Hi-Performance Sport Centre
Centurion

Pieter Steyn

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SUMMARY

Hi-Performance Sport Centre
Centurion

Pieter Steyn
Mentor: Clinton Hindes
Study Leader: Prof Schalk le Roux

The city of Centurion houses various sporting facilities such as SuperSport Park and Centurion Gymnastics Club as well as other training facilities. The proposed site for this thesis is on the edge of the Hennops River and forms part of the Lyttelton Agricultural holdings. It borders SuperSport Park as well as the Centurion Rugby club. The proposed site is located North of South Street in Centurion.

Currently there is only one Hi-Performance Sport Centre in South Africa. It is located on the Sports grounds of the University of Pretoria. This centre, although only one year old, is already fully booked well into the year 2004. The overwhelming response to this sports facility is a clear indication that centres like these are in great demand in South Africa. One of the main reasons for its popularity is our appealing weather that attracts many foreign athletes. Another reason is the diversity of sport in one complex and the highly equipped training facilities. The athletes can be monitored throughout training with the proper nutrition and medical support. It is the only facility of its kind, combining a training facility with accommodation.

This thesis proposes to provide the Centurion area with a similar centre and including improvements to the existing centre. According to the Centurion Integrated Development Framework the site and its surroundings should be used for sport development and recreational facilities. The surrounding sports grounds are another reason for the choice of site. The site is visible from the main road between Pretoria and Johannesburg (N1 Highway) which increases visibility. According to the Centurion Integrated Development Framework all the developments adjacent to the N1 highway should convey a hi-tech image.

This thesis evolved as a comprehensive reaction to the immediate site and the physical, social, cultural and technological conditions. It is the amalgamation of these concepts and ideas that serves as metaphor for the architectural response and process. Since the thesis deals with the professional sport industry and high technological precision research and training, so too does this project focus on presenting this idea of "precision" throughout the architectural-, space-, and tangible experience.

In totality, the proposed design is the synthesis of various interrelated influences. The product is site specific, individualistic and realistic.

OPSOMMING

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Centurion huisves tans 'n verskeidenheid van sportfasiliteite soos SuperSport Park en die Centurion Gimnastiekklub. Die betrokke terrein soos voorgelê in hierdie tesis grens aan die Hennopsrivier en is direk Noord van Suidstraat in Centurion. Dit maak deel uit van die Lyttelton Landbou Hoewes wat aan SuperSport Park sowel as die Centurion Rugbyklub grens.

Daar is slegs een Hi-Performance sentrum in Suid Afrika, geleë op die sportgronde van die Universiteit van Pretoria in Hatfield. Hierdie sentrum is slegs een jaar oud en is alreeds volbespreek tot diep in die jaar 2004. Hierdie oorweldigende belangstelling toon dat dinamiese Sportsentrums in groot aanvraag in Suid Afrika is. Een van die hoofredes vir die belangstelling is ons aangename weer wat baie buitelandse atlete lok. Die verskeidenheid van sportsoorte sowel as die hoë tegnologiese apparaat dien as 'n verdere rede vir die belangstelling. Die atlete word regdeur oefenprogramme gemonitor en word voorsien van die regte dieet en mediese bystand. Die sentrum is ook die enigste van sy soort om verblyf met oefenfasiliteite te kombineer.

Hierdie tesis stel voor om die Centurion area te voorsien van 'n soortgelyke sentrum, maar met moontilike verbeterings. Die stedelike ontleding van die area het aangedui dat die terrein en sy omliggende gebied gebruik moet word vir sportontwikkeling en rekreasiefasiliteite. 'n Rede vir die keuse van terrein was die direk-aangrensende sportgronde. Die terrein is ook sigbaar vanaf die oorhoofse snelweg tussen Pretoria en Johannesburg. Volgens die Centurion Saamgestelde Ontwikkelings Raamwerk moet alle ontwikkelinge wat grens aan die N1 snelweg 'n "Hi-Tech" beeld uitdra.

Die uiteindelike voorstelling van hierdie tesis is 'n samevatting van determinante in en om die voorgestelde terrein: fisiese-, kulturele-, sosiale en tegnologiese invloede. Die effektiewe voorstelling en samevatting van bogenoemde determinante dien as metafoor vir die konseptuele/argitektoniese ontwikkeling. Omdat hierdie tesis met die professionele sportindustrie sowel as die tegnologiese presisie navorsing daarvan te doene het, poog dit om die voorstelling van hierdie konsep ook konsekwent aan die argitektoniese-, ruimtelike-, en tasbare ervaring van die gebruiker bloot te lê.

In die geheel gesien is die voorgestelde ontwerp die sintese van verskeie invloede wat onderling verbind word. Die produk is terreingebonde, individueel en realisties.

CONTENTS

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3. Digest of South African Architecture,2003, p49
4. Architectural Review. July-September 1998, p62
5. Architect & Builder. September 1995, p11
6. http:\\www.ais.org.au
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15-18. Architect & Builder. September 1995, p11,12,14
19-21. http:\\www.ais.org.au
22. Photo of Centurion site model- by author
23. Arial photo of SuperSport park- Centurion City Council
24-26. Bryce rendering-by author
27 Contour Plan- Centurion City Council
28-29. Bryce rendering-by author
30. Scanned Flood line Plan- Centurion City council
31. Exel charts- by author
32. SketchUp models- by author
33. Arial photo of SuperSport park- Centurion City Council
34. Photographs of site- by author
35. Scanned Flood line Plan- Centurion City council
36-47. Photographs of site- by author
48. Photo of Centurion site model- by author
49. Photograph of Parking, 7 March 2003- by author
50-52. Photograph of Leonie street, 7 March 2003- by author
53-59. Centurion City Council Integrated development plan p35,43,58,66,84,98,110
60. Arial photograph- SuperSport park- Centurion City Council
61. Scanned Flood line Plan- Centurion City council
62. Exel chart- by author
63-72. AutoCAD drawings- by author
73-76. Photographs of site- by author
77. Bryce rendering- by author
78. Photo of Centurion site model- by author
79-80. AutoCAD drawings- by author
81. Exel spreadsheet- by author
82. GA Document 46.1997. P65
87-97. Bryce rendering-by author
98. AutoCAD drawing- by author
99. CorelDRAW 10 graphic
100-101. AutoCAD drawings- by author
102-105. Bryce rendering-by author
106. AutoCAD drawings- by author
107-109. Bryce rendering-by author
110. Exel chart- by author
111. Bryce rendering-by author
112 Scanned photo from Pretoria MapStudio, STREET GUIDE, 12th Edition
113-117. Bryce rendering-by author
118-119. Http:\\www.hpc/video/analyze.com
120-121 Bryce rendering-by author
122. AutoCAD drawings- by author
123. Bryce rendering-by author
124. AutoCAD drawings- by author
125. Bryce rendering-by author
126. AutoCAD drawings- by author
127. Bryce rendering-by author
128. AutoCAD drawings- by author
129. Bryce rendering-by author
130-131. AutoCAD drawings- by author
132. Bryce rendering-by author
133. AutoCAD drawings- by author
134-137. Bryce rendering-by author
138. AutoCAD drawings- by author
139-147. Bryce rendering-by author

Chapter 1

Context and Brief

The Hi-Performance centre is a very versatile project from which the community and different corporations can benefit. For this specific reason the client does not necessarily have to be a corporation related to sport.
Possible clients:

SuperSport They are already the main sponsors of SuperSport park that is situated right next to the proposed site for the Hi-Performance centre.

Sport Institute of South Africa
This governmental institute is part of the Government who supports the development of sport in South Africa. The centre will also be open to develop young sport talent.

Centurion Town Council
The proposed site is currently the property of the Centurion Town Council. In the IDP there is a proposal that a complex that should focus on sporting activities and facility should be built on this site.

Apart from these clients funding the project, different sponsors can also be part of this innovative project.
Possible sponsors:

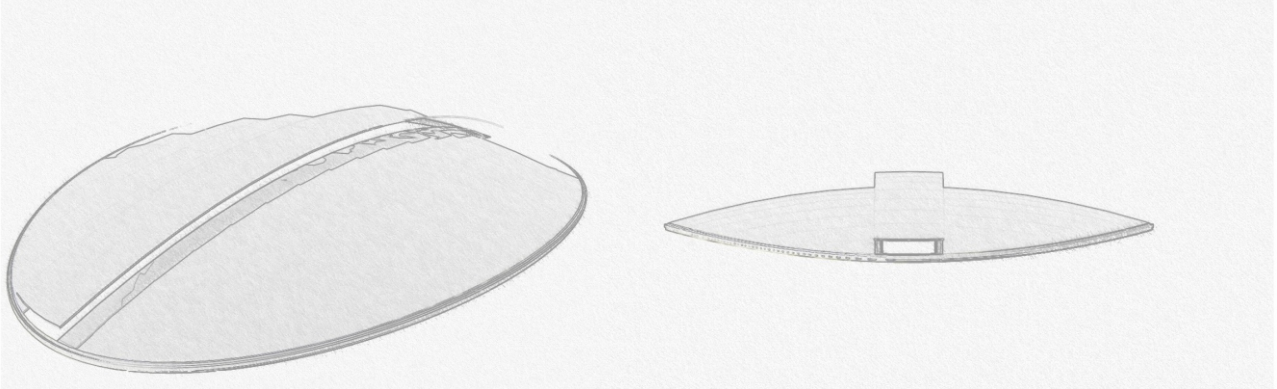
Toyota Sponsor for the shuttle service.

Smart Technology Sponsor of high-tech sport and gym equipment.

LG Electronics Sponsor for all electronic equipment, e.g., office and audio-visual equipment.

Ultimate Sport Nutrition Sponsor for sport nutrition and diets.

CSIR Analysing and reachers on athletes in action.



After three decades in the cold because of its apartheid policies, South Africa's return to international sporting competition was celebrated with its participation in the 1992 Barcelona Olympic Games. The impact that this extended period of isolation had on its athletes was only too apparent when measuring its performance with those of rival countries of similar strengths. Compared to Australia's 27 medals, South Africa could only achieve two, none of which were gold.

Australia's success in sport can be largely attributed to a decision in 1981 to establish and build an Institute for Sport which has an annual operating budget of between R200 and R400-million. Clearly, to contemplate spending anything like this during a period of reconstruction and development would be highly inappropriate. However, the important role that sport and sporting achievements can play in nation building must not be underestimated, as was evident in South Africa's hosting, participation and winning of the 1995 Rugby World Cup. The achievements of team sport such as rugby, cricket and netball have not suffered to the same extent as individual sports such as athletics. This is a clear indication that there is no lack of talent in the country, but rather that it is a matter of harvesting this talent.

Good training facilities as well as accommodation near such facilities are required by elite athletes. Many foreign athletes also come to train in South Africa, mainly because of our warm climate. In sport today, every one knows an elite athlete is a rare combination of talent, hard work and the right psychological profile. This is achieved by having access to the best training facilities, training methods and most nutritional food.

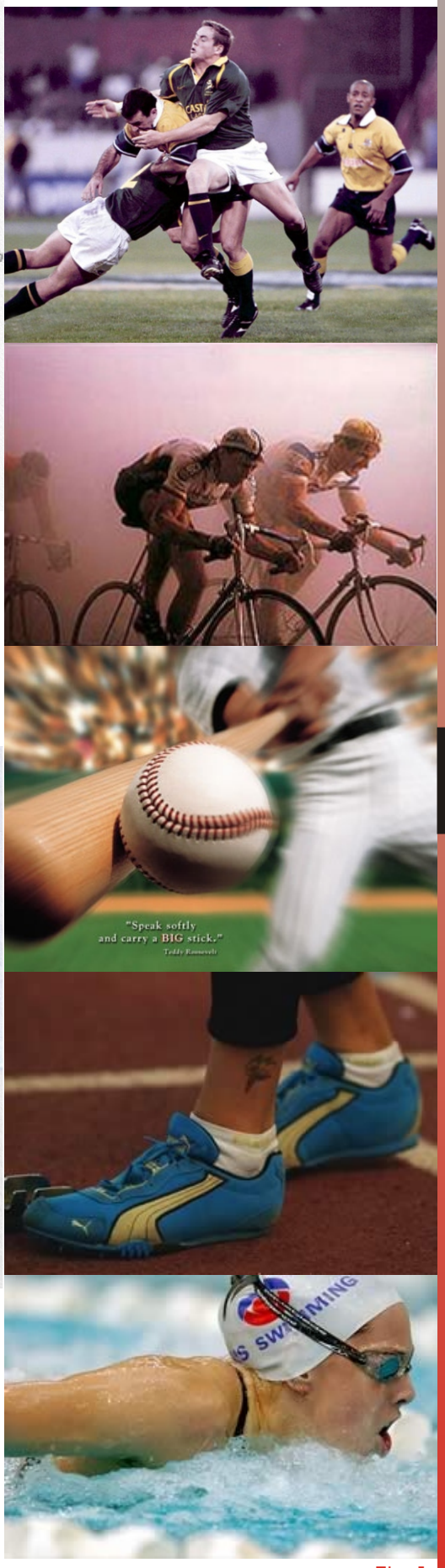
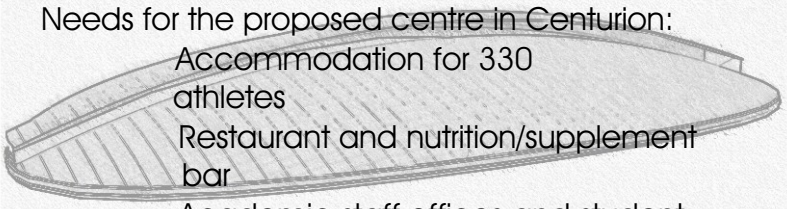


Fig.1

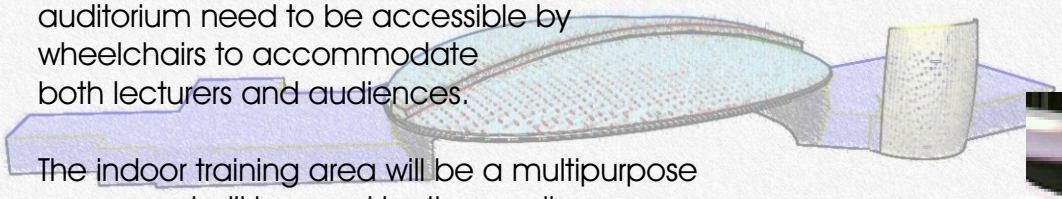
This brief has been drawn up after a thorough investigation of all the client and possible users' needs. Bookings of the HPC in Pretoria show that there is a demand for another facility like this.



Needs for the proposed centre in Centurion:

- Accommodation for 330 athletes
- Restaurant and nutrition/supplement bar
- Academic staff offices and student spaces including hostels and classrooms
- Administration offices
- Auditorium
- Service function incorporating sport medicine, sport injuries, physiotherapy and cardiac rehabilitation
- Research function including bio-chemistry, bio mechanics and bicycle and treadmill laboratories
- Sport training facilities like an Olympic size pool, rehabilitation pool, gymnasium, indoor track and exercise area.
- Covered parking

The building must be fully accessible for disabled persons. Special changing rooms need to be present for the disabled using the swimming pool, exercise area and gymnasium. Elevators should be supplemented where changes in floor levels occur while the upper and lower levels of the auditorium need to be accessible by wheelchairs to accommodate both lecturers and audiences.



The indoor training area will be a multipurpose space and will be used by the cardiac rehabilitation clinic as well as the bio-mechanics laboratory where experiments and research can be conducted on athletes in action. This area must be in the centre of a 200m track, with adequate roof clearance.

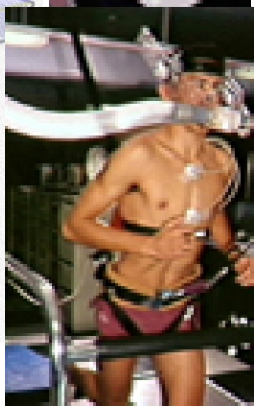
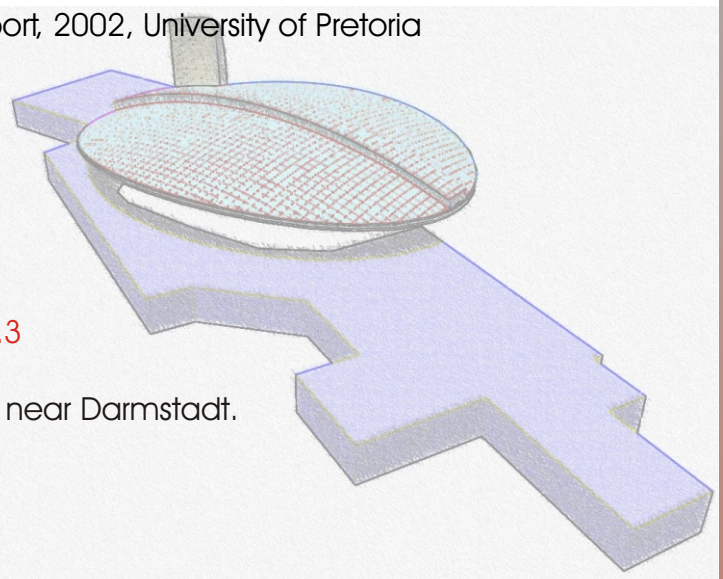


Fig. 2

1. Hi-Performance Sports Centre, Tukssport, 2002, University of Pretoria

Fig.3

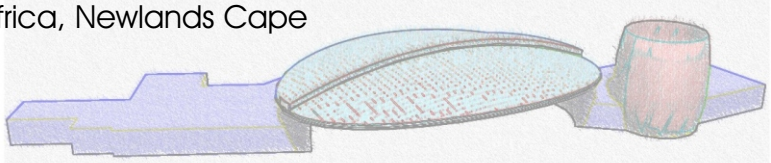


2. New Sports hall for a German school near Darmstadt.

Fig.4

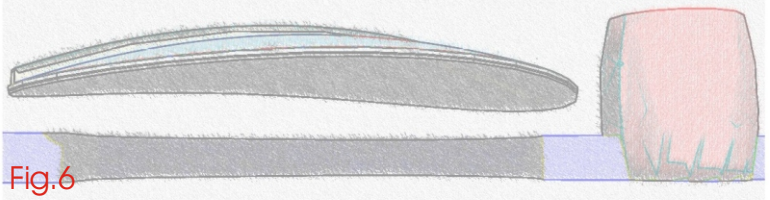
3. Sport Science Institute of South Africa, Newlands Cape

Fig.5



4. Australian Institute of Sport (AIS), 1981, Canberra.

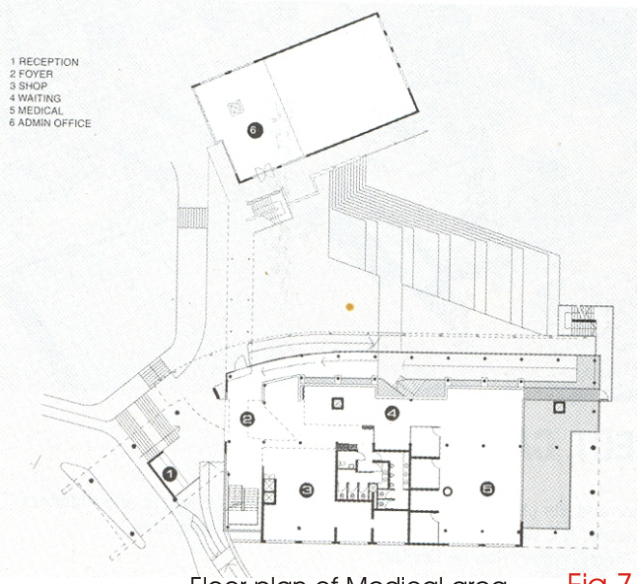
Fig.6



These Precedents are carefully selected to guide the context study. The Hi-Performance Sports Centre on University of Pretoria's sports ground, is the only one of its kind in South Africa and was visited and studied to act as an important guide and reference for the context study and brief. The other precedents studied were on another scale of interest and are discussed using other criteria. What follows is a detail description of each.

HI-PERFORMANCE SPORTS CENTRE, TUKSSPORT, UNIVERSITY OF PRETORIA

Soundspacedesign Architecture & Urban Design, 2002



Floor plan of Medical area Fig.7

Background

The 5000 m² phase project is one of its kind in South Africa and highly popular for foreign athletes for training.

The site was organised to maximise the sense of arrival, its connection to the highly urban Hatfield High Street, and its views of the rugby fields beyond, and to make legible the functional hierarchies that exist

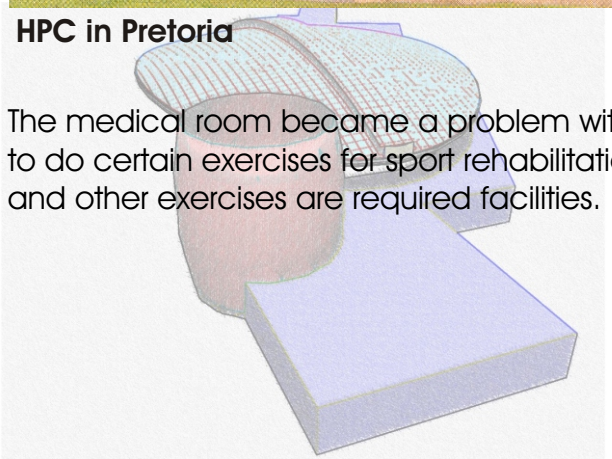
The HPC was mainly designed for rugby training. South Africa's attractive weather conditions makes' it a perfect destination for overseas sports teams for training. Because of this high request for training facilities, the HPC is now not used for all kinds of sport. The HPC gives athletes the opportunity to train on state-of-the-art sport-science diagnostics equipment and have access to the medical room with Physiotherapist and Biogenesis for sports rehabilitation. The dining-room give the athletes the opportunity to get a balanced nutrient meal every day.

