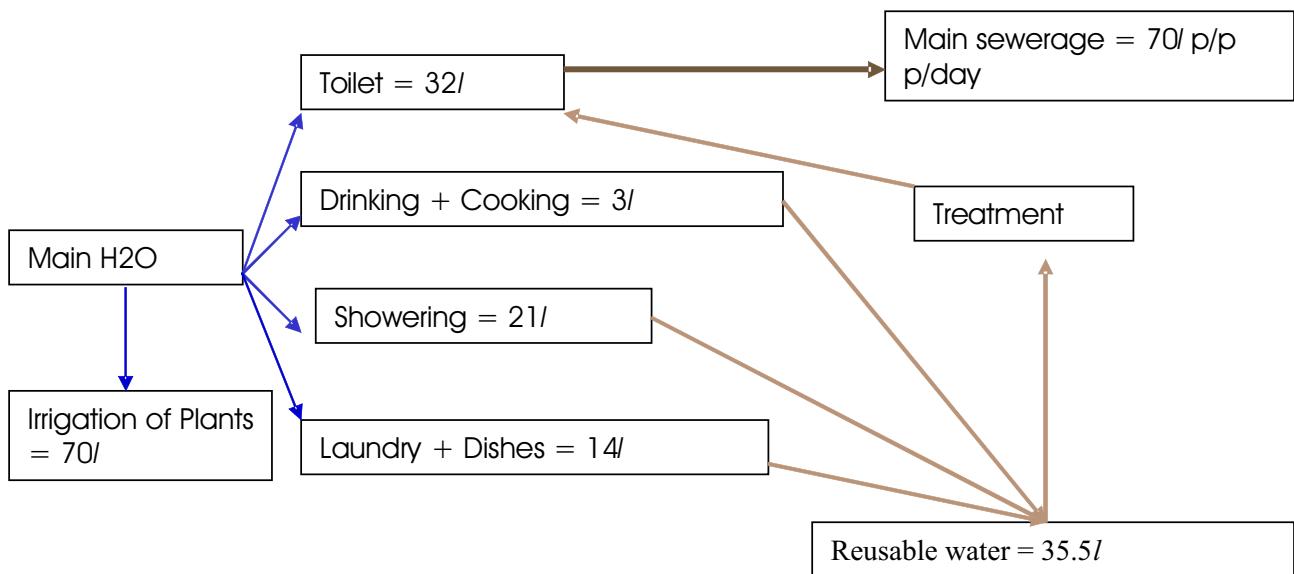
- Grey water

Target (4)

Water consumed in buildings can be classified as two types: gray water and sewage. Gray water is produced by activities such as hand washing. While it is not of drinking-water quality, it does not need to be treated, it can be recycled within a building, perhaps to irrigate ornamental plants or flush toilets. Well-planned plumbing systems facilitate such reuse.

Assessment (5)

Grey water is treated and reused for flushing toilets. Water treatment takes place in the toilets service ducts. All the grey water of the washing basins, showers and grey water of the kitchen will be treated. This system will also be used in the hostels and school to reduce grey water run off.



Total water = 140l

Water consumption per person per day Fig.99

- Runoff

Target (3)

Run off reduced by using perforated absorbent surfaces. Hard landscaping minimised, perforated surfaces specified for car parking and paths.

Assessment (3)

BG-Block, perforated concrete blocks, are used for the pavement in the parking area. Grass will grow through the BG-blocks that will make the parking area a softer space and run off is reduced. Perforated surfaces make it difficult for disabled with wheelchairs to use, therefore all pathways will be concrete blocks. The rest of the landscaping is grass to reduce run off.

2.4.2 Energy

Buildings consume about 50% of all energy produced. Conventional energy production is responsible for making a large contribution to environmental damage and non-renewable resource depletion. Using less energy or using renewable energy in buildings therefore can make a substantial contribution to sustainability.

- Location

Target (4)

Building located within 400m of public transport.

Assessment (3)

A bus terminal is allocated 700m from the site in John Voster Drive (see fig Fig.56). There is also a taxi drop-off point at the Pannevis and Southstreet T-junction.

- Ventilation System

Target (3)

Passive ventilation system must be used as far as possible to reduce energy.