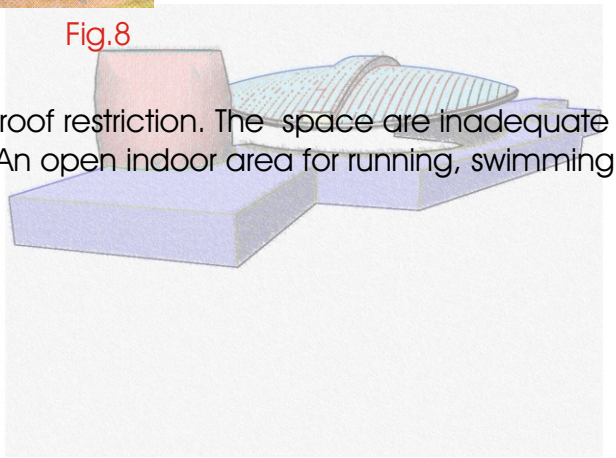
HPC in Pretoria Fig.8

Problems and changes

With the different kind of athletes visiting the HPC, it had to change some of its facilities to accommodate their needs. The Admin building has changed into a school for permanent scholars staying in 'The lockers'.

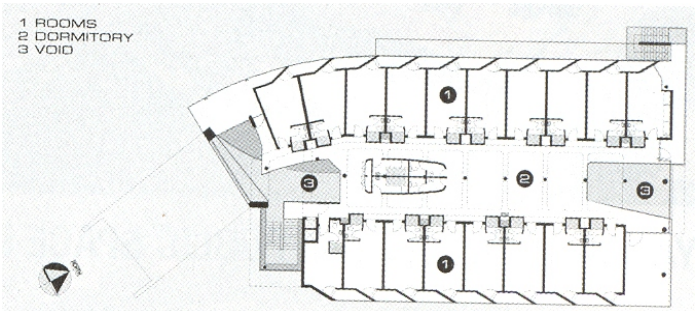
The medical room became a problem with its roof restriction. The space are inadequate to do certain exercises for sport rehabilitation. An open indoor area for running, swimming and other exercises are required facilities.





Request from personnel

More office space
More private Medical treatment
Larger Consultation rooms
Open indoor area with 200m running track and high roof for sport injuries and research
Sanitation in Medical room
Deeper swimming pool for exercises
More bedrooms
More classrooms
Under cover parking for personnel and shuttle service



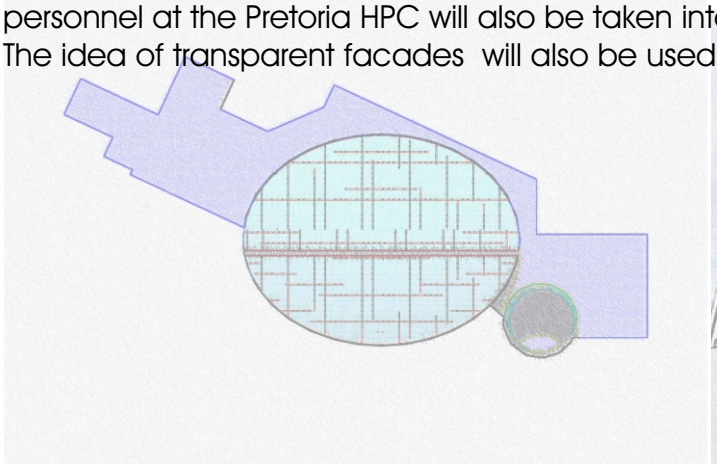
Second floor plan Fig.9

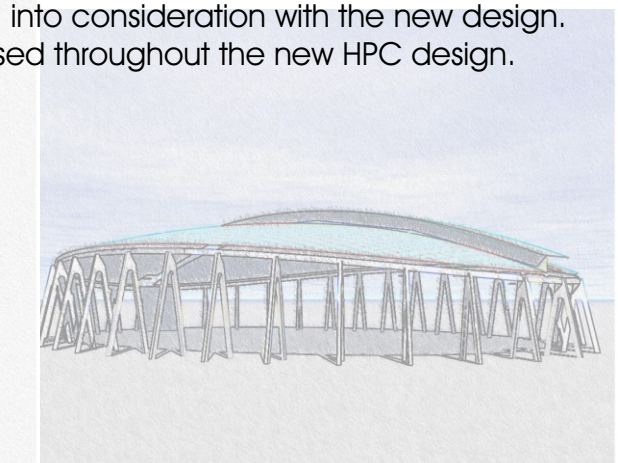
Architecture

Architecturally the building conveys a high technology image with its concrete, steel and glass finishes. In the design of a HPC it is difficult to design it in such a way that the building gives you an expression and feeling that it is a sport facility. In the design this objective is well accomplished with the site selection and transparent facade that reveals the vibrant activities in the building. The vertical elements (fig.9) are not taken through the whole facade breaking the building up in fragments. The western facade with its glass finish contributes to the energy consumption of the building. The hostels(lockers) that are situated away from the building give it a more private setup where sportsmen can relax.

Conclusion

The tremendous demand for this type of facility in South Africa makes this HPC over populated according to 2003-04 bookings. Currently the accommodation at the HPC is private, where the athletes can relax in the evenings without feeling that they are at a training facility. To accomplish this at the HPC in Centurion, the Hennops River will be used to separate the training area from the accommodation. The requests from the personnel at the Pretoria HPC will also be taken into consideration with the new design. The idea of transparent facades will also be used throughout the new HPC design.





New Sports hall for a German school Darmstadt.

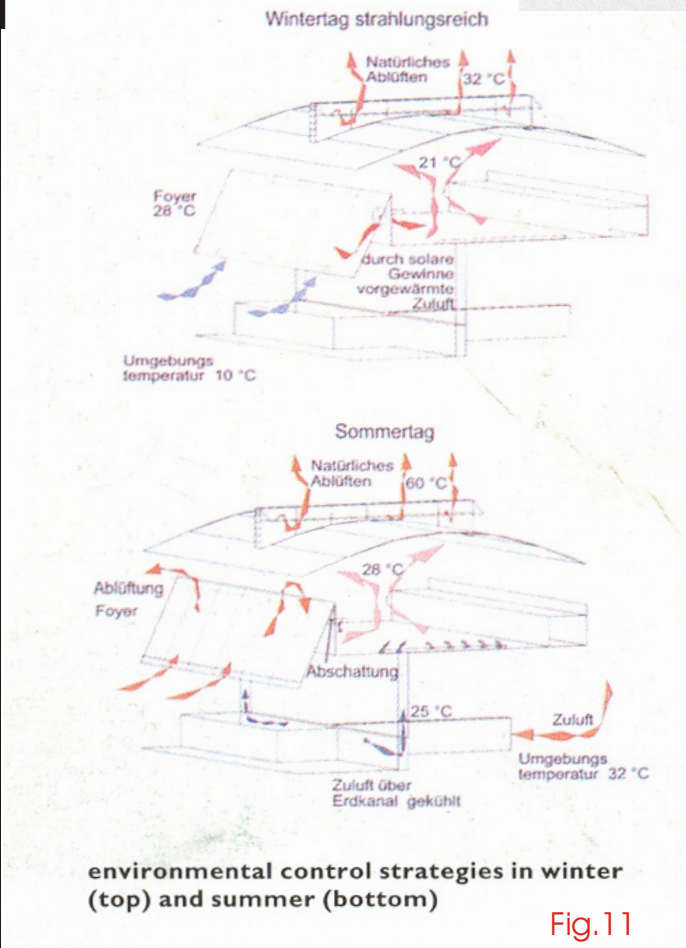
Peter Hubner,
1997

Background

New Sports hall in Darmstadt Fig.10

The Odenwaldschule is one of a handful of private schools started in Germany as a result of the progressive School reform movements in the 20th century. Set in hill country south of Darmstadt, the school occupies a steep wooded hillside, dominated architecturally by it's villa-like boarding houses.
The sloping site with its numerous trees and its strict nature conservation rules seemed at first to offer no plausible place for a large building such as a sports hall. Hubner saw the possibility of setting it into the hill on the edge of a meadow and letting the sea of waving grass continue onto its roof. A curved profile would allow the ground surface to rise and fall again, while leaving the optimum space inside to accommodate the trajectory of a ball.

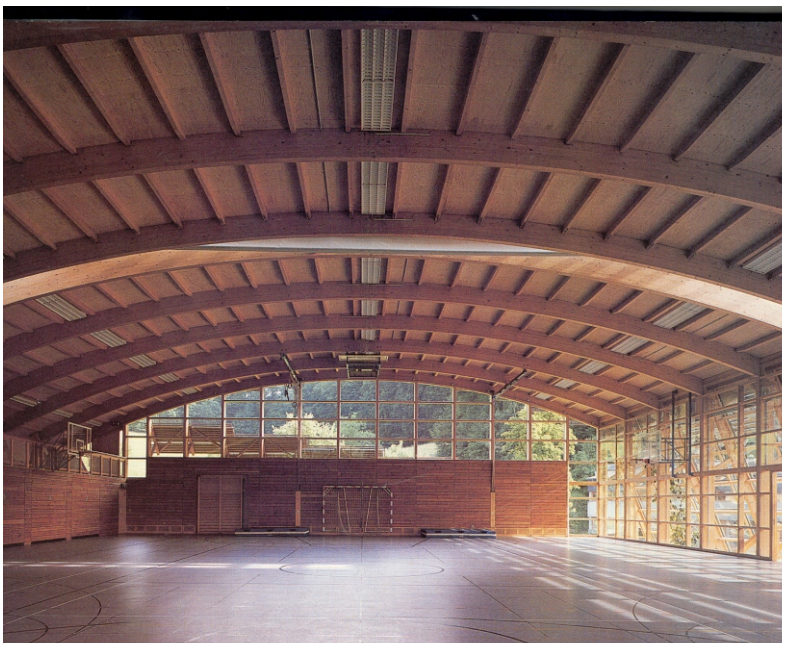
Problems and solutions



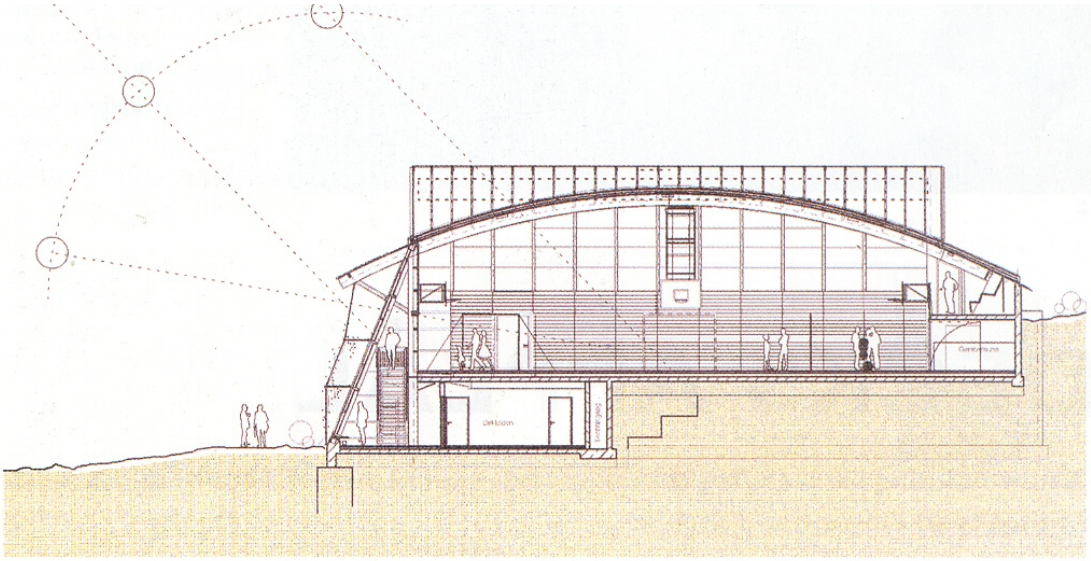
environmental control strategies in winter (top) and summer (bottom) Fig.11

The major problem in the centre was the need that the hall should be divisible in two with a central curtain, for it seemed impossible that such a thing is hung from the curve, remains removable, and leave the volume unobscured. Hubner conceived the idea of housing the curtain within a straight box projecting up to appear on the curved profile like a backbone. Glazed it could be visually delicate while introducing a shaft of daylight into the centre of the room. So began a servicing strategy that is truly green, since it saves on both building and running costs. It avoids complex mechanical plants that are expensive to install and maintain and air conditioners that burn energy and use noxious chemicals. Instead, it balances out the given conditions with a series of open able barriers. On hot summer days, the glazed box on the roof heats contained air so that it rises through open vents, drawing more with it.

It is on winter afternoons that the foyer really starts to work for its living, both as a buffer for the hall and as a solar collector. When it reaches the required temperature, a photocell-powered fan cuts in to deliver its hot air to the hall. The parts of the building belonging to the ground are in concrete, the parts above in timber and glass. The roof deck is of thick plywood covered by insulation, membrane and turf, giving a natural surface at once protective and insulating.



New Sports hall interior Fig 8



cross section Fig 9

Conclusion:

The investigation shows that green architecture can be applied to sport halls with all its thermal requirements.
Despite its undoubted green inspiration, the large building makes the gentlest impact in its precious context, and is a joy to use. Sport is not compulsory at this school and is left to pupils to co-operate and organize teams. Since the new building was opened sport has become more popular meaning that good architecture can truly changes lives. The design of a building can be successfully incorporated in nature without restricting the designer. The concept of green Architecture will be incorporated in the design process of the Centurion HPC.

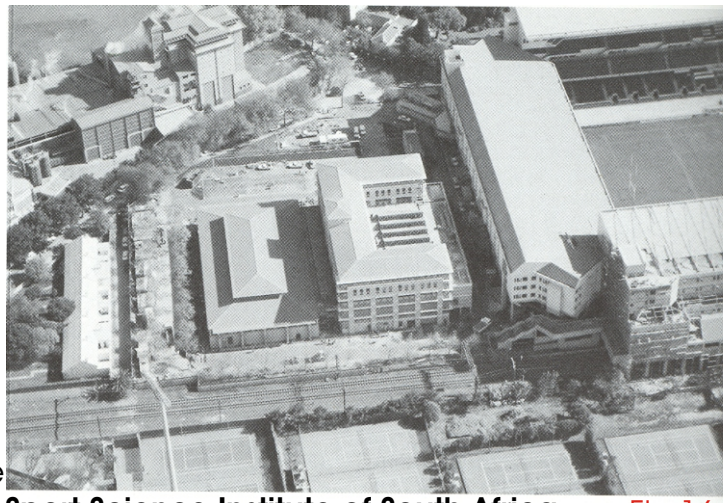
New Sports hall northern Facade Fig 10

Sport Science Institute of South Africa, Newlands Cape town, MLH Arcitects and Planners, 1991

Sport Science Institute of South Africa Fig.15

Professor Tim Noakes' internationally acclaimed Bioenergetics of Exercise Research Unit-operating without adequate equipment and facilities in the dingy semi-basement of the Physiology Department on the University of Cape Town's medical campus- was the obvious structure around which such a Sports Science Institute could be created. It had set itself five primary goals:

- To undertake world-class research in applied sports focusing on a select group of sports;
- To apply the knowledge acquired from the research programs to improve the competitiveness of South Africans who participate in those sports;
- To advance and coordinate the teaching and research activities in sport medicine and the sports sciences in South Africa.
- To initiate and coordinate scientifically based training programs;
- To assist in the development of broad-based programs to optimise the identification and nature of those persons with special sporting talents.

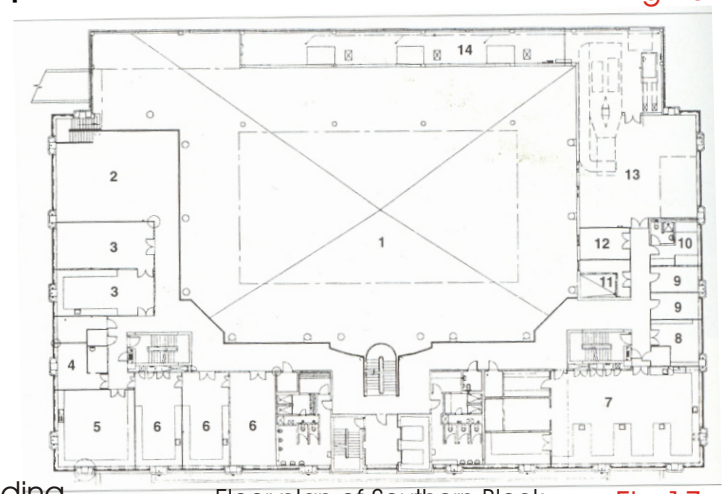


Sport Science Institute of South Africa Fig.16

Design

Three basic design influences of the building.

- Separate high-activity areas allocated for semi-public and common usage from more private offices, research and teaching areas.
- Provide sufficient site parking
- Recognise the many site constraints



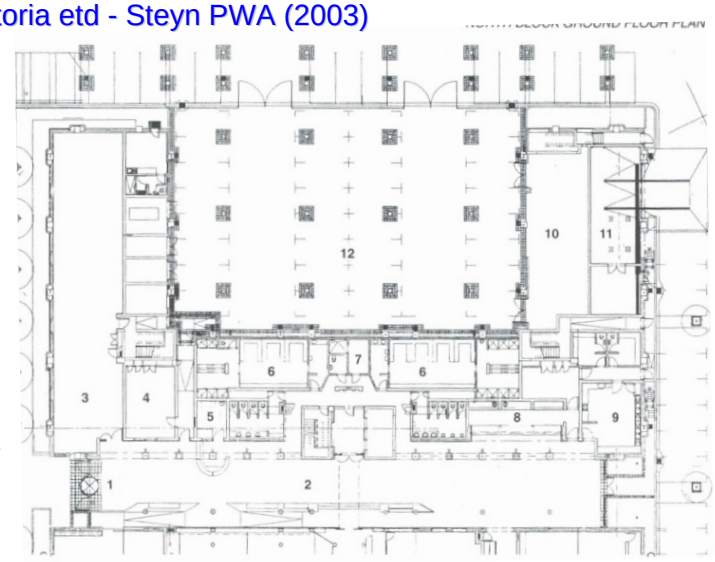
Floor plan of Southern Block Fig.17

1. Entrance
2. Galleria
3. SARFU Museum
4. Building Management
5. Security
6. Change/showers
7. Disabled change/showers
8. Juice Bar/Servery
9. Kit area
10. Planparking room
11. Refuse rooms
12. Undercover

The high activity areas required
- Natural light
- Large spans
- Open areas

The sport Science Institute's three main Functions:
- Services
- Academic research
- Teaching

These three functions are arranged over three consecutive levels and are connected vertically by an internal steel staircase. The public interface service function on the first floor of the North Block incorporates sports medicine, treatment of sports injuries and physiotherapy and it is from here that clinics for cardiac rehabilitation and weight-loss programs will be run.



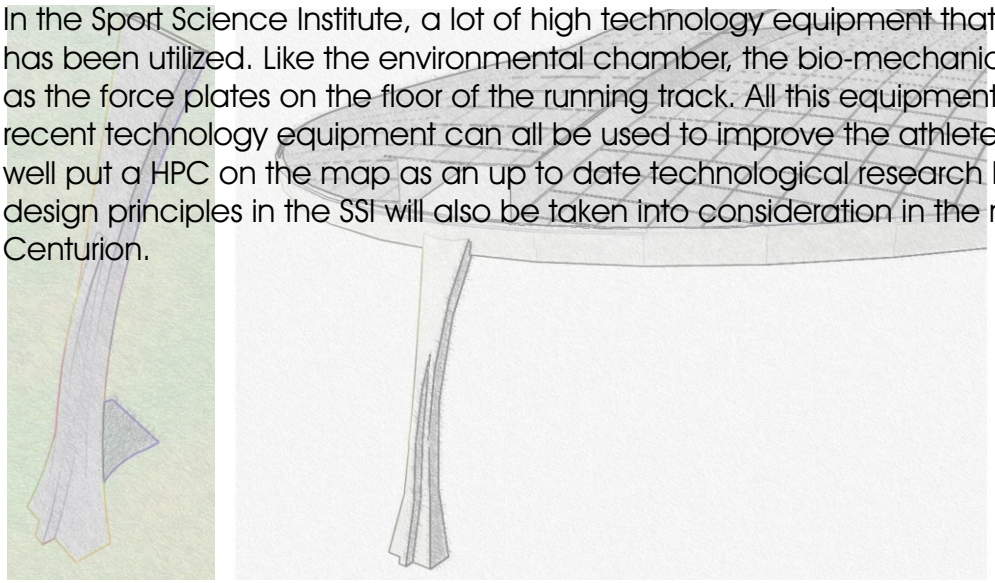
Floor plan of Northen Block Fig.18

1. Galleria
2. WP Rugby Academy
3. Auditorium
4. Seminar/lecture rooms
5. Swimming pool
6. Toilets
7. Change/ shower rooms
8. Control desk/office
9. Filtration/ventilation Plant room

Consulting rooms for both UCT staff as well as outside specialists are provided. The bio-mechanics laboratory, where research will be conducted on athletes in action will be linked by stairs to a multipurpose hall. This hall is large enough for most indoor sports, even tennis, but is used mainly for exercise. An external elevated track makes it possible for athletes to run into the building so that their movement can be measured electronically on force plates in the floor of the track and also monitored and filmed for analysis.
In addition, experiments will be undertaken in an environmental chamber in which athletes will be subjected to simulated climatic conditions and where the effects of temperature, humidity and wind on their performance will be analyzed.
The two sections of the gymnasium are linked by a steel bridge over the swimming pool. From this bridge swimmers can be observed and filmed from the top. The first floor of the gymnasium has an indoor running track around the perimeter. Specialised floor finishes in the gymnasium and exercise hall have been laid to international standards and specifications

Conclusion

In the Sport Science Institute, a lot of high technology equipment that is not usually used has been utilized. Like the environmental chamber, the bio-mechanics laboratory as well as the force plates on the floor of the running track. All this equipment as well as more recent technology equipment can all be used to improve the athlete's performance as well put a HPC on the map as an up to date technological research laboratory. The three design principles in the SSI will also be taken into consideration in the new HPC in Centurion.



Australian Institute of Sport (AIS),1981, Canberra.

Background

The Australian Institute of Sport (AIS) leads the development of elite sport in Australia.It has been highly successful and is regarded internationally as a world best practice model for elite athlete development.

Australian Institute of Sport Fig 19

Achievements

Fig 20

The AIS made a significant contribution to Australia's tremendous efforts at the 2000 Sydney Olympic Games with 321 of the 620 strong team being currents or former AIS scholarship holders. Of the record 58 medals that were won at the Sydney Olympics, 32 came from current or former institute athletes. They won 8 gold, 11 silver and 13 bronze medals. It was a similar story at the 2000 Paralympics with just under half of the record 149 medals won by current or former AIS athletes. AIS Paralympians won 32 gold, 14 silver and 13 bronze medals.

Programmes

The AIS operates nationally from a 65-hectare site in Canberra.

It offers scholarships annually to about 700 athletes in 35 separate programs covering 26 sports, and employs around 65 coaches. Programs are located in most states as well as Canberra.

The AIS also operates an Athletes with Disabilities scholarship program which has set a benchmark for training athletes with a disability.

An indigenous athletes program is operated in conjunction with the Aboriginal and Torres Strait Islander Commission (ATSIC).

Facilities

The AIS is the pre-eminent elite sports training institution in Australia providing athletes with world-class training facilities, high performance coaching, state-of-the-art equipment, a world-class sports medicine and sport science facility as well as accommodation for 350 residents on site.

Fig.21

Support

Another support service to scholarship holders is the Athlete Career and Education(ACE) program, which was set up to enhance the personal development and performance of Australia's elite athletes through a number of career and education services. A national network of advisers helps athletes with educational guidance, career planning, job searching and personal development to make sure they plan for life after sport. The AIS also provides administrative, sport science and coaching services, as well as funding assistance, to state sporting institutes and academies of sport and to national sporting organisations. The AIS is at the leading edge of sport science and research developments through its Science and Sports Medicine division. The division comprises some of the world's leading authorities in physiology, biomechanics, psychology, nutrition and sports medicine.

Conclusion

This is probably the best example of a successful Sport Institute in the world. The AIS combines everything an elite athlete needs on one site. All the tracks, training, medical, research and nutrition facilities are within the athletes reach. This centre also only makes use of state of the art equipment and world class sport medicine. The positive results accomplished by this centre can only be a result of their strive to only use the best technology and really looking after the interests of their athletes. This centre also helps the athlete plan a life after sport through career guidance, training and job search. This positive and motivational attitude will be taken throughout the whole HPC in Centurion. Only the newest technology equipment will be used and the centre will strive to accommodate all types of sport. A variety of sport fields surround the site, and extra fields will be added with the development of the sports hub. Where it is not practically possible to accommodate a sport, arrangements like a shuttle service will be provided.

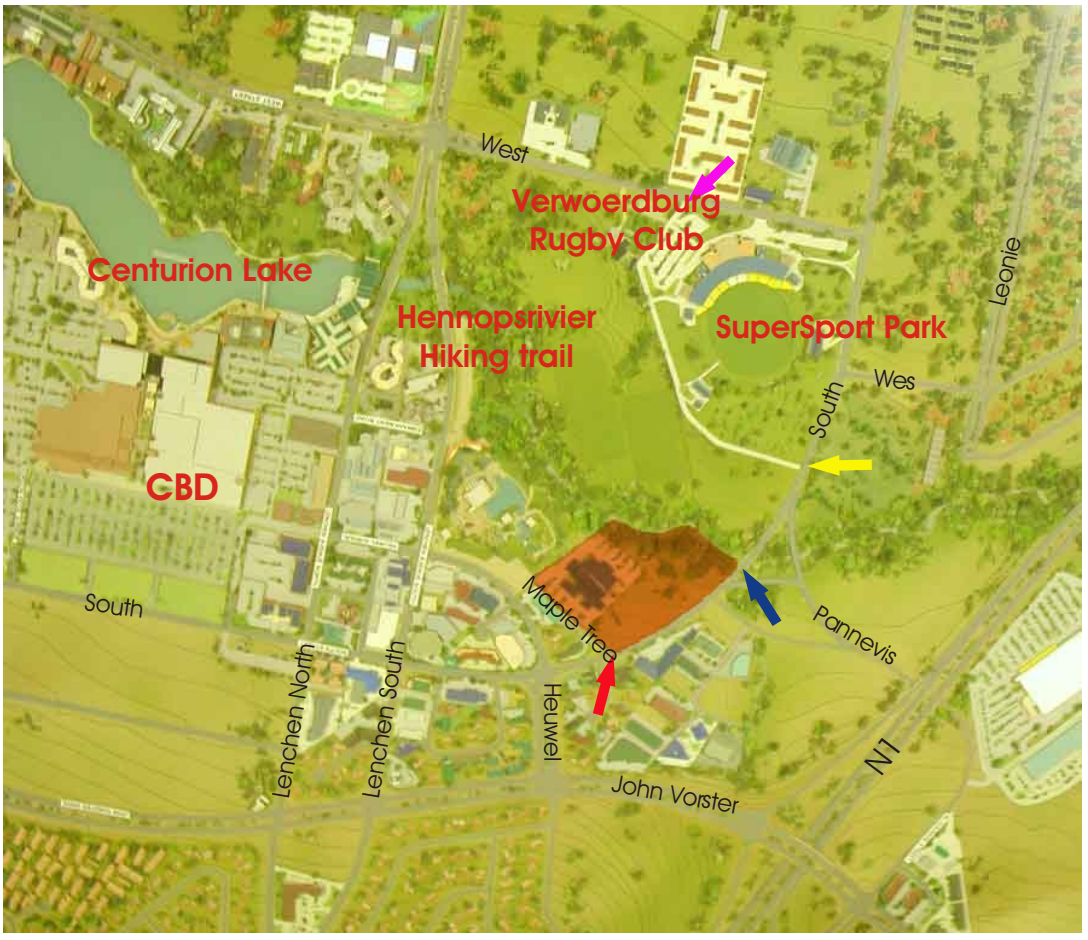
1.5.1 Location

The proposed site is next to SuperSport Park cricket stadium in Centurion. The proposed site is sub divided into three smaller sites:

The property represents Portion 1 of Holding 44 of the Lyttelton Agricultural Holdings and covers an area of 5.09 ha.
The property represents Portion 47 of the Brakfontein farm and covers an area of 2.01ha Structure on site to be demolished.
The total site area is 8.27 ha.

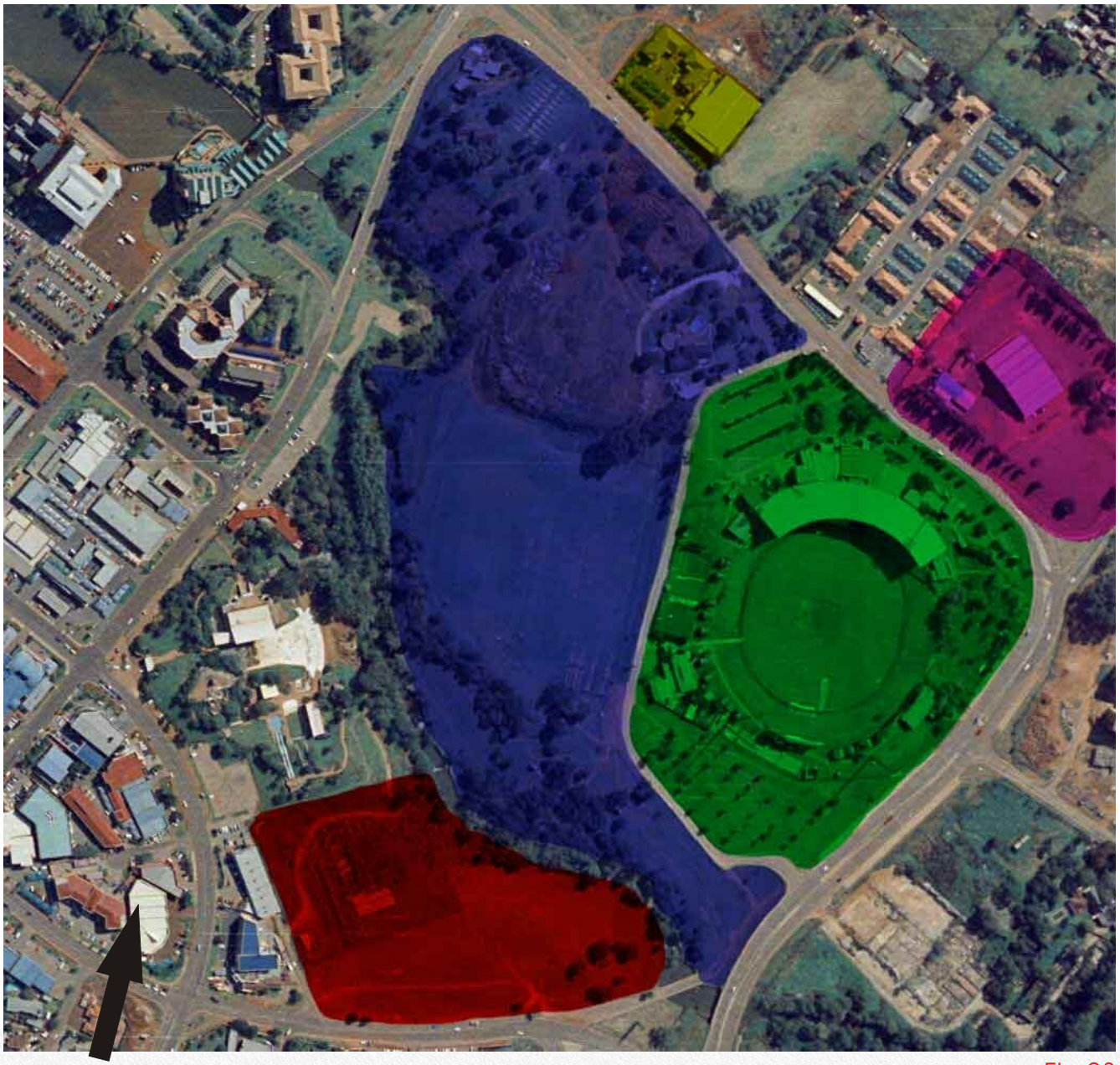
Access to the site is from the corner of Maple tree and South Street, South Street in the east and West Avenue in the North.

Access to the site is from:
- Corner of Maple tree and South Street
- At South Street and Pannevis weg T-junction
- South Street
- West Avenue in the North.



Site location map

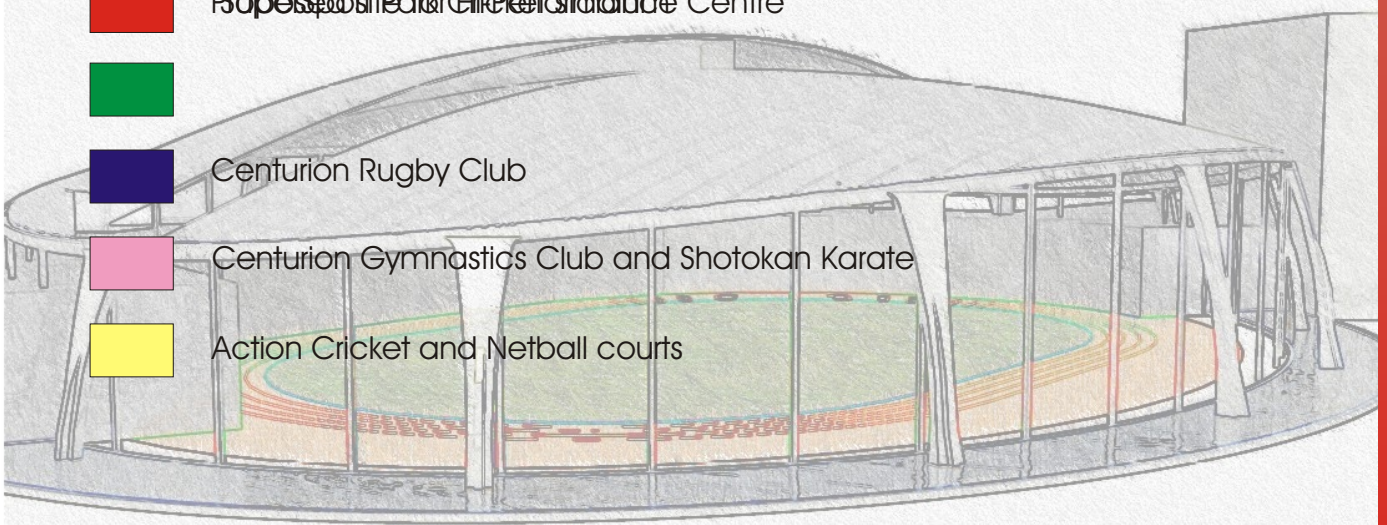
Fig.22



N

Arial photo of SuperSport Park Fig.23

- Proposed site for Cricket and Performance Centre
- SuperSport Park
- Centurion Rugby Club
- Centurion Gymnastics Club and Shotokan Karate
- Action Cricket and Netball courts

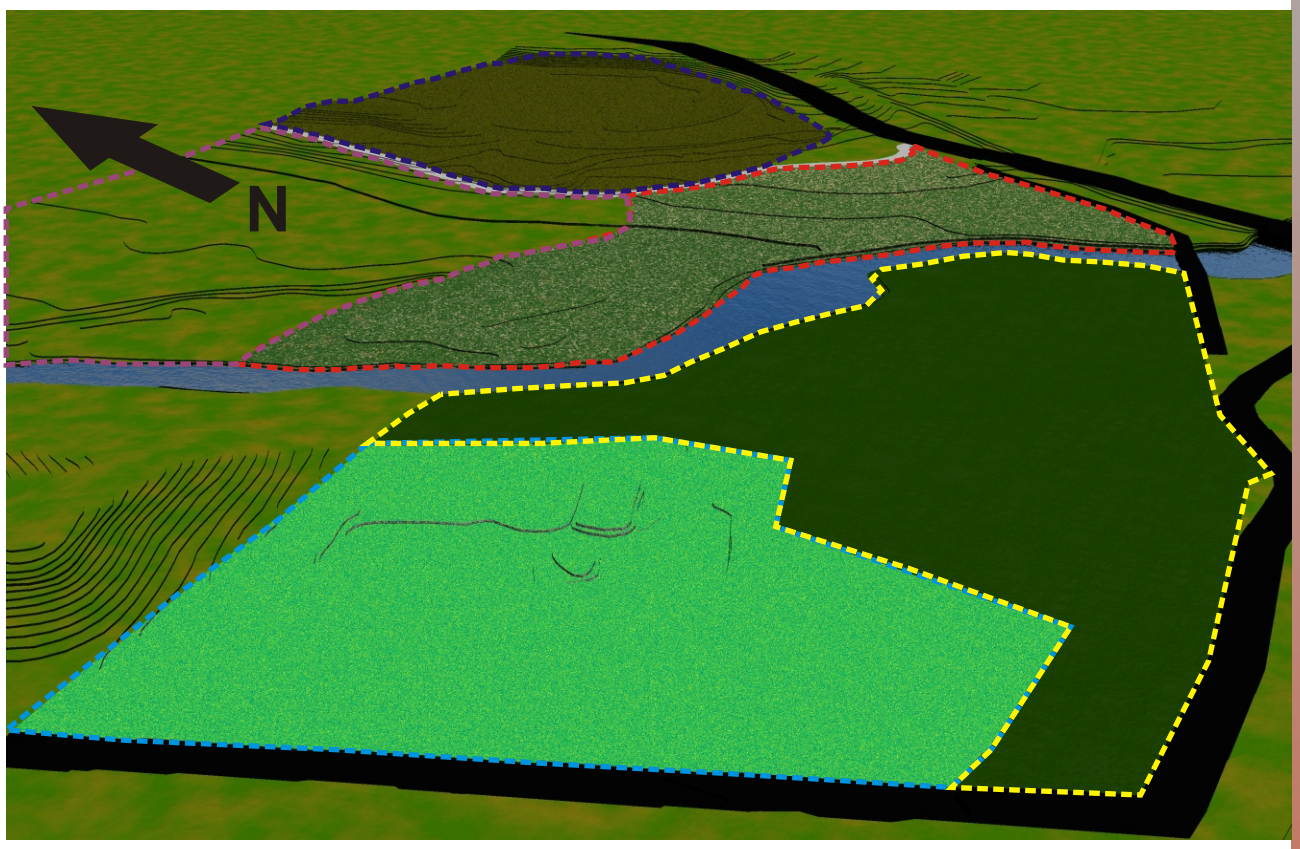


The property represents Portion 1 of Holding 44 of the Lyttelton Agricultural Holdings and covers an area 5.09 ha.

The property represents Portion 47 of the Brakfontein farm and covers an area 2.01 ha. Structure on site has no aesthetic or historical value and will be

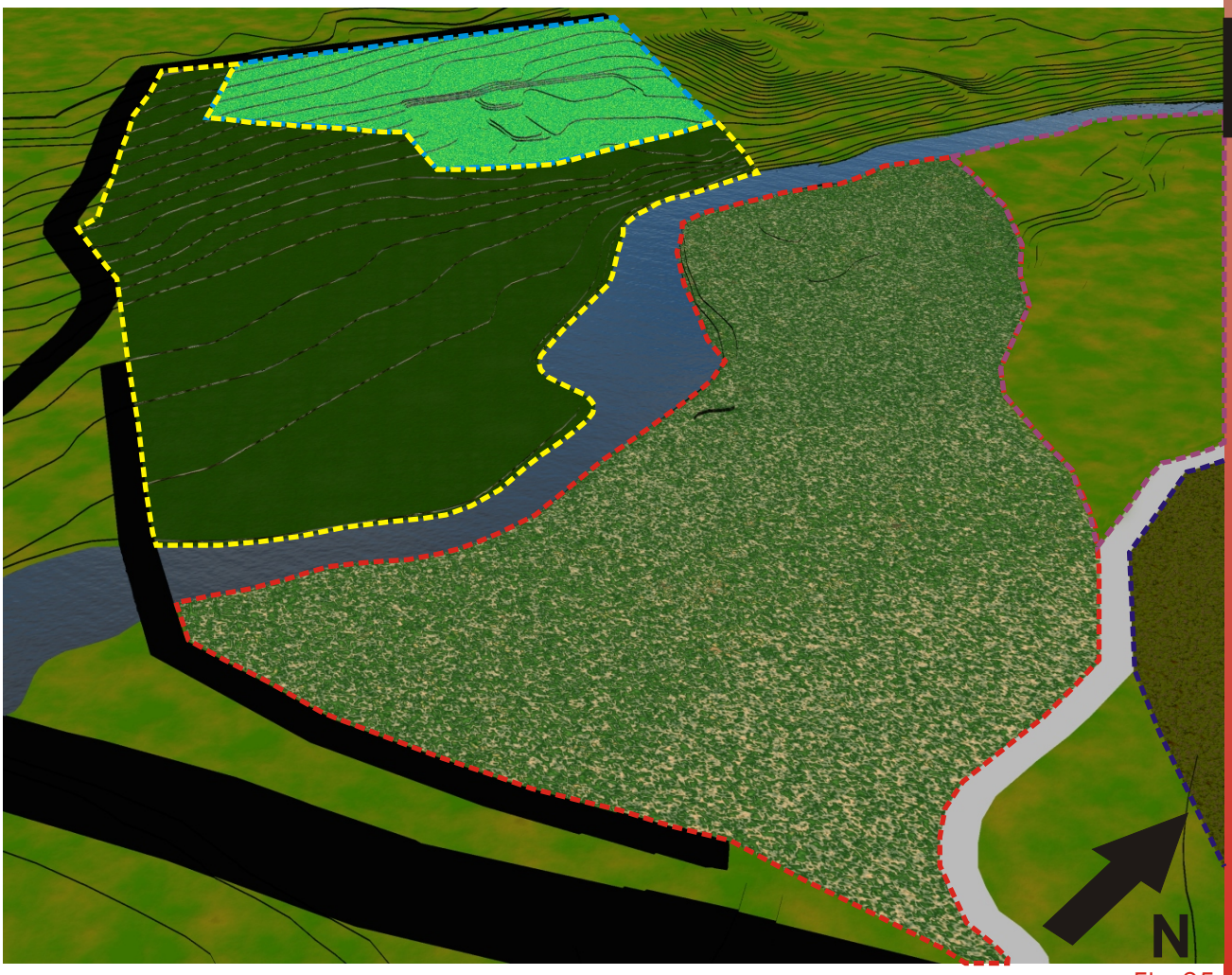
Centurion Rugby Club. The property represents a part of Portion 168 of the Lyttelton farm. No 381-JR covers an area of 24.83 ha.