Assessment (4)

Passive ventilation system is used as discussed in Section 1.1.2. The only other form of ventilation that is used is the extractor fans in the toilets, kitchen and auditorium. The big window openings contribute to the natural cross ventilation of the building.

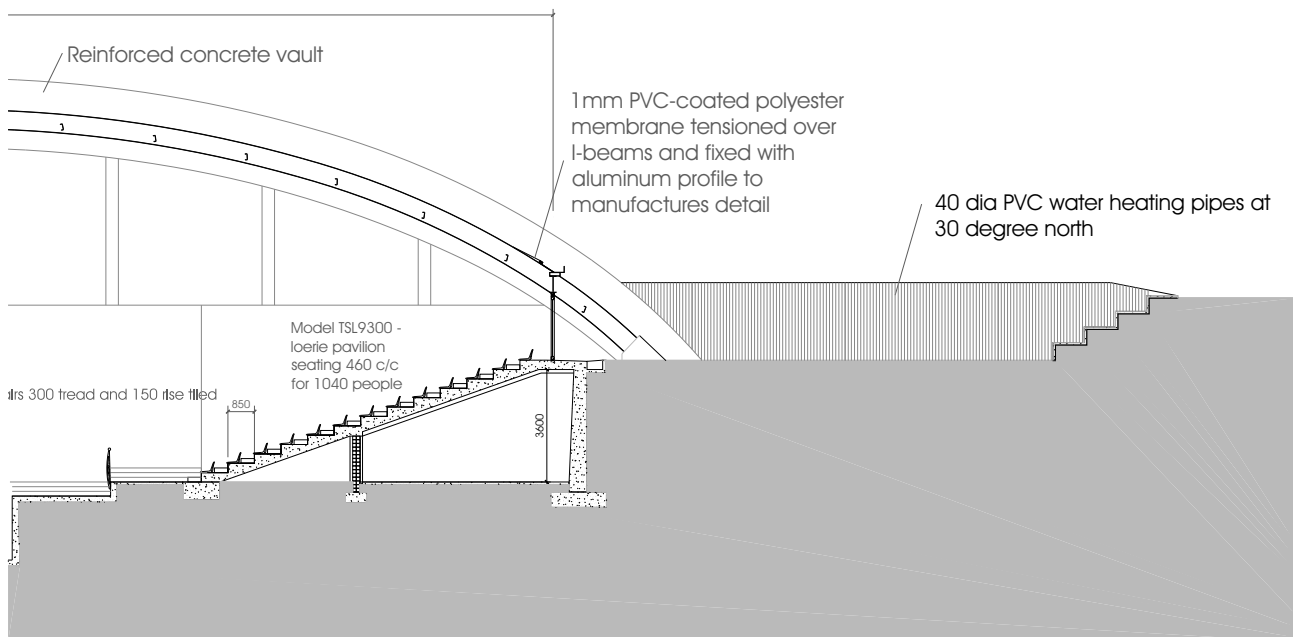
- Heating and Cooling System

Target (4)

Passive environmental control system must be used as far as possible.

Assessment (5)

Passive environmental control system is used as discussed in Section 1.1.2. There are only two airconditioning plant rooms on the second floor. The rock storage underneath the auditorium is a passive system. The heating of the swimming pool water is done by 40mm dia PVC pipes on a 30° embankment on the western side of the swimming pool (Fig. 100).



Section through swimming pool showing water heating pipes Fig.100

- Appliances and Fittings

Target (4)

Energy efficient fittings and devices must be specified to save energy. 80% of light fittings must be fluorescent/low energy consumption lighting.

Assessment (4)

Flourescent bulbs and tubes will be used in the offices, gymnasium, medical centre and auditorium with low roofs. 250W HPS/E lights will be used in the indoor open space and the swimming pool with high roofs. The hostels and school will also make use of flourescent lighting.

Gas appliances will be used in the HPC to minimize the use of electricity. All stove plates in the kitchen will run on gas. Multi-point gas geysers will be used in the kitchen and bath rooms. The steam baths will also run on gas. Gas appliances such as gas heaters are also very efficient and will be used in offices.

- Renewable Energy

Target (4)

The building must generate electricity from renewable sources eg. the sun where possible.

Assessment (3)

When using solar energy

An area must be allocated where the panels can be installed in an outside open space.

Inverters are required to convert the electric current from DC(Direct Current) to AC(Alternating current).