SuperSport Park. The property represents Portion 169 of the Lyttelton farm NO 381-JR and covers an area of 7.57 ha.



Bryce Rendering of Site

Fig.24

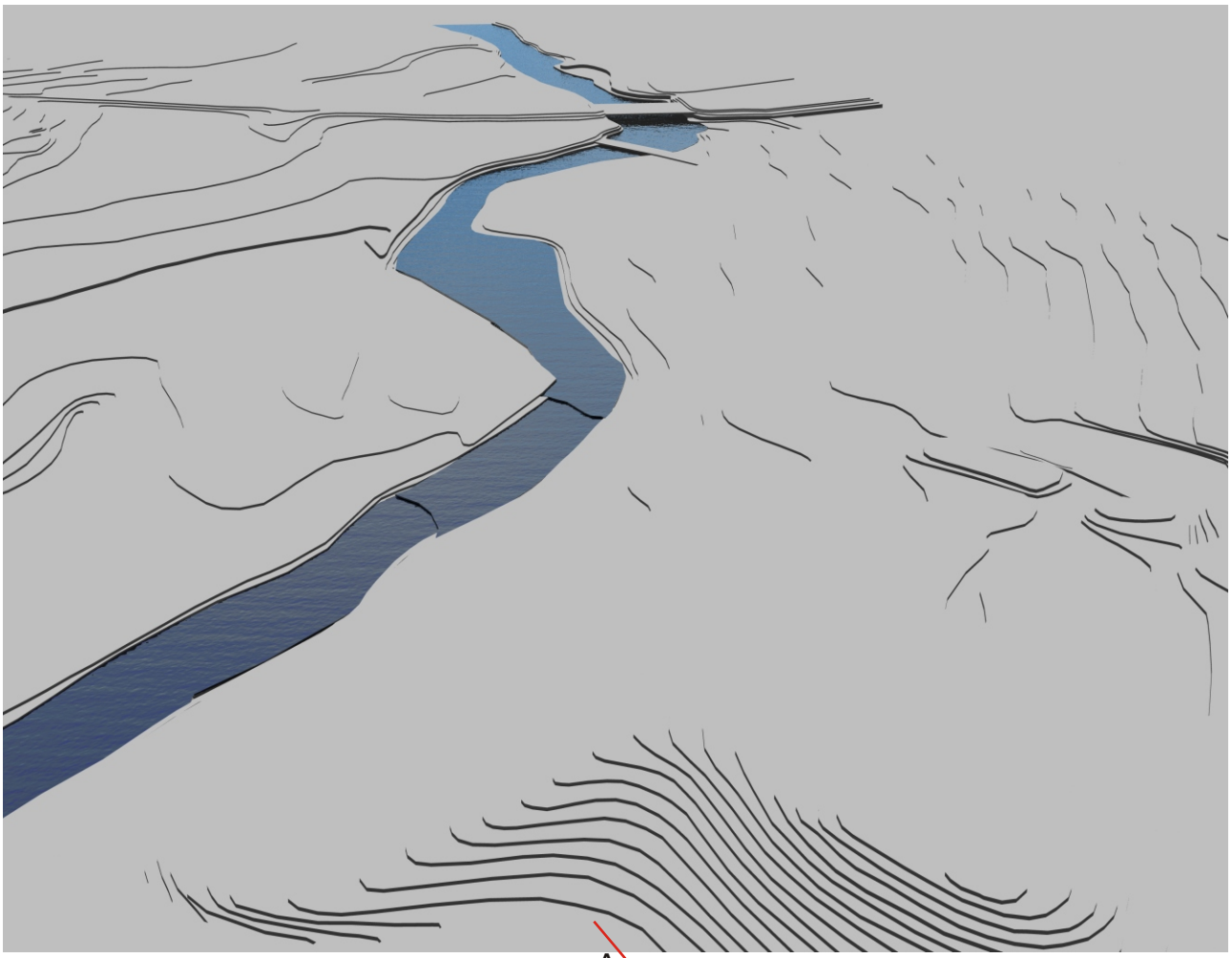


Bryce Rendering of Site

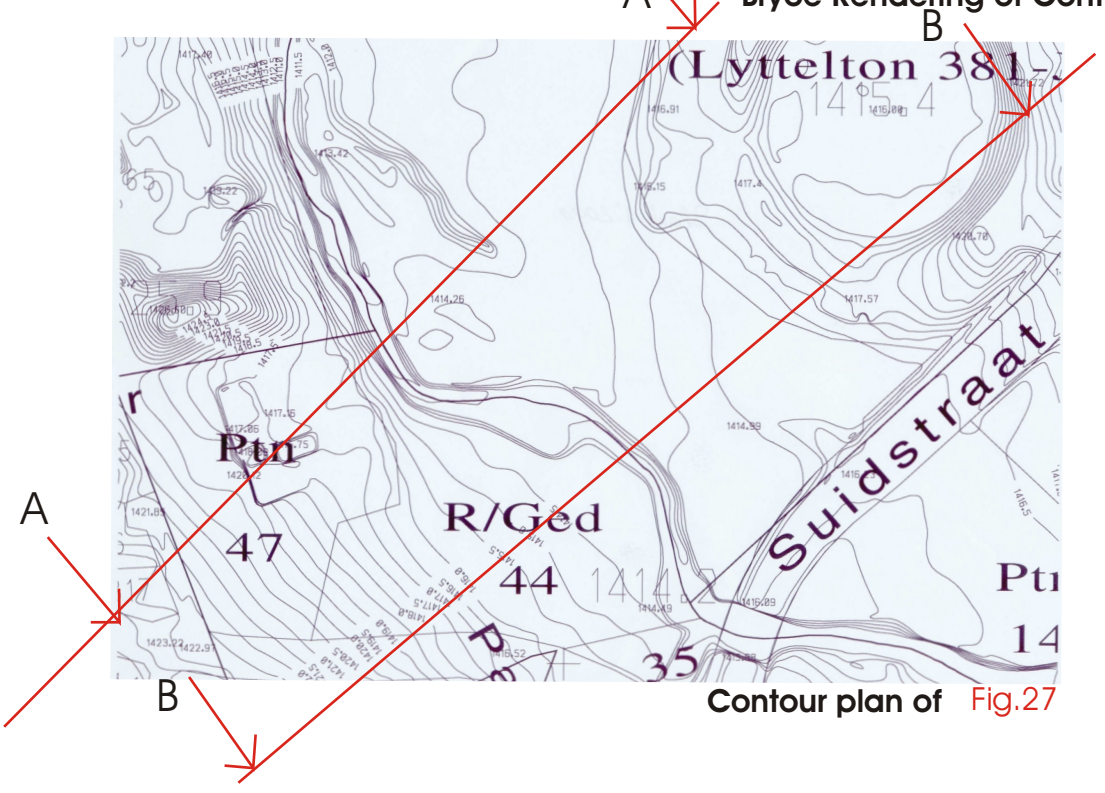
Fig.25

1.5.2 Topography

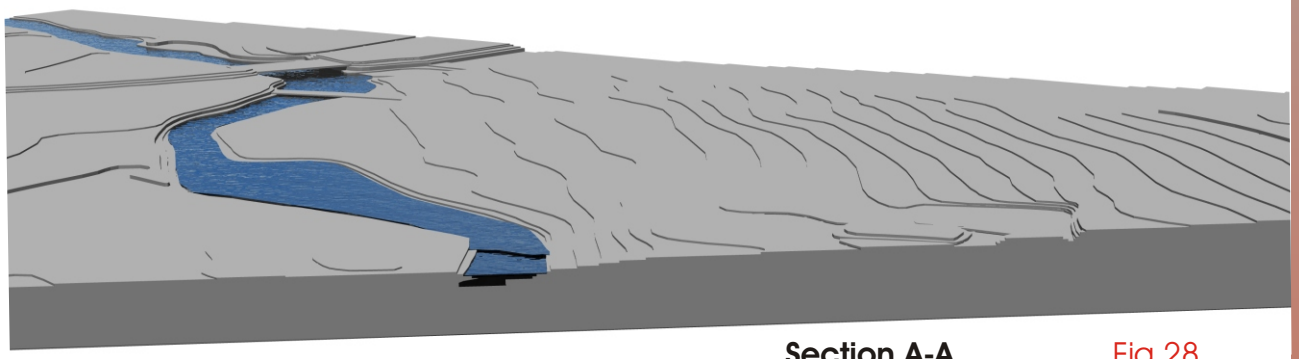
The proposed site has a mild slope towards the Hennops river, but only about 6,5° in the South side of the Hennops river and 2° in the North.



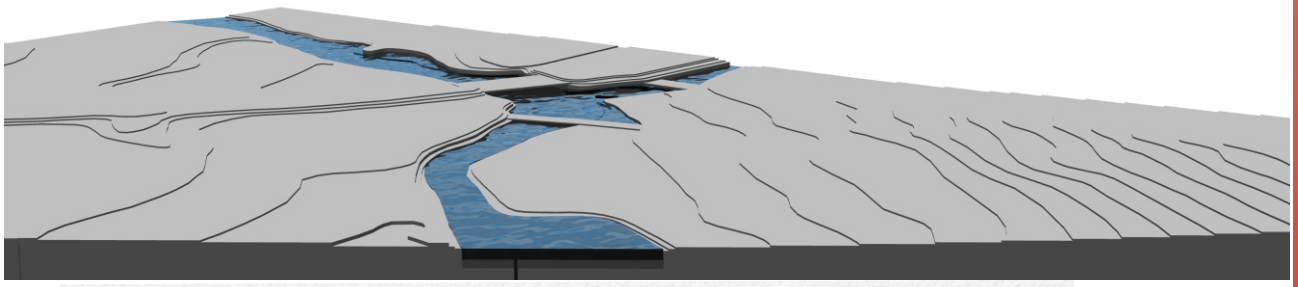
Bryce Rendering of Contour Fig.26



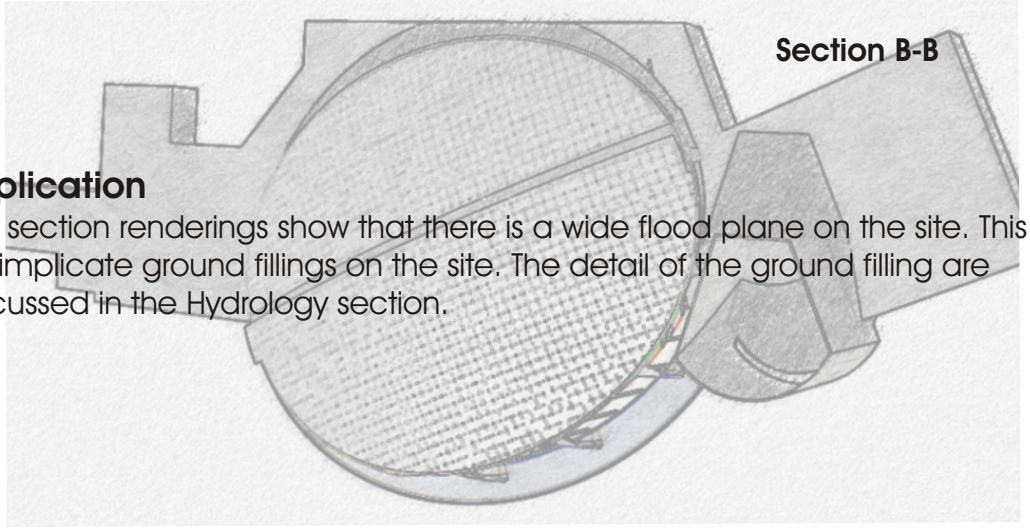
Contour plan of Fig.27



Section A-A Fig 28



Section B-B Fig 29

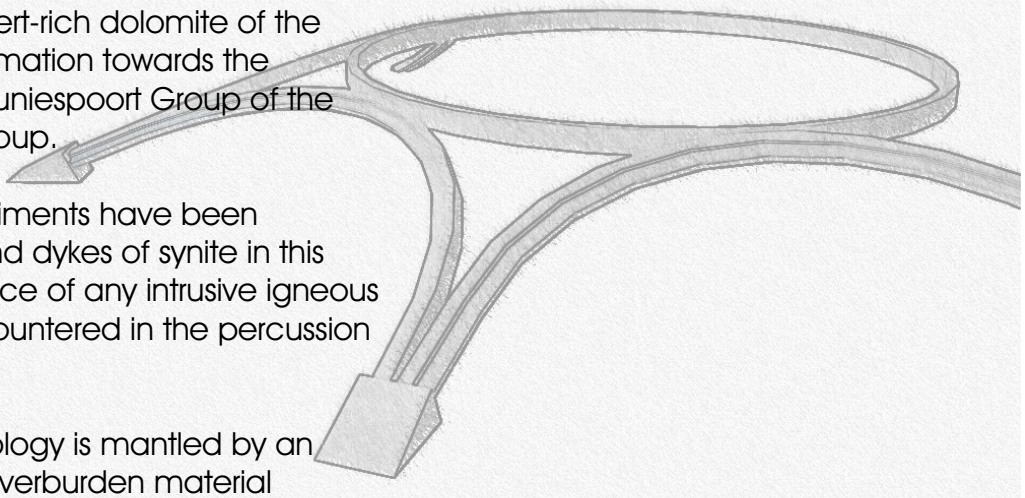


Implication

The section renderings show that there is a wide flood plane on the site. This will implicate ground fillings on the site. The detail of the ground filling are discussed in the Hydrology section.

1.5.3 Geology

According to the 1:50000 Geological Series, Sheet No. 2528CC Lyttelton, the entire area is underlain by chert-rich dolomite of the Monte Christo Formation towards the bottom of the Chuniespoort Group of the Transvaal Supergroup.

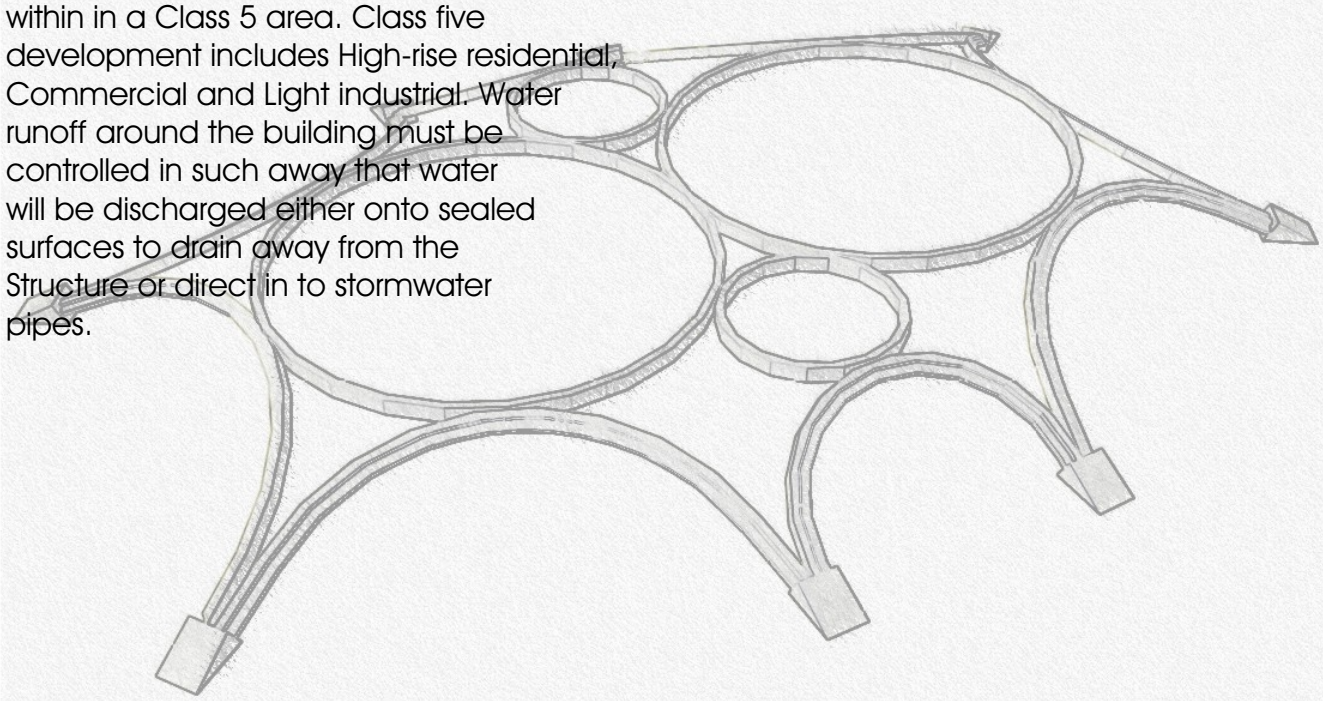


The dolomitic sediments have been intruded by sills and dykes of synite in this region. No evidence of any intrusive igneous material was encountered in the percussion boreholes.

The hard rock geology is mantled by an irregular layer of overburden material comprising both colluvial and residual soils.

Implication

Restrictions are placed on the types of development that are regarded as suitable within in a Class 5 area. Class five development includes High-rise residential, Commercial and Light industrial. Water runoff around the building must be controlled in such away that water will be discharged either onto sealed surfaces to drain away from the Structure or direct in to stormwater pipes.



1.5.4 Hydrology

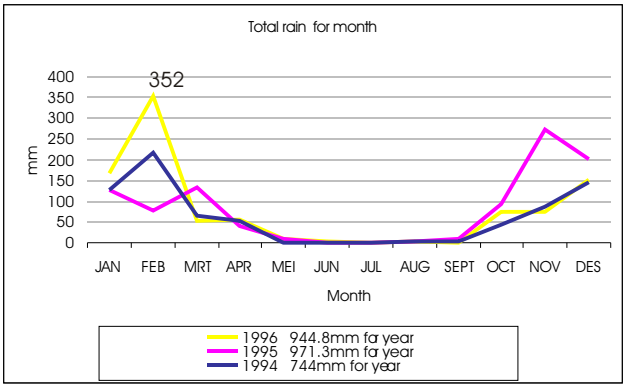
50 year flood line

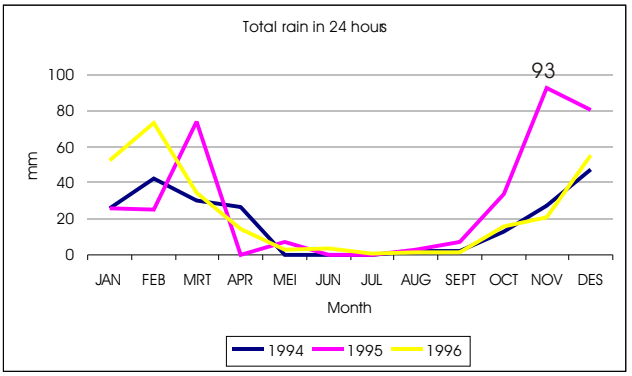
Retaining wall for ground filling

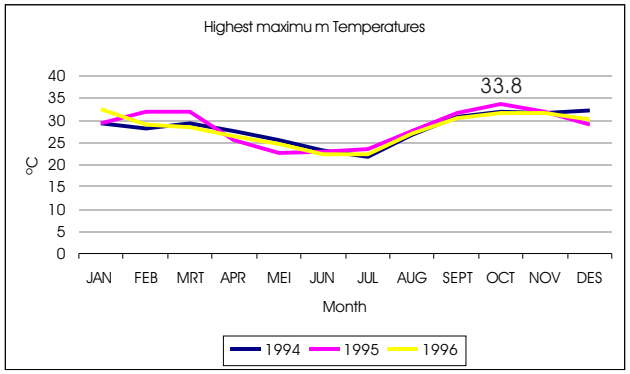
Flood line plan Fig.30

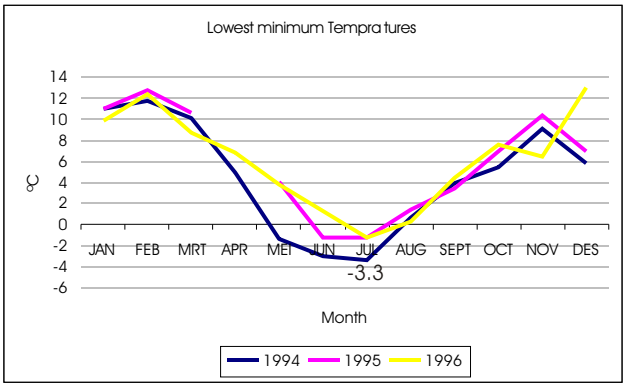
According to Engineering specifications the site could be filled up to the proposed retaining wall without any negative impact on the stream flow. Wooden decks will be used on the remaining area where there are no ground fillings recommended. This makes it possible to get the deck area close to the river. On the Northen side of the Hennops River there is a 2m Fall from the 50-year flood line to the river. The type of development that is being proposed on the Northen side of the Hennops River will be constructed on pillars so no ground filling will be required. The reason for this kind of construction is that it will minimise The impact the construction might have on the environment. This will also maximise the development potential.

1.5.5 Climate









Climate figures Fig 31

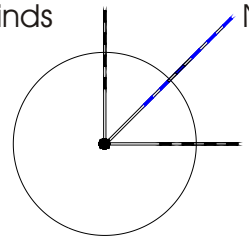
Summers are warm to hot, with fairly dry air, relieved by thunder storms generated from thermal air movement. Hail is not uncommon. Winter days are pleasantly sunny with clear cold to very cold nights.

Percentage daylight hours:

Summer: 61%
Autum/Spring: 68%
Winter: 84%

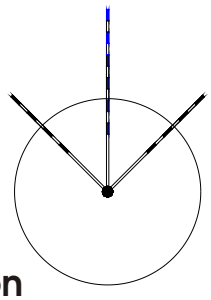
Prevailing winds

Summer



N-E to N-W

Winter



Implication

The total rain per month will indicate the total rain catchment for the roof and size of water storage tanks. The total rain in 24 hours will determine the roof structure and gutter sizes. The temperature charts will determine the methods that must be used to accomplish the most comfortable temperatures inside the building. The percentage daylight hours will determine the amount of solar energy that can be converted into electricity with solar panels. Prevailing winds indicates where window openings must be situated for the best natural ventilation

Sun Angles

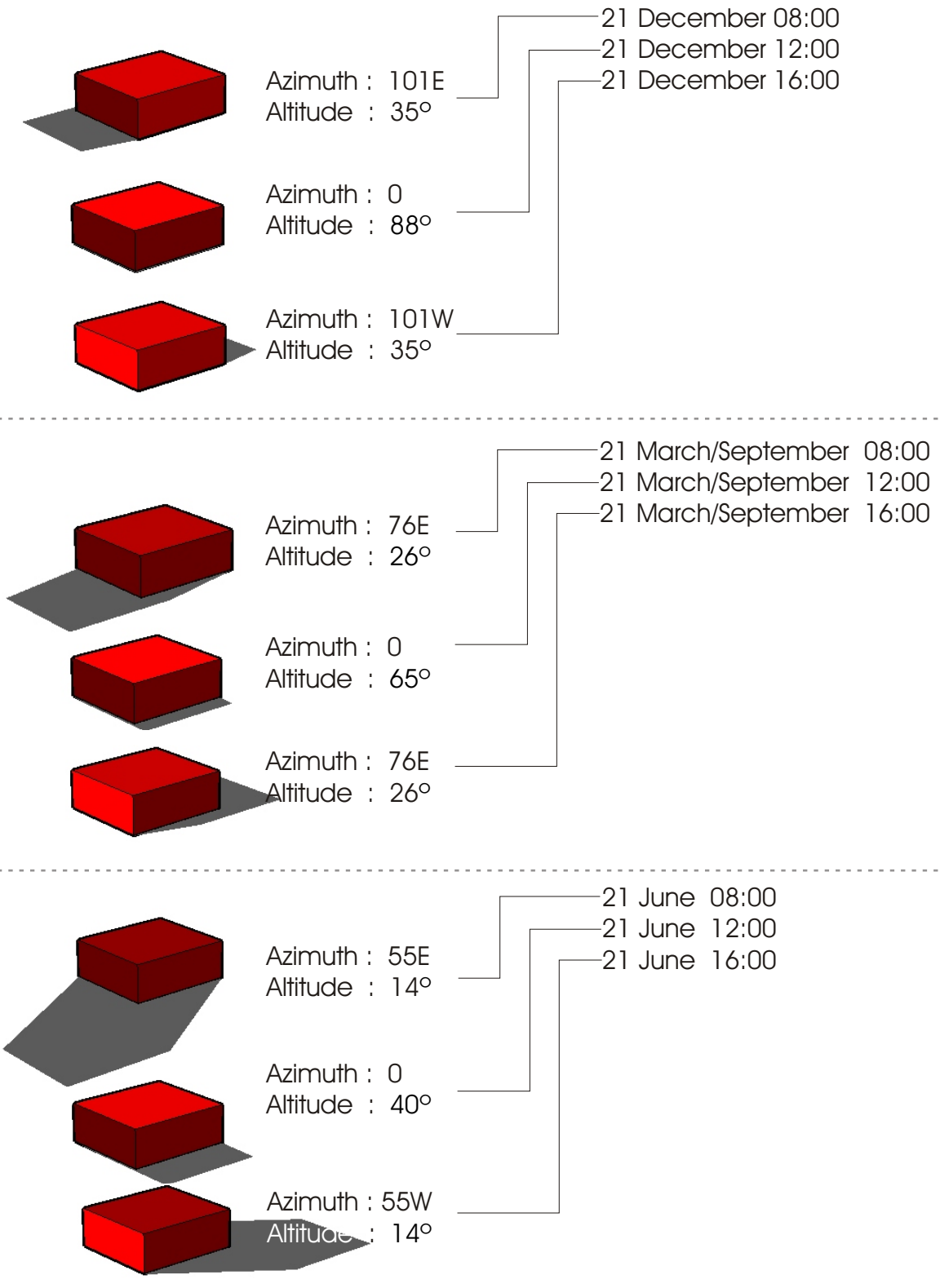


Fig.32

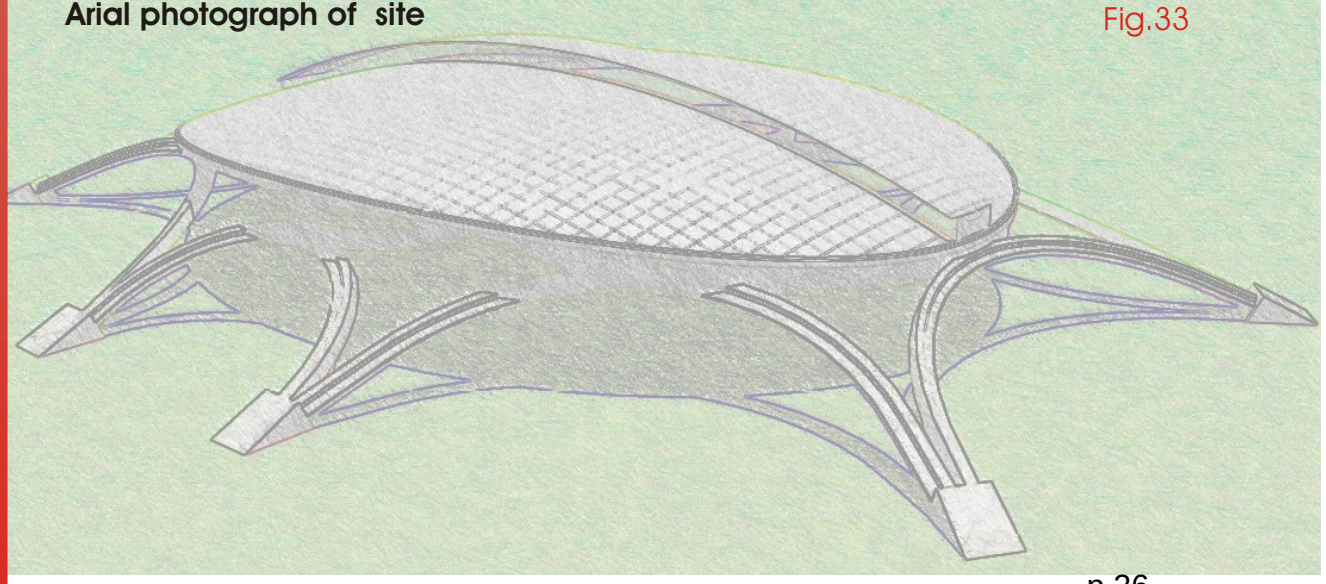
Implication

The sun angles will determine the transparency for the facade and the type of solar control that is needed to control the sun at all times. The sun angles in the west and east are very low and vertical louvres will be used. On the northen facade the horizontal louvres will be adjustable to allow maximum sun in the winter and to block the sun in the summer.

1.5.6 Vegetation

Arial photograph of site

Fig.33



Zone1 :Weeping Willow(Salix babilonica)
Zone2 :Acacia
Zone3 :Combretum erythrophyllum
Zone4 :Quecus robur
Zone5 :Rhus pyroides

The Combretums on the northern side of the river with its high foliage gives a spacious feeling where sportsmen can relax. The big Weeping Willows hanging over the river in Zone 1 pronounce a tranquil atmosphere next to the river on which the restaurant can be located. The Oak tree in Zone 3 is the only one on site and may be considered of significant value.

Implications

Different spaces with different characteristic values are formed in the landscape and will be taken into consideration with the design and site layout. There has to be an interaction between the building form and the spaces formed by the trees.

Vegetation On site Fig.34

1.5.7 Site description

Arial photo indicating camera shots Fig 35

The site can be described as an open area next to the Hennops River.
There are a variety of trees growing next to the river as well as on the site. These trees are described in detail under the Vegetation heading earlier in this chapter. There is currently a ruin structure on the Western side of the site. This will be demolished for the new proposal.

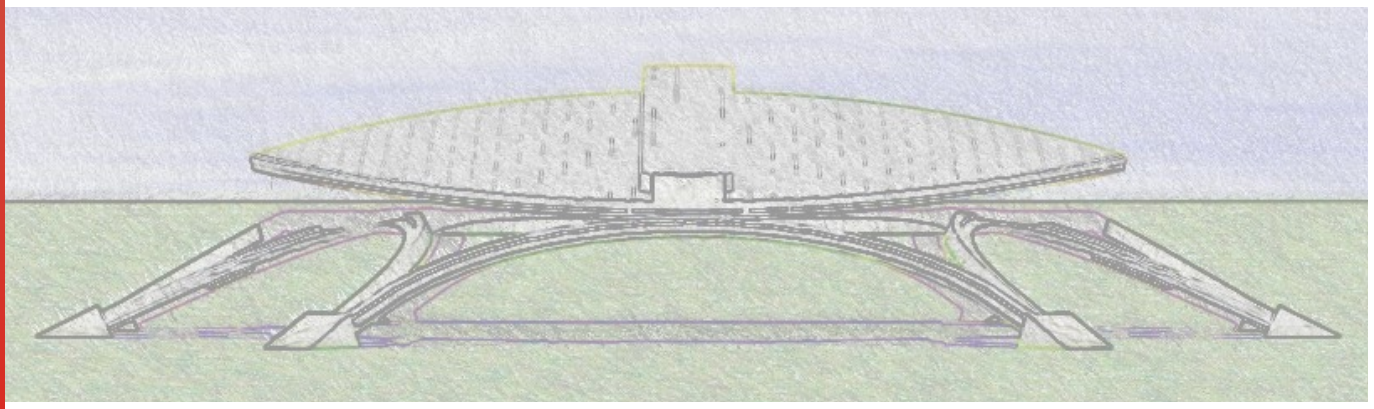


Fig 36

The Hennops river flowing through the proposed site that gives a tranquil feeling.

Fig 37

Open area parking for developing sports hub.

Fig 38

Bridge overcrossing for pedestrians between sports hub and HPC.

Fig 39

Proposed relaxation area with tables and benches.

Fig 40

Inclosed and private open space for further sport development.

Fig 41

Open space allocated for further development of sports hub.

Arial photo indicating camera shots

Fig 35

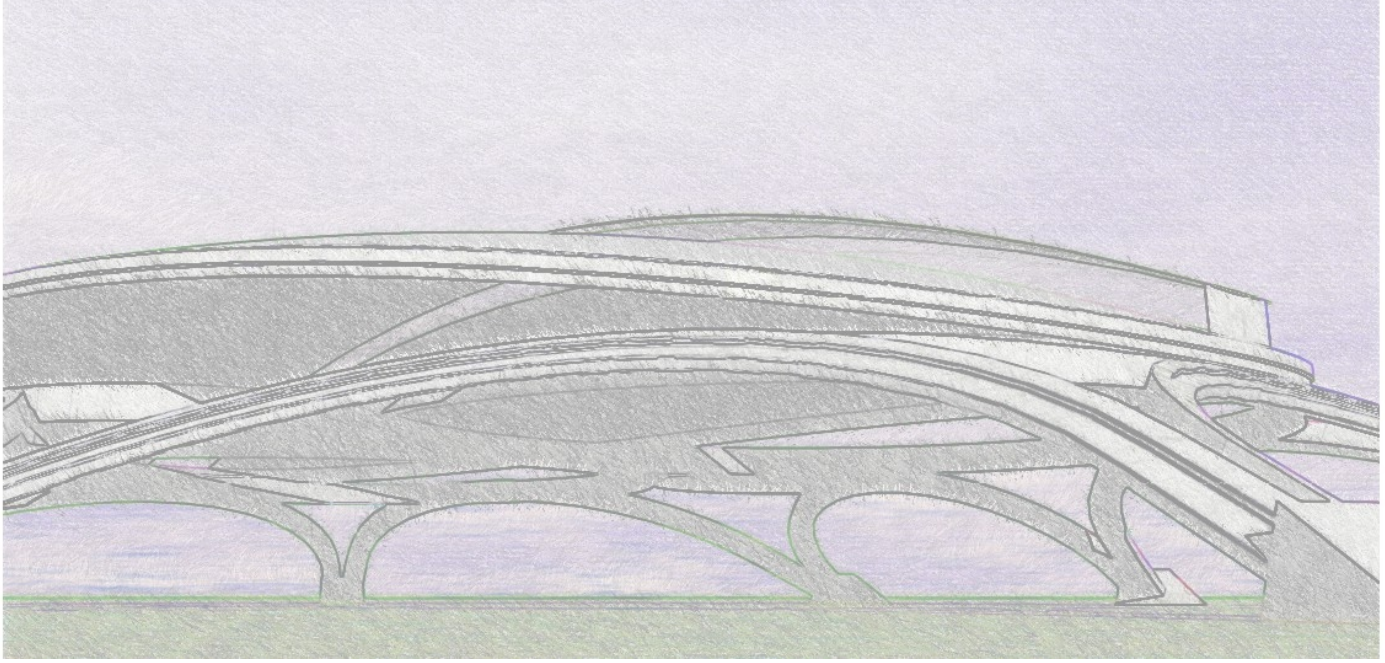


Fig 42

Open area for proposed HPC. Acacias must be incorporated into the design of the HPC.

Fig 43

Proposed area for bridge overcrossing between sport hub and HPC.

Fig 44

The Structure on the western side of the site has no historical value or value at all, and will be demolished

Fig 45

Open area for proposed HPC.

Fig 46

Hennops river with its weeping willows.

Fig 47

This scenery contributes to the site's serene environment that has to be incorporated with the design.

1.5.8 Detail vehicle circulation

Map showing detail circulation Fig.48

- Class 1- Highways
- Class 2- Arterial road
- Class 3- Collection roads
- Class 4- Distribution roads
- Class 5- Access roads

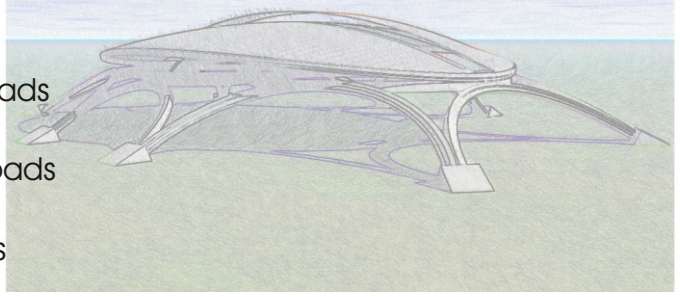


Fig.49

On March 7, 2003, a Cricket World cup game between Sri Lanka and Australia was played. Fig.49 Shows the cars(832 cars) that parked on the proposed site during the match. Alternative parking facilities had to be provided for the spectators during cricket matches.

Fig.50

Approximately 8750 cars are parking in the Streets of Centurion CBD that cause huge traffic problems. Fig.50 shows cars that parked in Leonie Str, 1.6 km from SuperSport Park. Parking is spread all over Centurion CBD and makes secure parking very difficult. Parking must be centralized at one parking area to ensure secure parking for spectators.

Fig.51

"Park and ride" are provided on the open space at the northwest corner of Lenchen North and John Vorster Rd. Fig.51. Spectators park their cars in the secure parking bay and are transported with a shuttle service to SuperSport Park. Currently this service isn't used to its full extent. Only a small portion of the open space is used, because the spectators are unaware of this facility.

Fig.52

Implication

The site covers an area of 162 520 m^2. Fig.52. If the parking bay is well controlled, a total of approximately 8250 cars can have a secure parking during a cricket match. By using this open space it will solve the theft of vehicles and the traffic and parking problem in Centurion CBD.

Access to the site is from:

Proposed access for services: Corner of Maple tree and South Street

South Street and Pannevis weg T-junction is a busy connection of roads and will not be appropriate for the main access to the site.

Proposed access for main entrance to site: South Street

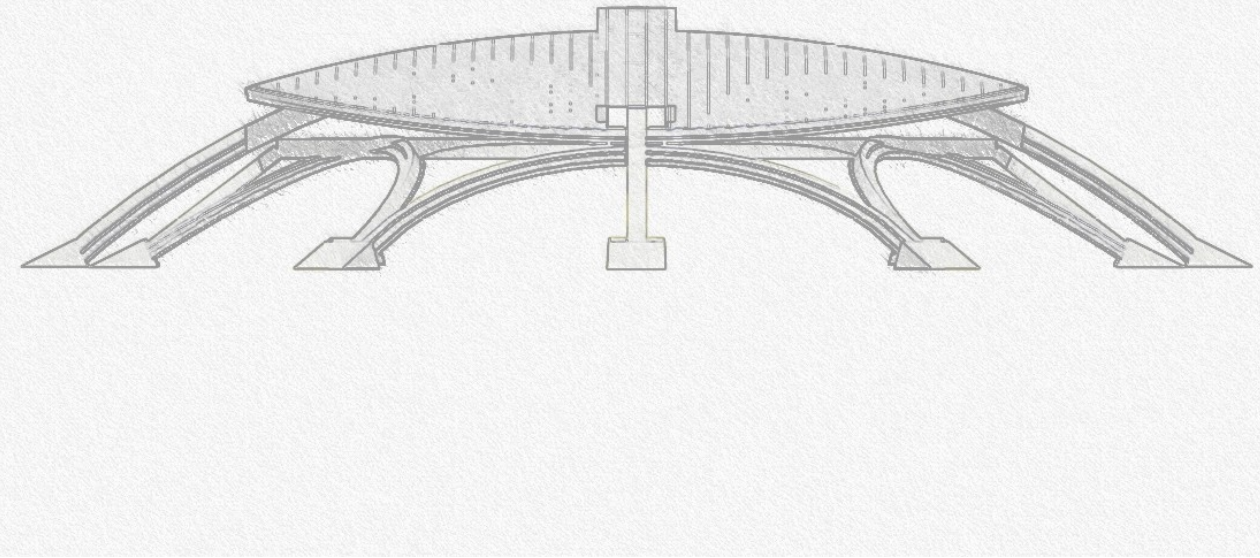
Proposed primary entrance to developing sports hub: West Avenue

1.5.9 Centurion IDP Spatial Framework

Centurion is in a great position to provide an ideal location

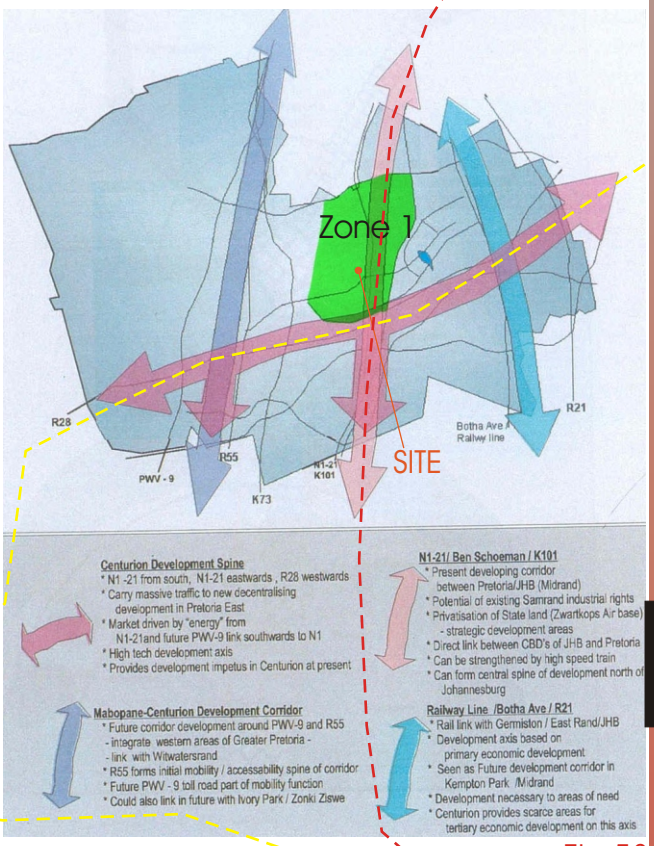
This plan has been formulated for the area under the jurisdiction of the Centurion Town Council. Centurion compromises the southern part of the Greater Tswane Metropolitan Council. The Centurion area has, in accordance with the greater Pretoria Metropolitan Council (GPMC) policy, been subdivided into planning zones. An IDP has been formulated for each of these zones. These plans, although formulated simultaneously with this city wide plan, have informed the process and contain more detail appropriate to a local level.

Centurion comprises the southernmost Metropolitan Local Authority in Greater Pretoria area, which is the northernmost Metropolitan Council in Gauteng. Its location straddling the N1 (Ben Schoeman) determines that Centurion forms an important link between the Southern part of Gauteng and Pretoria regions.