An area must be allocated where battery storage can be installed for electricity to be stored for night use.

Solar panels can only support low voltage applications like fluorescent lighting. High voltage applications will not be able to be supported by the solar panels like the 250W HPS/E lights in the indoor open space and airconditioning plants. The high voltage applications that are used in the HPC do not make it feasible to use solar panels. The ratio between the capital cost of the solar panel installation and ongoing cost is not feasible enough. The money will be used for the installation of the Building Management System (BMS) that will contribute to efficient electricity use.

2.4.3 Recycling and Reuse

Raw materials and new components used in buildings consume resources and energy in their manufacture and processes. Buildings accommodate activities that consume large amounts of resources and products and produce large amounts of waste. Reducing the use of new materials and components in buildings and in the activities accommodated and reducing waste by recycling and reuse supports sustainability by reducing the energy and resource consumption.

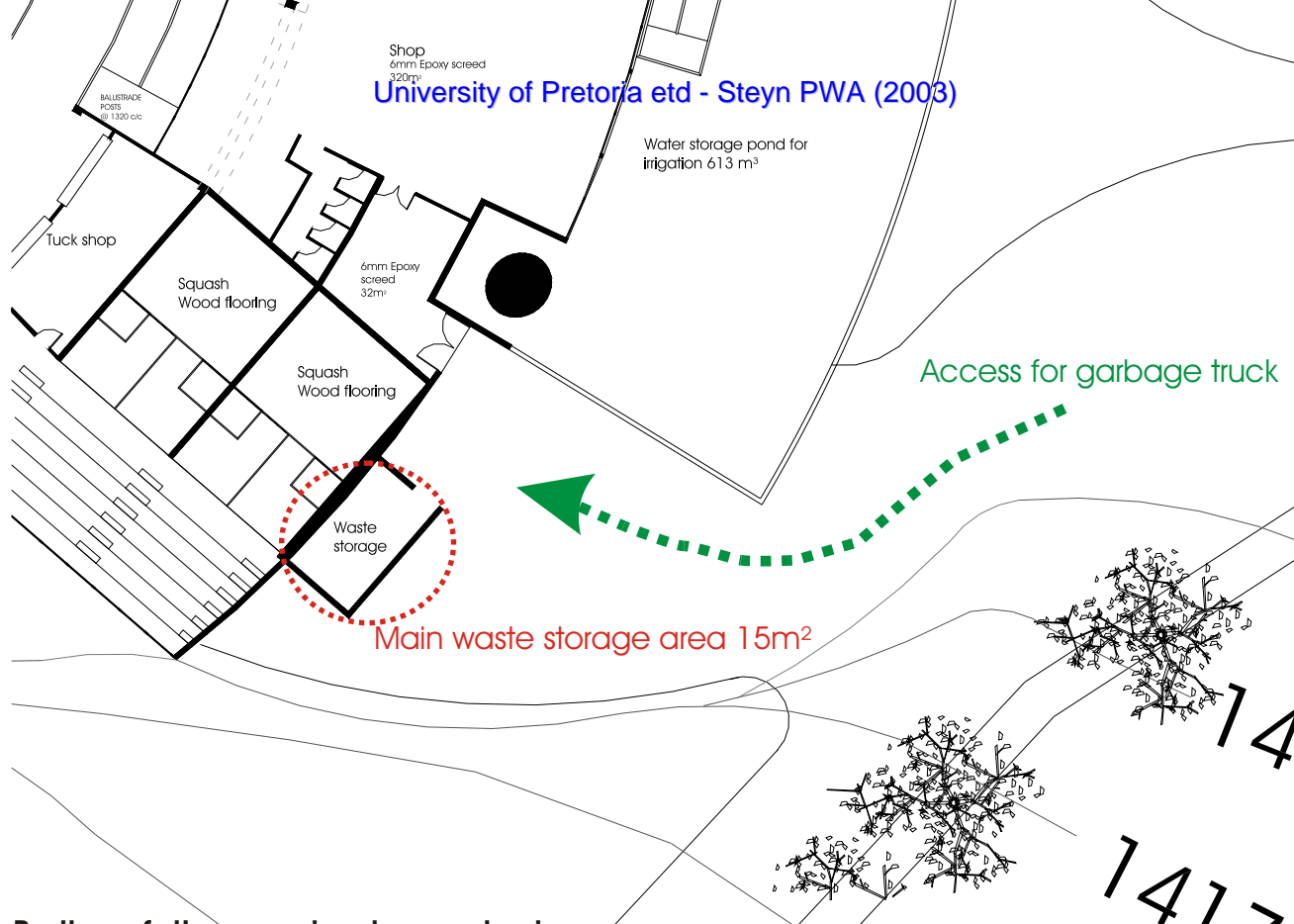
- Inorganic waste

Target (3)

Arrangements for sorting, storage and pick up of recyclable waste must be arranged.