Gauteng Spatial Development Framework

The economical forces within the core manifest itself linearly along certain highways bisecting the Gauteng Urban Region. In this context a critical strategic zone is being formed in the sub region of which Centurion forms a major part, where certain Development Corridors are emerging. The prime focus of these Emerging Development Corridors is the Urban Corridor that is developing between Pretoria and Johannesburg along the N1 highway. This Corridor also form's the backbone for the Gauteng Province Economic Development Strategy whose vision is to position Gauteng as The "Smart Province"



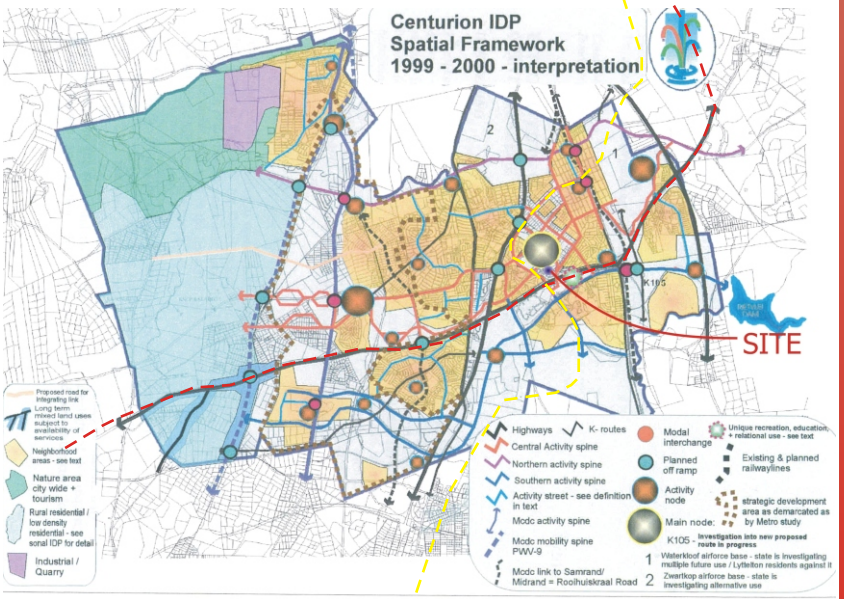
Centurion development spines Fig.53

Centurions Urban context

Its position on the N1/ Midrand growth axis enables the greater Pretoria area to draw benefit from the impetus and energy in that corridor. With the proposed developments on Centurion/ Midrand border, a large spill over of investments is anticipated. These are predominately job creating developments, which will benefit not only Centurion but the entire Pretoria region. Centurion is ideally located on the N1 corridor for clean/ high technology industries. Studies for the GPMC indicate the potential for Centurion to develop a high technology/ biotechnology cluster. Given the high emphasis on tertiary sector activities potential also exists to develop banking and financial service sectors.

Economic

Centurion has a young economy, less than 20 year's old. Centurion has maintained a very high annual economic growth rate of approximately 10.7% over the last seven years. A 5% unemployment rate which is relatively low-, was registered during a 1994 survey.



Centurion spatial framework map Fig.54

N1

John Voster rd

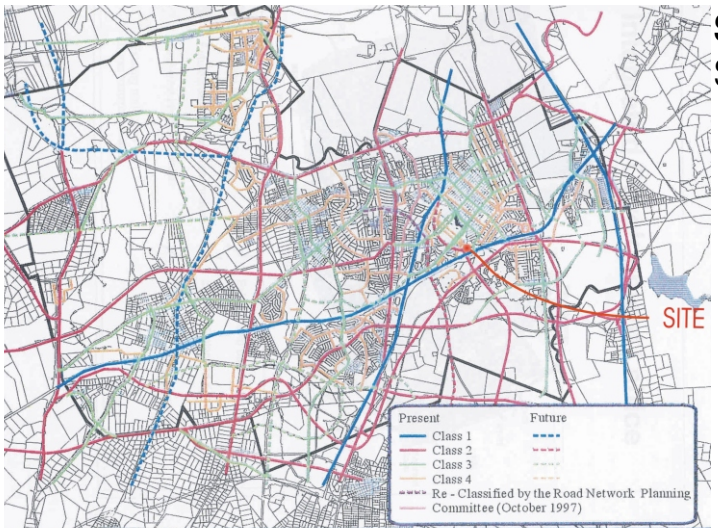
Social

Facilities

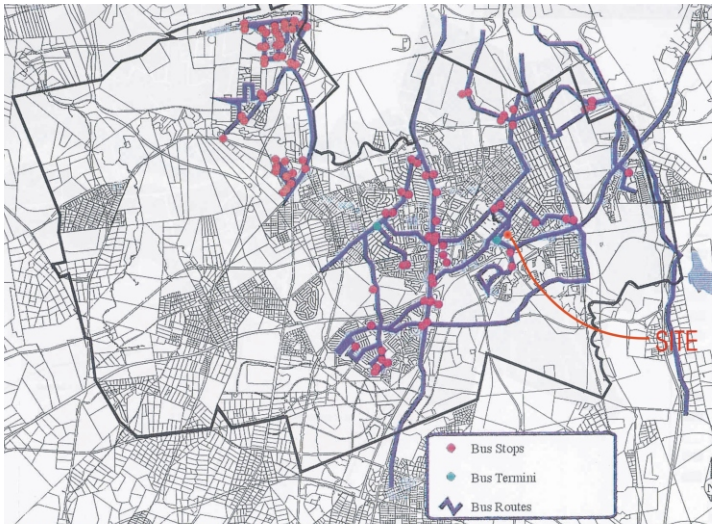
Centurion is generally well provided with social, community, educational and health facilities. In general a lack of adequate sport and recreational facilities as well a general feeling of insufficient safety and security exist in the area.

Demography

The population that currently lives in Centurion is estimated at ± 224 000 people. Of this total population, ±80640 (36%) people live in zone 1. The population is fairly young with 31% being under the age of 18. Currently the 25-34 year age group comprises the largest age group in Centurion (26,2%). The potential economic active section of the population (19-54 years) has increased since 1983 from 51.6% - 54.9% in 1995.



Road calcifications in Centurion Fig 55



Transport nodes in Centurion Fig 56

Spatial Development Program

Social

The need to conserve and enhance the natural environment.
Upgrading Atlantis Water Park("to make something of it") and establishing and expand sport and recreational facilities in Centurion.
Upgrading and expanding the public transport system.

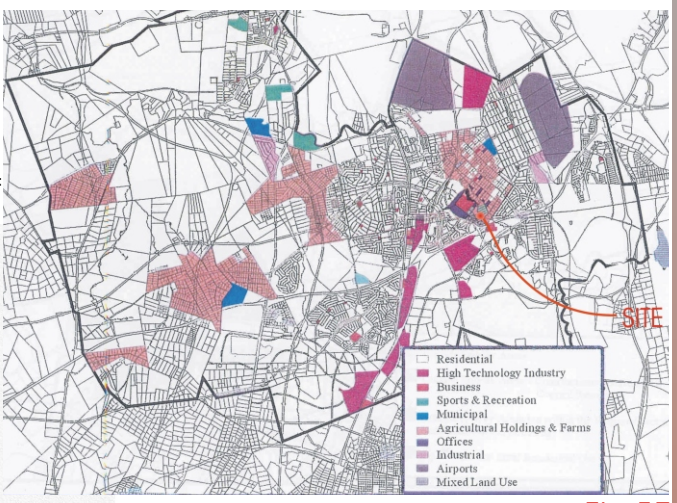
Economical

To stimulate cost-effective sustainable development with a positive multiplier effect and no negative side effects, that result in a net increase in job opportunities for all sectors of the community.
To maximize the benefits of Centurion's location within Gauteng.
To tap into the energies of existing and developing corridors such as the high technology N1 corridor (Midrand strip).

Lyttelton Agricultural Holdings

Medium intensity non-residential development serving the local population and supporting the mixed use character of the area could be accommodated along the spine street. Typical character supporting land use typologies will include The following:

Office park
Office block
Education- or instuitional centre
Filling station and store
Restaurants/ tea-gardens
Recreational and sport centre
Neighborhood centre
Arts and Craft



Land use in Centurion Fig.57

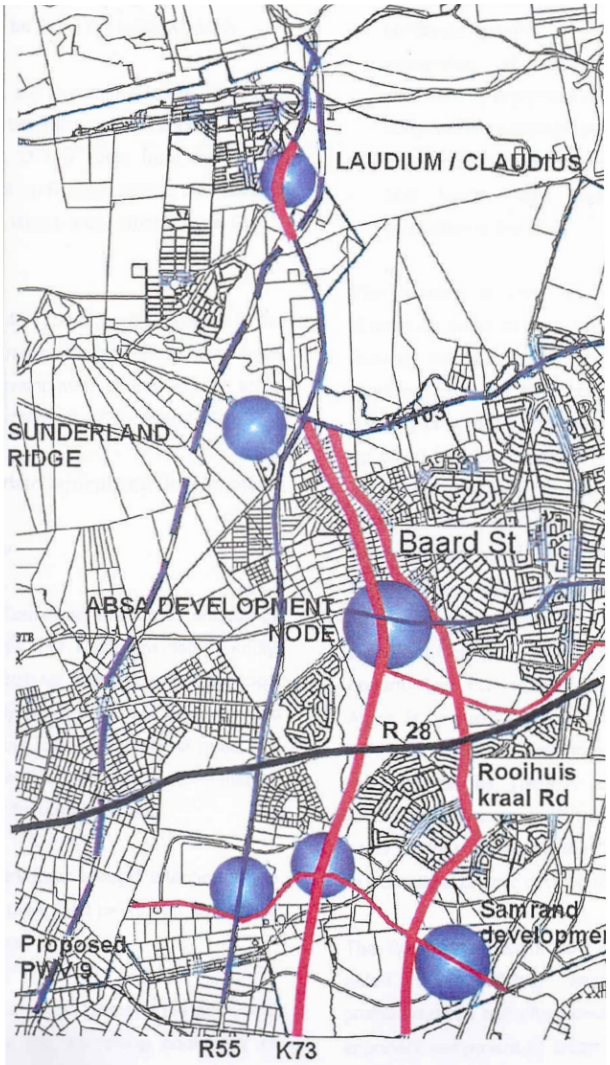
Sport and Recreation

This zone should focus on sporting activities and facilities(indoor and outdoor, formal and informal, competitive and leisure). A recreational destination supporting the pedestrian network should be established in this zone. Large sport facilities should ensure an appropriate interface on the water edge.

A visibility strip accommodating primarily the high tech uses along the N1. Buildings and spaces should convey a prestige corporate and high tech image. Buildings should be placed away from the boundary with extensive landscaping, establishing a strong park like character through well landscaped soft open spaces adjacent to the N1, low coverage's and a coarse grain of building.

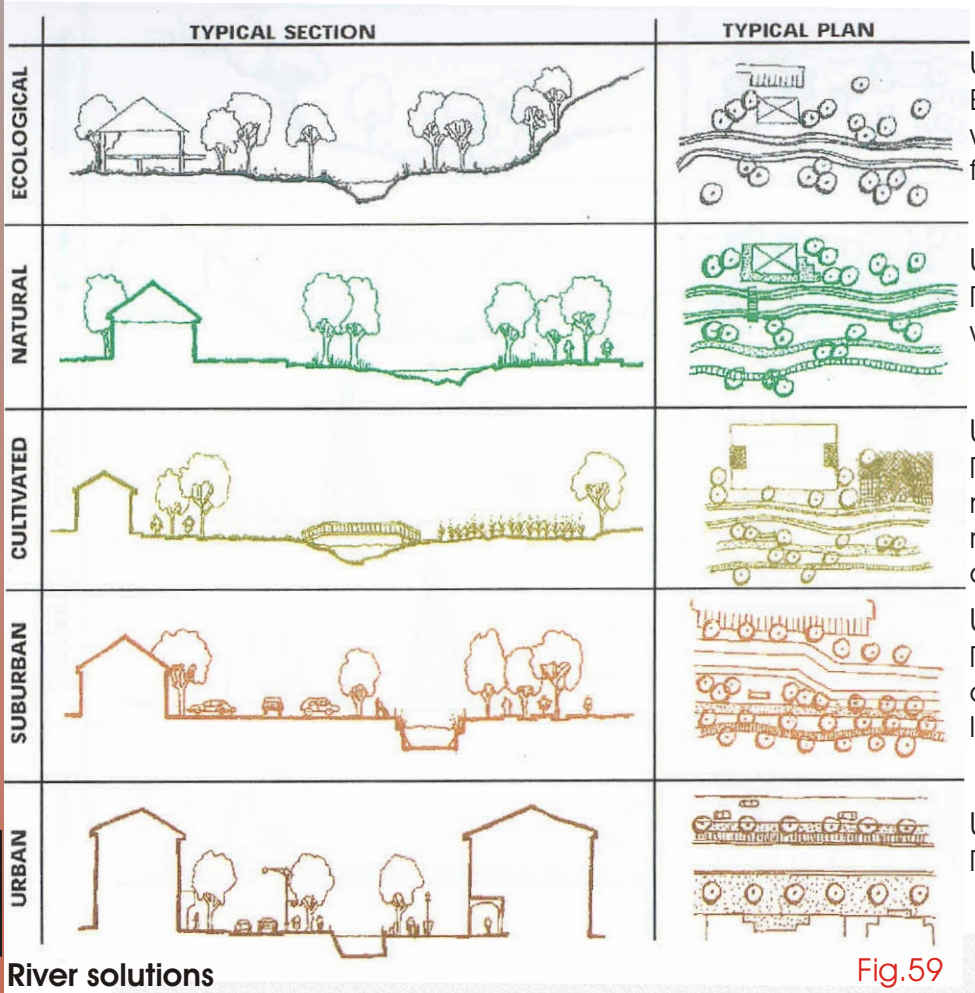
Special precincts

Exploit the potential for the establishment of unique precincts enhancing legibility, but also marketability, with potential precincts such as the agglomeration of sport fields and other outdoor and indoor recreational activities around the Centurion Cricket Stadium that could promote the establishment of a "fitness Precinct."



Development nodes Fig 58

Proposed Solution for River development.



Urban Form:
Ecological pristine area with river as ecological focal point

Urban Form:
River in natural setting with natural flood line

Urban Form:
River (canalised or natural) as basis for recreational or agricultural activities.

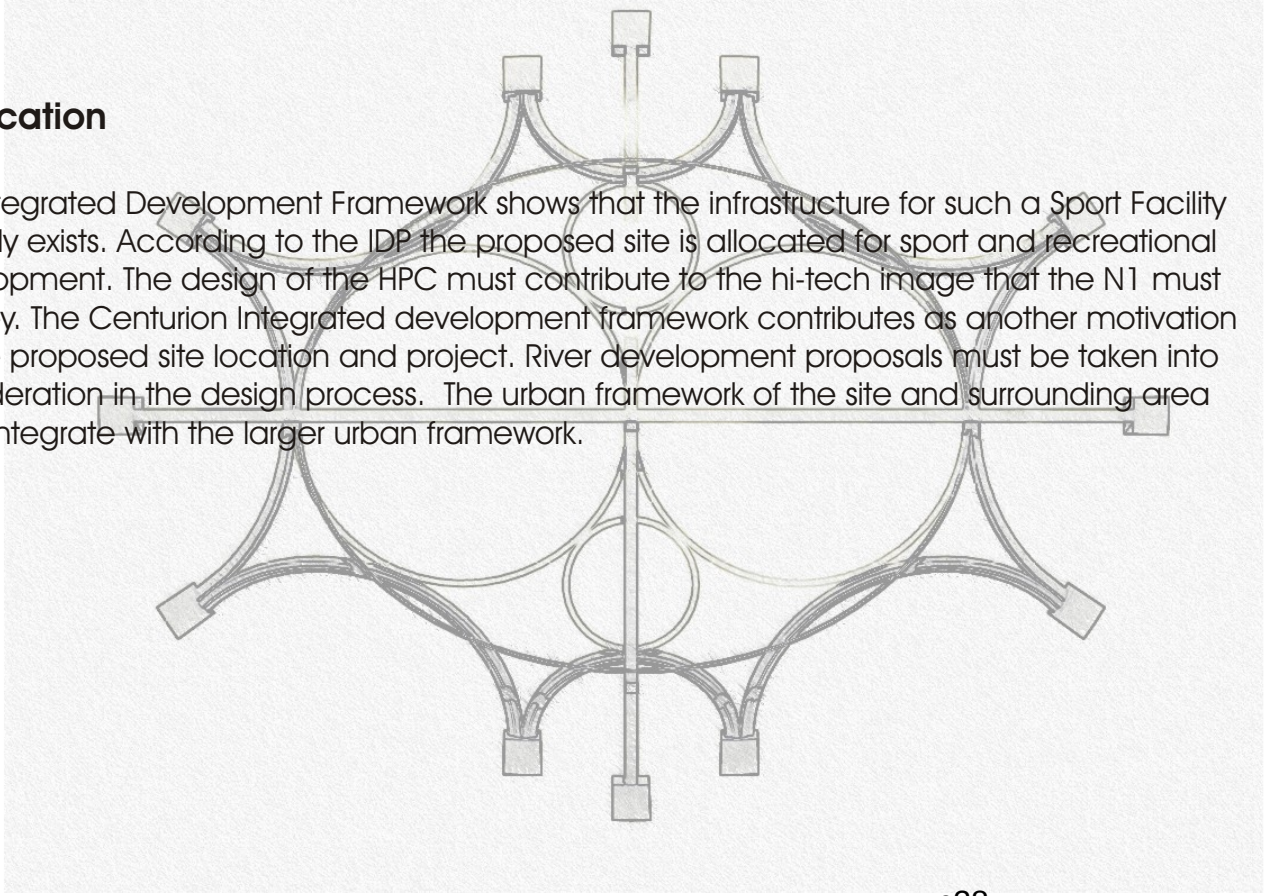
Urban Form:
River can be canalised as a water feature of a linear park

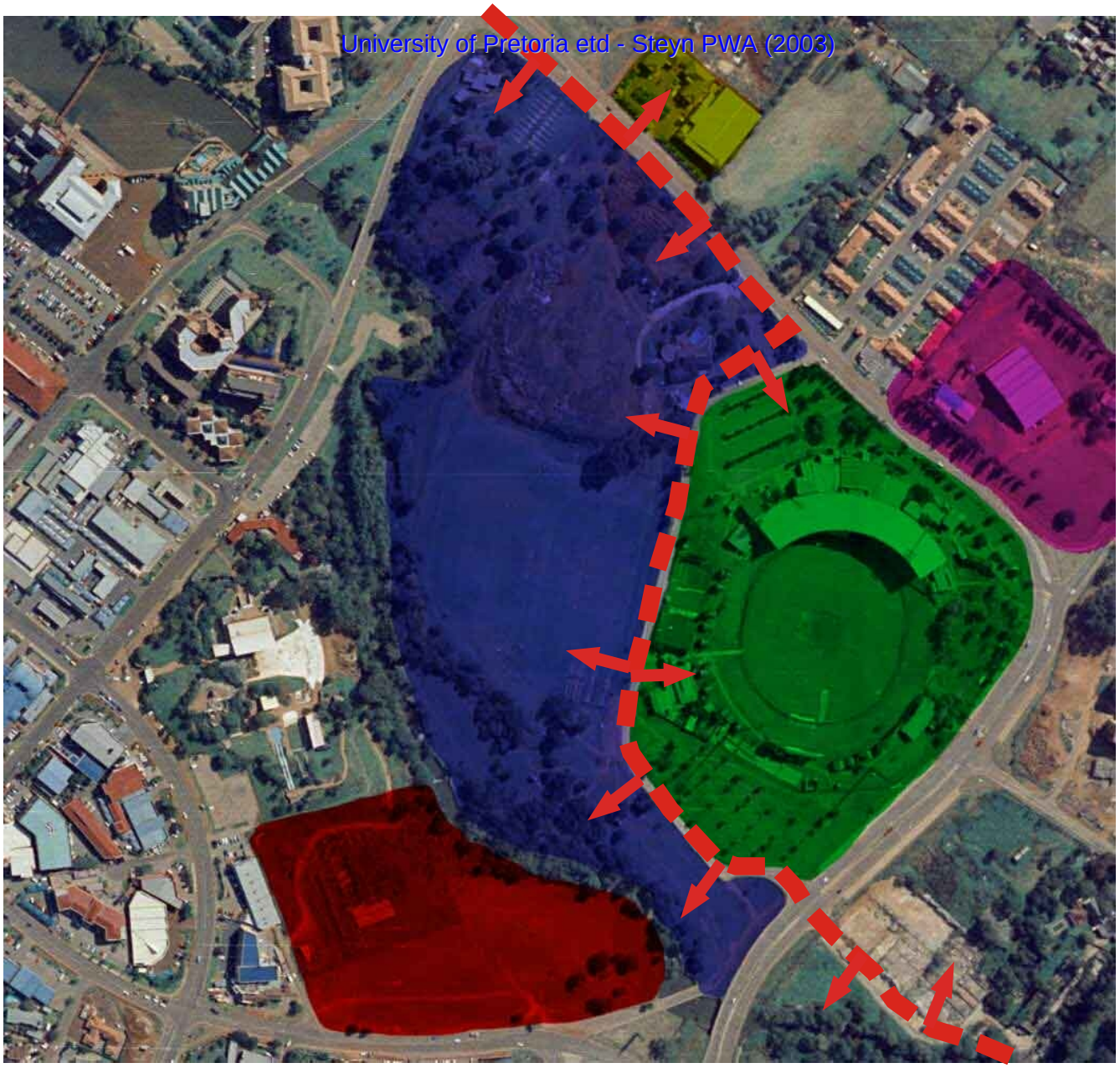
Urban Form:
River Promenade

River solutions Fig.59

Implication

The Integrated Development Framework shows that the infrastructure for such a Sport Facility already exists. According to the IDP the proposed site is allocated for sport and recreational development. The design of the HPC must contribute to the hi-tech image that the N1 must convey. The Centurion Integrated development framework contributes as another motivation for the proposed site location and project. River development proposals must be taken into consideration in the design process. The urban framework of the site and surrounding area must integrate with the larger urban framework.





Arial photo of SuperSport Park Fig.60

N

Proposed site for Hi-Performance Centre

Centurion Rugby Club

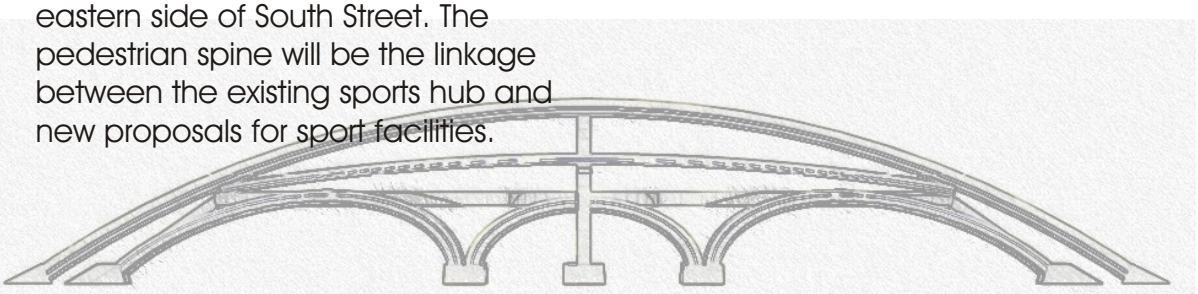
Centurion Gymnastics Club and Shotokan Karate

Action Cricket and Netball courts

Pedestrian spine that will became the backbone which all the sport facilities will feed from in the developing sports hub

Flood line plan Fig.61

According to the site analysis the surrounding sites are mainly sports venues that contribute that this area can be classified as a sports hub in Centurion. According to the Centurion Integrated Development Framework this zone should be used for sport development and recreational facilities. With all the surrounding sports facilities a central pedestrian spine is developing from which all the facilities will feed from. The Centurion Rugby Club will be upgraded for rugby, soccer and other sport that need fields for training. Any further sports development will take place on the eastern side of South Street. The pedestrian spine will be the linkage between the existing sports hub and new proposals for sport facilities.



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Proposed area for HPC. Interactive connection with river front.

Proposed area for accommodation which will be connected with a pedestrian bridge to the developing sports hub.

Proposed Learning Centre for high performance athletes of school going age and hostels

Proposed Parking area for developing sports hub

Indicate the main routes between different areas of Hi Performance Sport Centre as well as links with the sports hub.

Connection between the proposed HPC and SuperSport Park.

Proposed area for further sport development which will contribute to the existing sports hub.

Proposed central parking for developing sports hub.

Pedestrian spine which will become the backbone from which all the sport facilities will feed from

Main entrance to site and sports hub. Will became an important node in further development of sports hub.

This entrance may become the primary entrance to the developing spots hub.

Entrance limited for services only

SportScience Centre

The Hi-Performance centre sport science services vision is to be a state of the art leader in revolutionizing the management of sport performance and sport development in South-Africa.

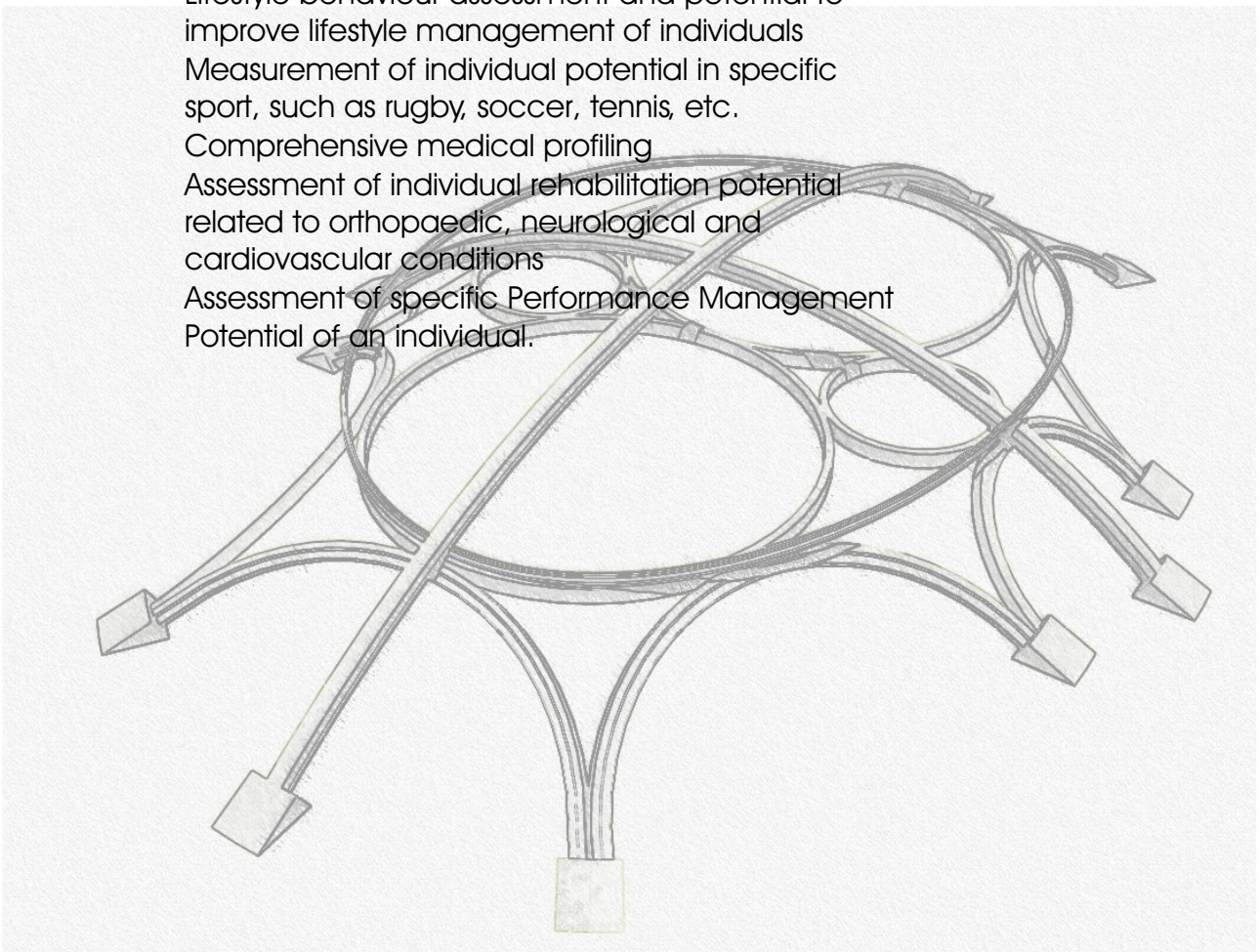
The sport science services will offer a seamless product mix, appealing to the high performance athletes who belong to the top echelons of their national, provincial, club or school structure, performance enhances who want to improve their performance, health and fitness enthusiasts, and patients requiring rehabilitation and intervention who are required by virtue of an injury or illness to a frequent curative service.

Medical Research Centre

With the aim of being the state of the art leader in multi disciplinary assessments, the assessment centre will offer a range of products focussing on scientific analysis and the measurement of an individual entailing physical and psychological assessment.

The product mix will include:

Comprehensive biophysical measures
Lifestyle behaviour assessment and potential to improve lifestyle management of individuals
Measurement of individual potential in specific sport, such as rugby, soccer, tennis, etc.
Comprehensive medical profiling
Assessment of individual rehabilitation potential related to orthopaedic, neurological and cardiovascular conditions
Assessment of specific Performance Management Potential of an individual.



Sport Science Gym

The sport science gym is set to revolutionize the health and fitness industry in South Africa by:

- Using advanced training technology
- Employing multi disciplinary professional staff members and applying a scientific paradigm.
- Lifestyle management and education
- Outcomes-based measurement and reporting on multi disciplinary intervention strategies
- Networking and initiating synergistic relations with other role players in the industry

Sport Science Gymnasium uses the most advanced equipment and technology currently available in the fitness industry using SmartTechnology®, which provides an outstanding way to manage exercise and training. This is integrated with other software programs to provide a comprehensive member management system.

The Smart Key® is a computerized key that is assigned to each member once they have been through a health and fitness assessment. The key stores all personal data and is used to log training sessions. For each training session it is inserted into the control panel of the TechnoGym®System equipment, where it directs and controls the workout intensity and records all the information from the session. The Wellness Expert® is an interactive touch screen computer console providing feed for members to view workout details for the day, test results, previous training results and performance indices, and to download the information saved from a completed workout onto the central database.

The training system used by Sport Science Gymnasium during lifestyle management is uniquely sophisticated in that:

- All cardiovascular training is heart rate controlled (even spinning and aerobics classes). Heart rate controlled training increases the individual effectiveness and safety of cardiovascular training. It enables one to exercise at an intensity that stimulates the optimal adaptation for specific goals without the risk of under or over training. It also provides a safe environment for members with high cardiac risk, or previous cardiac problems to exercise in a safe, monitored manner.
- Strength training controls range and speed of motion. Once again, the control facilitates optimal adaptation and avoidance of injuries. It also provides an environment for those members with special exercise needs to work safely.
- The individual "key" directs and controls each workout, and gives immediate feedback on exercise execution and records workout data. This biofeedback system ensures that the intensity of exercise and rate of progression is determined individually and internally. Internal control means the system is responding to the person holistically, which is essential as mental, emotional, and psychological factors all contribute toward physiological responsiveness.

Auditorium

The Auditorium will provide a high tech environment focussing on comfort with ergonomically designed chairs, and will be enhanced by state of the art audiovisual equipment. The auditorium will be available for hiring to groups and will also be able to screen movies and sporting footage at regular intervals for individuals and groups to enjoy.

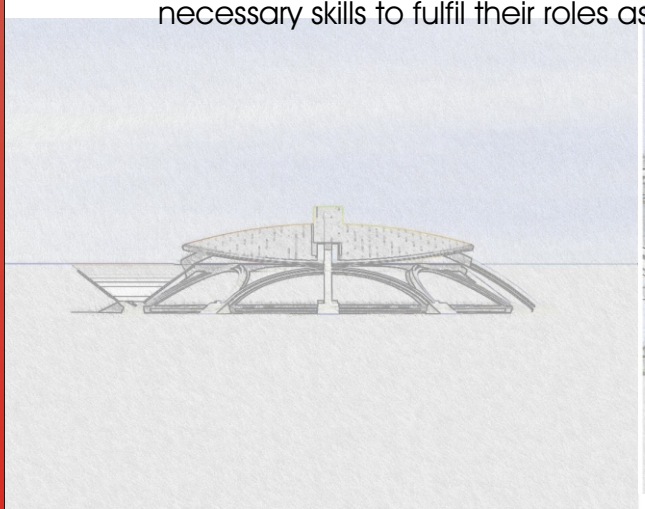
Learning Centre

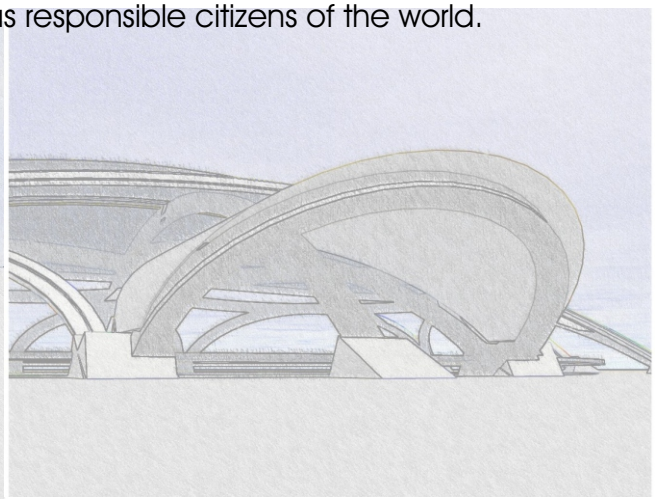
The learning centre's vision is to create a centre of academic distinction that compliments and echoes the vision of its sport partners.

The learning centre will offer a flexible and internationally recognised academic programme to high performance athletes of school going age. The learning centre will acknowledge and support the unique sporting needs of its learners, but will also place a high premium on academic excellence. It will embrace the Hi-Performance centre philosophy of holistic development, and will aim at developing well-rounded sporting individuals.

The learning centre will support learners in their goal to achieve academic distinction by offering:

- A curriculum of the highest academic standard that is recognised by Universities and Technikons, nationally and internationally
- Establishing and maintaining communication with various sports coaches to detail the academic and sport programmes of learners
- Designing tailor-made academic paths for students, taking cognisance of their sporting programmes
- Offering a structured learning environment in which learning is facilitated by supportive and highly qualified teachers and tutors
- Embracing technology by providing interactive computer assisted learning programmes that allow learners to keep up with their studies despite their demanding schedules.
- Allowing learning to take place at learners' own time and pace
- Implementing a system of continues assessment that will allow learners and teachers to monitor the academic progress of learners
- Implementing a comprehensive life skills programme to equip learners with necessary skills to fulfil their roles as responsible citizens of the world.





Accommodation Schedule			Area	Total area	Light intensity	Temperatures	Ventilation	Air changes
Phase 1								
Administrational area				**639 m²**				6
	Entrance			151 m²		18 °C	0.50 W/m³ °C	
	Reception			30 m²		18 °C	0.33 W/m³ °C	
	Administrational offices	4	22 m² per office	88 m²		20 °C	0.33 W/m³ °C	
	Strongroom			5 m²		18 °C	0.08 W/m³ °C	
	Securityoffice			12 m²		20 °C	0.33 W/m³ °C	
	Shop			341 m²		18 °C	0.17 W/m³ °C	
	Circulation			12 m²				
Gymnasium				**1707 m²**				10
	Control desk/Supplements			24.6 m²				
	4 Consultation rooms		16.3 m² per room	65 m²	500 lux	18-21 °C	0.17 W/m³ °C	
	Circuit training and Cardio equipment			420 m²	200 lux	16 °C	0.25 W/m³ °C	
	Weight training			361 m²	200 lux	16 °C	0.25 W/m³ °C	
	VIP Weight training			275 m²	200 lux	16 °C	0.25 W/m³ °C	
	Aerobics			245 m²	200 lux	16 °C	0.25 W/m³ °C	
	Toilets			87 m²	100 lux	24 °C	0.33 W/m³ °C	
	Male			83.8 m²				
	Showers	4						
	Toilets	2						
	Urinals	3						
	Washbasins	7						
	Handicap	1						
	Lockers	50						
	Steam bath	1	6 m²					
	Female			101m²				
	Showers	4						
	Toilets	5						
	Washbasins	7						
	Handicap	1						
	Lockers	50						
	Steam bath	1	8.7 m²					
	Circulation			45 m²				
Restaurant				**701 m²**				
	Restaurant		1.4 m² per seat	462 m²	200 lux	18 °C	0.33 W/m³ °C	
	Kitchen			101 m²	500 lux	18 °C	0.33 W/m³ °C	20-60
	Circulation			115 m²				
	Toilets			23 m²	100 lux	24 °C	0.33 W/m³ °C	10
	Male		11.5 m²					
	Toilets	1						
	Urinals	1						
	Washbasins	3						
	handicap	1						
	Female							
	Toilets	1	11.5 m²					
	Urinals	1						
	Washbasins	3						
	handicap	1						
Medical				**308.3 m²**				
	Reception/Office			20 m²	200 lux	20 °C	0.50 W/m³ °C	6
	Storeroom			3 m²		15 °C	0.08 W/m³ °C	
	Waiting room			27.8 m²		18 °C	0.67 W/m³ °C	
	5 Consultation rooms		22.6 m² per room	113 m²	500 lux	18-21 °C	0.17 W/m³ °C	
	Specialized equipment			76.2m²	200 lux	18 °C	0.25 W/m³ °C	
	Circulation			30.9 m²				
	Toilets			37.4 m²	100 lux	24 °C	0.33 W/m³ °C	10
	Male		17.9 m²					
	Toilets	2						
	Urinals	1						
	Washbasins	3						
	Changing	1						
	Pandicap	1						
	Female		19.5 m²					
	Toilets	3						
	Washbasins	3						
	changing	1						
	Handicap	1						
Auditorium		100 persons		**275.9 m²**	100 lux	18 °C	0.67 W/m³ °C	10
Swimming				**2055m²**				
	Swimming pool	8 lanes		1512 m²	200 lux	26 °C	0.17 W/m³ °C	
	Pavilieon for 1200 people			610 m²	200 lux	26 °C	0.17 W/m³ °C	
	Pump and services			95 m²				
	Office and administration			120 m²	200 lux	20 °C	0.5 W/m³ °C	
	Circulation			182 m²				
Squash				**219.6 m²**				
	Courts	2	63.8 m²	127.6 m²				
	Pavilion for 132 people			71 m²				
	Circulation			21 m²				
Indoor openspace				**5312 m²**				
	Ruining track 200m			3987 m²	200 lux	18 °C	0.25 W/m³ °C	
	Circulation			1325 m²				
TOTAL				**11 218 m²**				

Chapter 2

Baseline and technical documentation

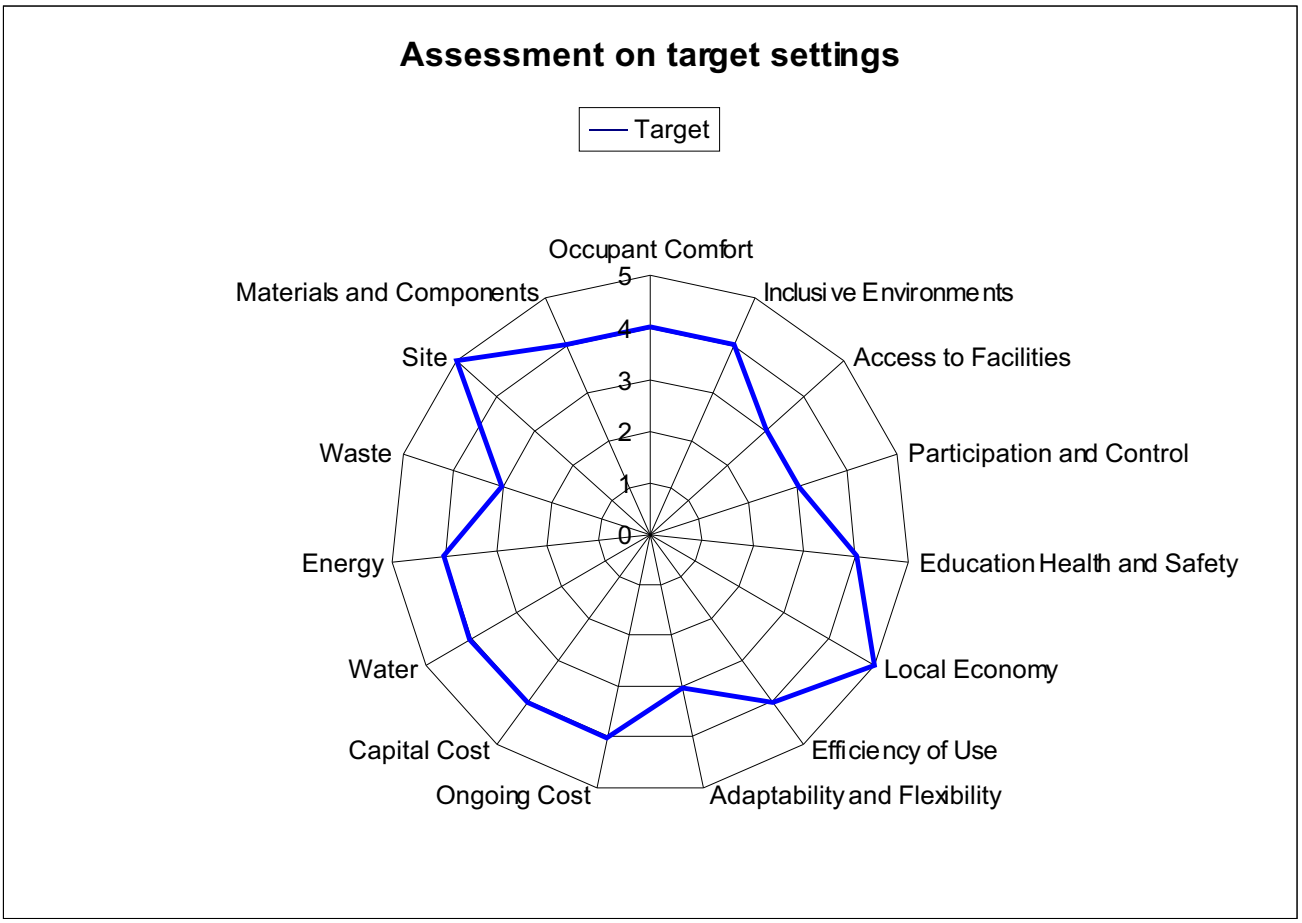
The Sustainable Building Assessment Tool

Introduction

Non-renewable resources are being depleted and there is increasing environmental damage as a result of human activities. It is therefore increasingly important that this is addressed, and sustainability should become a key issue in the way we live and work. Buildings can play an important role in supporting sustainability. This is done through careful planning in which design decisions, such as material specifications are carefully evaluated in terms of their long term impact on the economic, social and environmental sustainability of a society and the natural environment.

The Sustainable Building Assessment Tool (SBAT) has been designed to help evaluate the sustainability of buildings. This is done by assessing the performance of a building in relation to a number of social, economic and environmental criteria. The tool has been designed to be particularly appropriate for use in developing countries and therefore includes aspects such as the impact of the building on the local economy, as economic issues are often a priority.

The Sustainable Building Assessment Tool (SBAT) will be used to set up targets regarding the social, economic and environmental performance of the HPC. This is done in order to encourage the development of more sustainable buildings by enabling different options to be rapidly evaluated.