Assessment (3)

HPC will make use of Waste Contractor that is a company that specialises in waste sorting and recycling. Inorganic waste is picked up weekly by the company and are the sorted and recycled. All waste will be stored in municipal garbage bins in different allocated areas in the building. These bins will be moved weekly to the main waste storage area on the eastern side of the building.



Portion of site map showing waste storage

Fig.101

- Organic waste

Target (2)

Organic waste must be separated from inorganic waste and recycled for compost.

Assessment (2)

The kitchen is the only area that will have organic waste. The kitchen waste will be taken to the main waste storage area where it will be separated from the inorganic waste. This organic waste will also be picked up by the Waste Contractor for recycling.

- Construction waste

Target (4)

Construction waste is minimised through design and careful management of construction practices. Design limits wastage by designing to comply with modular dimensions of materials etc.

Assessment (3)

The concrete structure is precast to minimise construction waste. All the grinds that are excavated will be used to fill up the site on the western side of the HPC where the school and hostels will be built. All the concrete walls and interior columns will be insitu-cast. Construction waste will be recycled for use in aggregates in tar and concrete.

2.4.4 Site

Buildings have a footprint and a size that takes up space that could otherwise be occupied by natural ecosystems which contribute to sustainability by helping create and maintain an environment that supports life. (for instance by controlling the carbon dioxide and oxygen balance and maintaining temperatures within a limited range). Buildings can support sustainability by limiting development to sites that have already been disturbed, and working with nature by including aspects of natural ecosystems within the development.

- Neighbouring buildings

Target (4)

Building must not have a harmful effect on neighbouring buildings ie over shading, where access to sunlight is important.

Assessment (3)

The nearest building to the HPC's site is the building on the western side of the HPC (Fig.102). The site of the HPC will be filled up on the western side and therefor will not block the view of the nearby buildings. There will also be no problem with shading.



Building on the western side of the HPC.

Fig.102



View of building on the western side of the HPC.

Fig.103



Building on the eastern side of the HPC. This building view may be blocked by the HPC

Fig.104



View of building on the eastern side of the HPC.

Fig.105

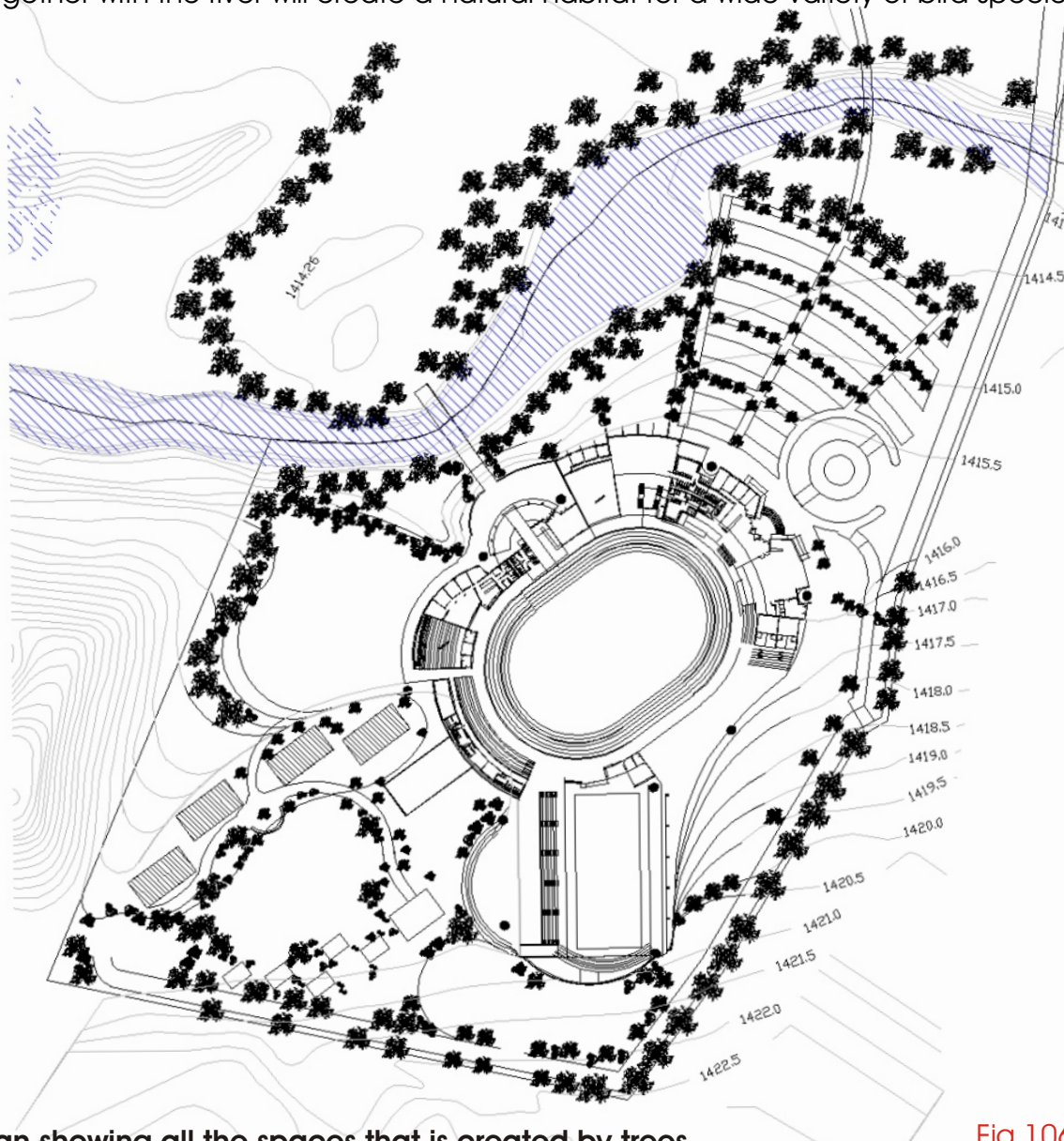
- Vegetation and Habitat

Target (4)

The site must have extensive vegetation. Opportunities must be taken to plant trees in car parking areas. The site must provide habitats for animals. This includes some coordinated landscaping strategies that must be taken into account.

Assessment (5)

The existing vegetation on the site is discussed on p.25. The Combretums on the northern side of the river create a spacial feeling and natural habitat for a wide variety of bird species. The Velvet bushwillow (*Combretum molle*) will be planted in the car park for shading. This Combretum family has high foliage that is quite dense and is a suitable tree for shading. A variety of fruit trees and bushes will be planted on the western side of the HPC for shading and creating a habitat for different bird species. The Spineless monkey orange, Water berry and Kudu berry are some of the trees that will be planted. These trees together with the river will create a natural habitat for a wide variety of bird species.



Site plan showing all the spaces that is created by trees

Fig.106

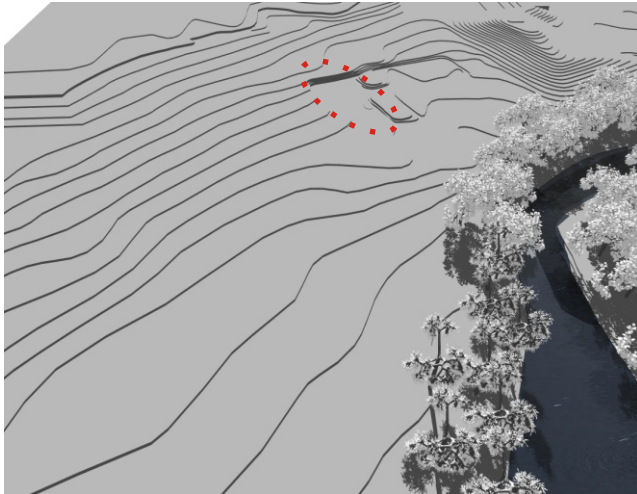
- Landscape inputs

Target (4)

Site excavations must be minimised. All excavated soil must be reused for land fillings.

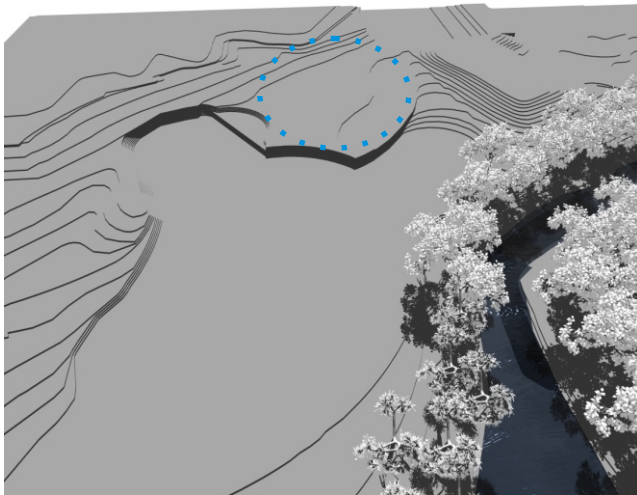
Assessment (3)

The HPC requires flat ground because of the indoor athletic track and swimming pool. The site will be excavated to create a flat surface area for the building of the HPC. This excavated soil will be used to fill the site in the wester side of the HPC where the school and hostels will be built.



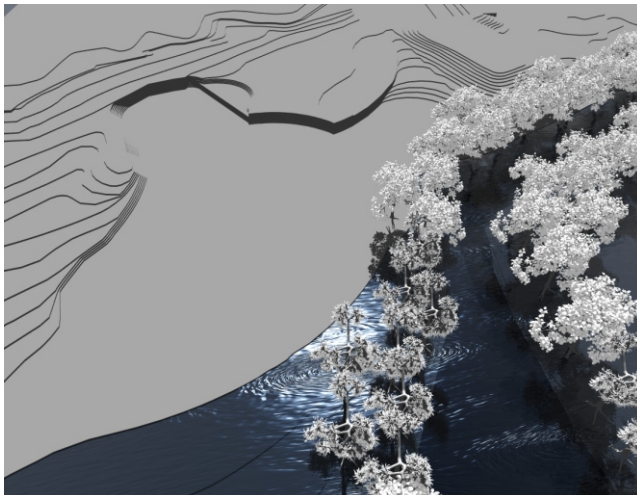
The site fall 6.5° to the river side. The HPC is designed that the underground water catchment tank fit into the landscape. Topology is discussed more in detail on p.19

Site contour model. Fig.107



A flat surface is created where the school and hostels will be built. Excavated soil will be used to fill this area.

Site after excavations and land fillings. Fig.108



Excavated soil is used too fill the site at the river side according to the hundred-year flood line. Hydrology is discussed more in detail on p.22

Hundred year food line after excavations and land fillings. Fig.109

2.4.5 Materials and Components

The construction of buildings usually requires large quantities of materials and components. These may require large amounts of energy to produce. Their development may also require processes that are harmful to the environment and consume non-renewable resources.

- Embodied energy

Target (5)

60% of the building materials and components must be made from materials and components with low embodied energy. Low embodied energy materials include locally made and sourced timber, concrete, concrete block timber windows and doors.

Assessment (4)

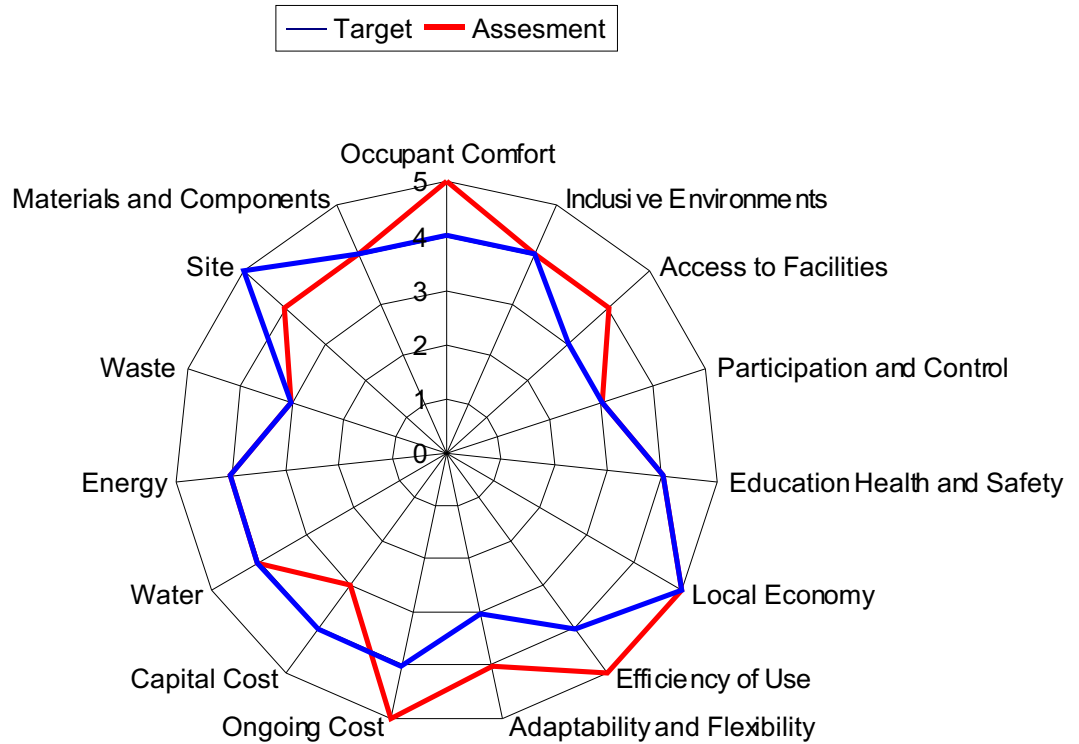
Materials	Use	Embodied energy MJ/kg	Thermal resistivity mK/W	Reuse/ Recycle
Pre-cast concrete	Structure	1.9	2,69	2
Foamed concrete	Walls	3.6	4.8	3
Spectrally selective coating glass	Glasing	12.7	1.9	2
Steel	Roof structure	36	0.0176	1
Softboard	Ceiling, portioning	8	18.18	3
Transparent membrane	Roof covers	19.27	2 K/Wm	2
Aluminum	Roof cladding 0.5mm	79	0.0172	3
Polyethylene	Insulation	12.19	28.6	1

Recycle index 1-Low 2-Medium 3-High

On paper aluminium has a very high embodied energy index if it is compared to galvanised steel that is only 38 MJ/kg. Embodied energy is calculated according to the material's weight, aluminium weight 2690kg/m³ and galvanised steel 7850 kg/m³. Aluminium recycles much easier than galvanised steel, it is maintenance free and are a very flexible material to use in complex designs. It is therefore a very appropriate material to be used in the building of the HPC.

A combination of aluminium and recycled aluminium will be used in the production of the roof panels. 1/3 of the roof panels will be newly produced aluminium (embodied energy of aluminium is 201 MJ/kg). 2/3 of the roof panels will be of recycled aluminium (Embodied energy of recycled aluminium is 17.3 MJ/kg). The embodied energy of the aluminium(0.5mm) in the roof panels adds up to a total of 79MJ/kg. More than 90% of materials and resources that are used in the HPC are from renewable resources.

Assessment on target settings



Assessment on target graphic

Fig.110

Fig.110 show the assessment on the target that is set up for the HPC. In some cases the target could be achieved and in other cases it could not be achieved according to the target settings. The areas that are not achieved according to the target settings are:

Site - The site excavations on site to create an even surface are the main reason why the goal is not achieved.

Capital cost - The main reason for failure is the high cost of the structure.

Areas that are over achieved:

Occupants comfort - The building is designed for athletes to train in a comfortable environment and special care is taken to achieve this goal.

Access to facilities - The site is selected near the CBD of Centurion to make access to facilities easy, the banking facility in the HPC also contribute to this achievement.

Efficiency of use - The building with its facilities is designed to be used by the high performance athletes as well as the public that makes it very efficient. Facilities will also be used for a wide variety of activities.

Adaptability and flexibility - The HPC structure and movable partitioning makes it a very adaptable and flexible building.

Ongoing cost - The material selection in the HPC makes the maintenance on it is quite low that contributes to the low ongoing cost.