Target settings graphic for the HPC Fig.62

2.2.1 Occupant Comfort

The quality of environments in and around buildings have been shown to have a direct impact on health, happiness and productivity of people. Healthier, happier, more effective people contribute to sustainability by being more efficient and therefore reducing resource consumption and waste. However, the quality of this environment needs to be achieved with minimal cost to the environment.

- Lighting

Natural light when brought into a building in a non offensive way - not too bright, glaring or too hot - contributes to the comfort within the building. The selection of light bulbs for artificial lighting should therefore attempt to combine comfort and energy efficiency. Energy efficient lighting usually means the conversion to fluorescent bulbs, either tubes and/or compacts

Target (3)

According to the accommodation schedule different light is required for different purposes. The more detailed and exacting the work that is to be carried out in a working environment such as the offices, kitchens and medical centre, the higher the level of illumination on the working plane needs to be. The building must be designed and oriented in such away that maximum sunlight efficiency can be achieved and less electrical light is used.

Assessment (5)

Windows on the northern side receive up to two to three times the amount of light compared to southern facing windows, even when ignoring direct radiation.

The central concern associated with day lighting is the heat gain that can result when natural light is brought into the building. To accomplish this:

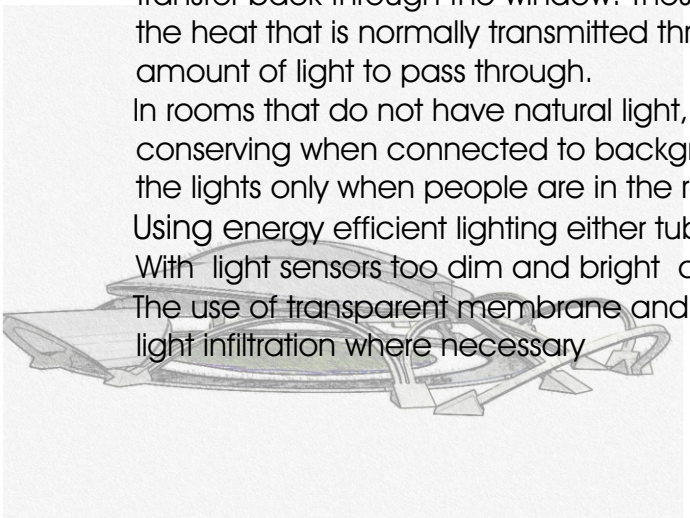
Automated louver's system that adjusts according to sun movement to prevent direct light in summer and light infiltration in the winter

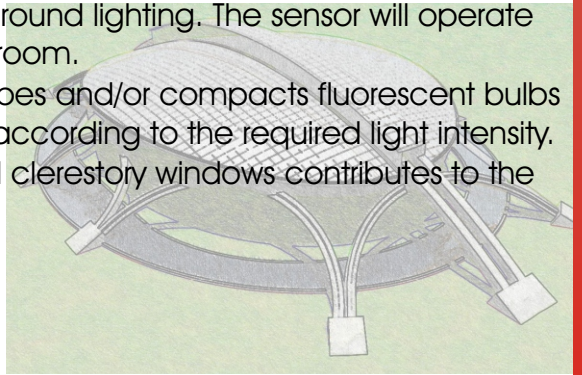
Low-emissivity (low-e) glass has a special surface coating to reduce heat transfer back through the window. These coatings reflect from 40% to 70% of the heat that is normally transmitted through clear glass, while allowing the full amount of light to pass through.

In rooms that do not have natural light, an occupancy sensor can prove highly conserving when connected to background lighting. The sensor will operate the lights only when people are in the room.

Using energy efficient lighting either tubes and/or compacts fluorescent bulbs With light sensors too dim and bright according to the required light intensity.

The use of transparent membrane and clerestory windows contributes to the light infiltration where necessary





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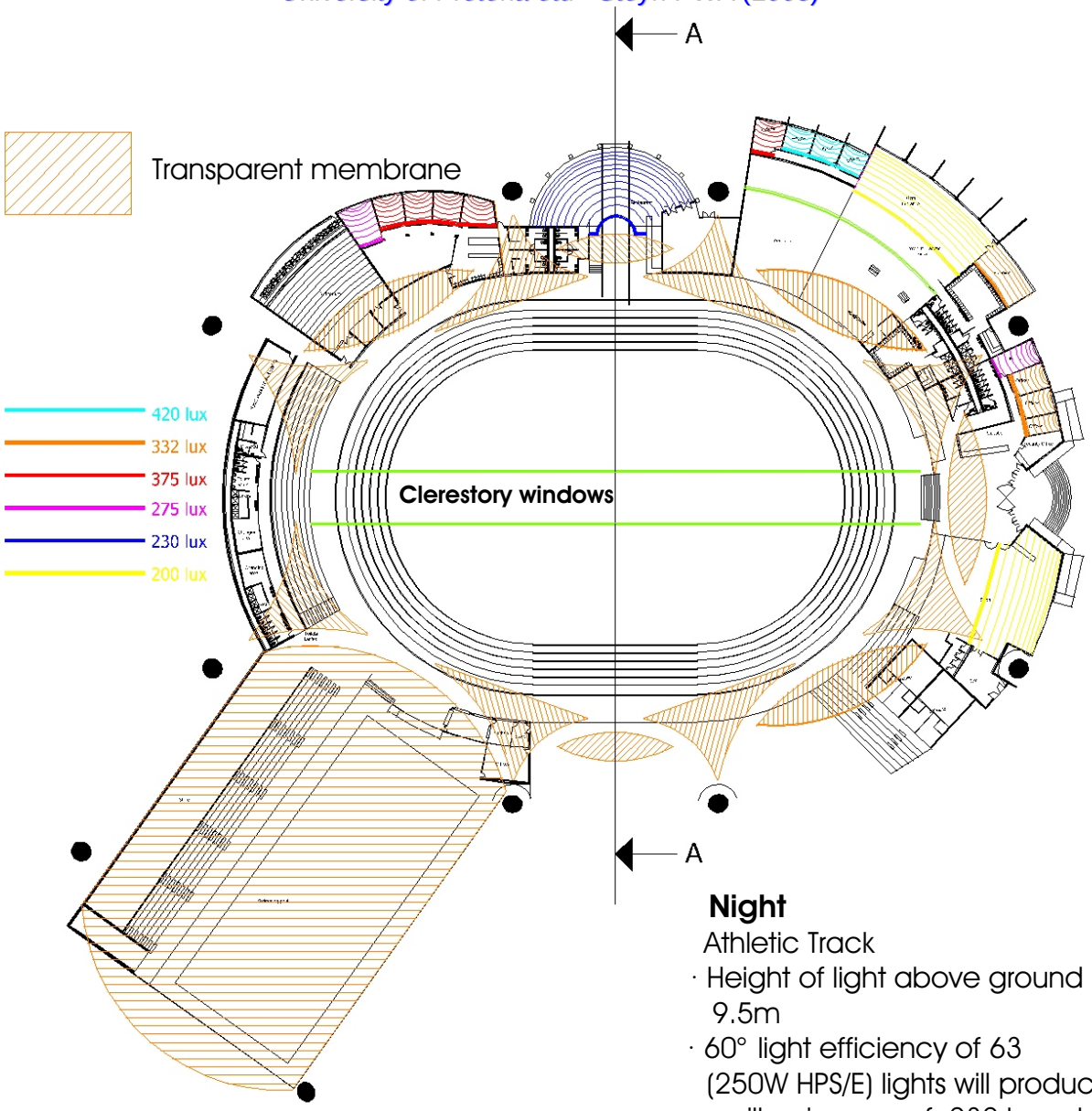


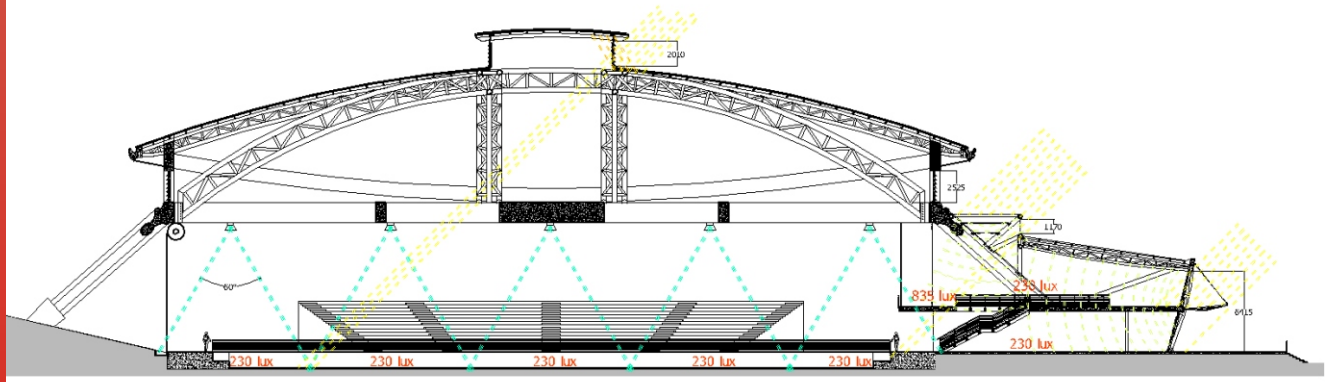
Daylight factor contours Fig.63

Night

Athletic Track

- Height of light above ground is 9.5m
- 60° light efficiency of 63 (250W HPS/E) lights will produce an illuminance of 232 lux, which is more than the required 200lux.

The light illuminance requirement for the indoor open space is 200lux. . In summer time the northern and southern windows allow 171lux light illuminance. The clerestory windows allow another 82lux light illuminance that adds up to a total of 253lux in the indoor area.



Section A-A indicates light infiltration Fig.64

- Ventilation

Ventilation is used to exchange the air inside a room with fresh air from outside. This ensures:

Sufficient oxygen supply
Removal of carbon dioxide, smells, unwanted moister and unwanted heat

Required ventilation is provided naturally and by mechanical ventilation where natural ventilation is insufficient.

Target (5)

In the HPC the target is to ventilate all the areas in the building to the required recommendation with the maximum use of natural ventilation and passive control. Some of the most important ventilated areas will be discussed.

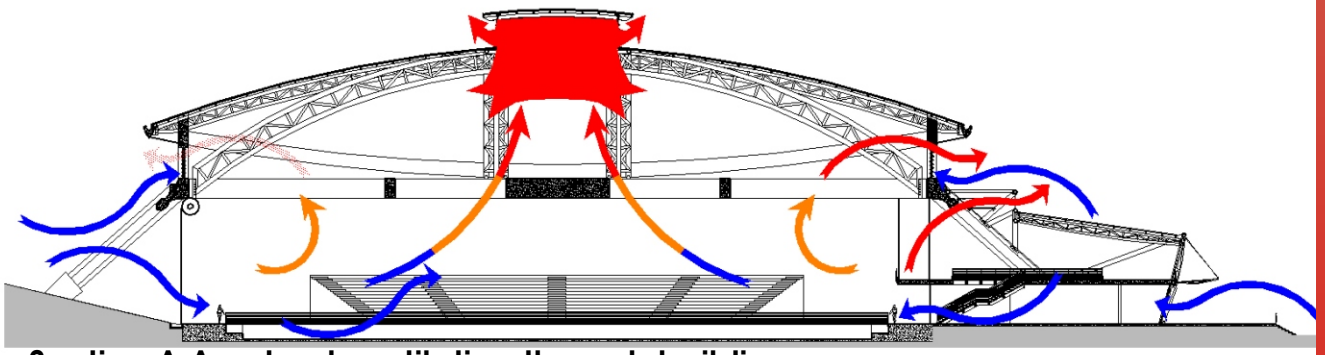
In the indoor open space with 3000 seated spectators and 80 performing athletes an air change rate of 3,9 air changes per hour is needed to ensure their occupant comfort.
The gymnasium with 150 people training an air change rate of 9.2 air changes per hour.
In the inclosed spinning area with 25 cyclists an air change rate of 30.4 air changes per hour are required.
In the aerobics hall with 40 active occupants an air change rate of 13.2 air changes per hour are required.

Assessment (5)

Methods of ventilation

Wind forces
Thermal forces (are primarily due to the result of the stack effect)
Mechanical ventilation

Openings placed perpendicular to the direction of prevailing wind, which remains effective up to 60 deg deviation. With the design of clerestory windows it will allow a stack effect that will cause an air movement which then will draw fresh air in from the outside.



Section A-A natural ventilation through building Fig.65

Indoor open space:

The 3080 occupants produce 697kW of heat that contributes to the thermal force.
To achieve an air change rate of 3.9 air changes per hour and a comfortable air flow of 0.2m/s a window opening of 275m² and ventilation tempos of 9,09m³/s that is comfortable.
At night time the heat radiation of the lighting adds up to a total of 15,7 kW that will require an air changes rate of 0.08 air changes per hour and a window opening of 7,3m²
The window opening in the indoor open space area is 1128m²

Gymnasium

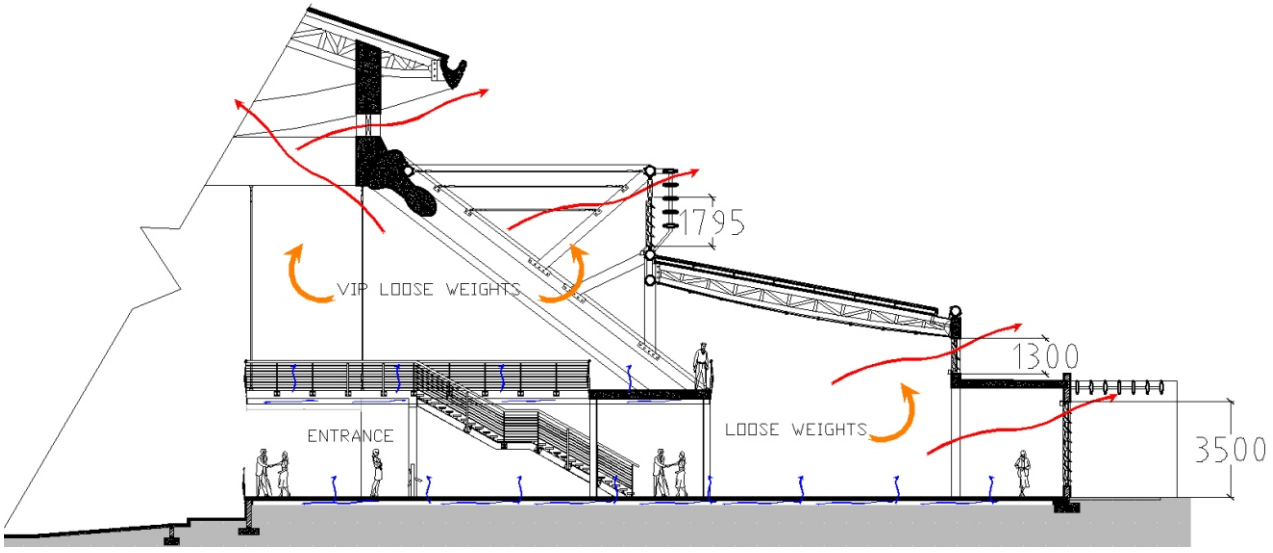
The 150 occupants produce 66kW of heat that contributes to the thermal force.
To achieve an air change rate of 7.8 air changes per hour a window opening of 30.1m² is required that will produce an airflow of 0.2m/s that is comfortable.
The window opening in the gym is 46m²

Spinning

The 35 occupants produce 15.4kW of heat that contributes to the thermal force.
To achieve an air change rate of 31 air changes per hour a window opening of 7.3m² is required that will produce an airflow of 0.2m/s that is comfortable.
The window opening in the spinning area is 18m²

Aerobics

The 45 occupants produce 19,8kW of heat that contributes to the thermal force.
To achieve an air change rate of 7,5 air changes per hour a window opening of 9,4 m² is required that will produce an airflow of 0.2m/s that is comfortable.
The window opening in the aerobics area is 17.8m²



Section thought gym with air conducts underneath the floor Fig.66

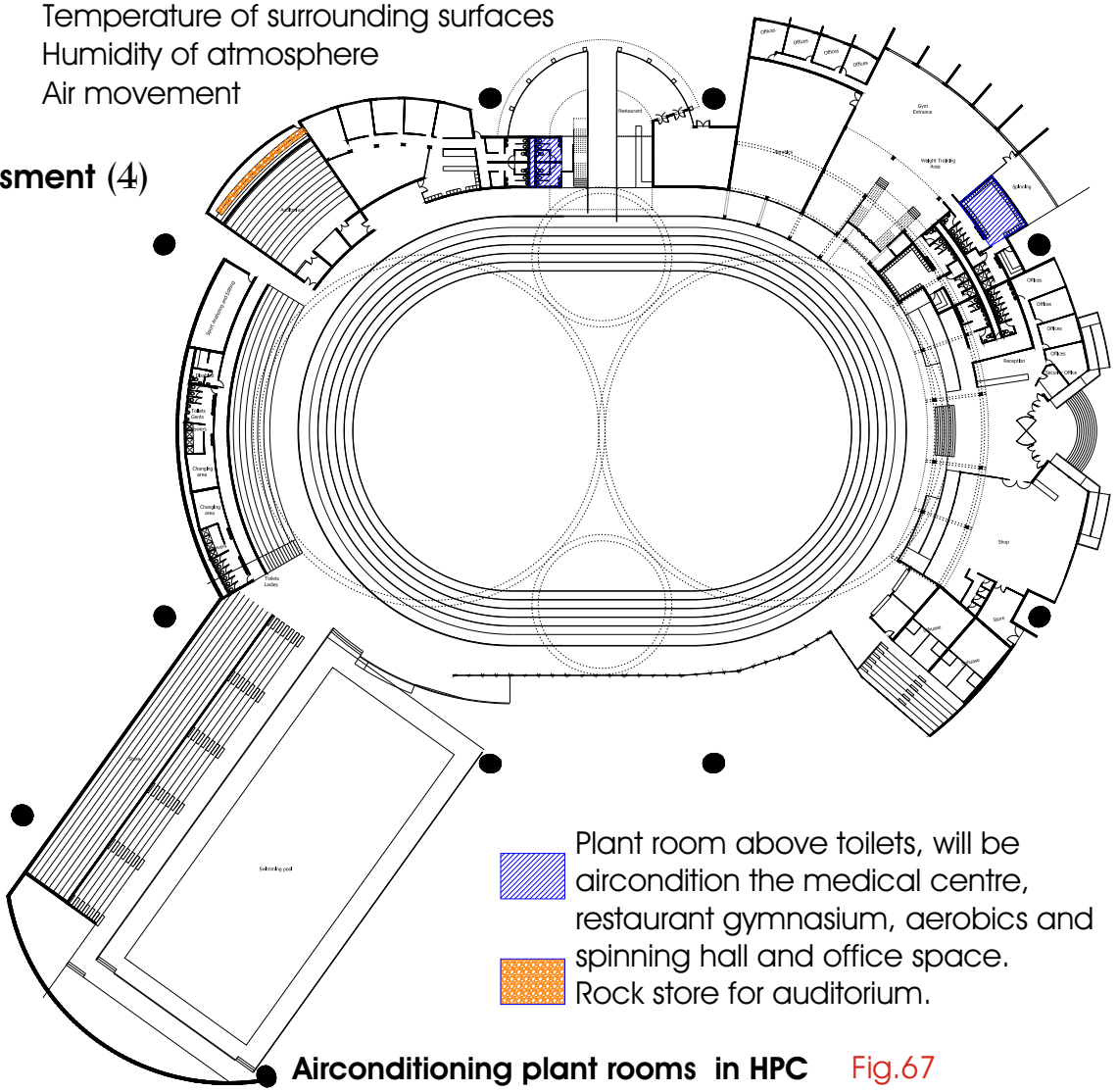
- Thermal comfort

Target (4)

A pleasant thermal environment will result within a building once the following factors are within acceptable limits:

Air temperature
Temperature of surrounding surfaces
Humidity of atmosphere
Air movement

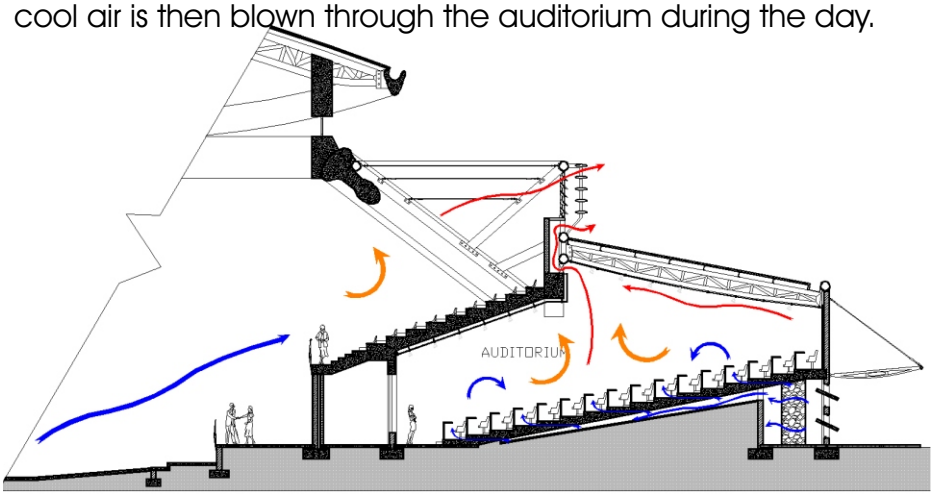
Assessment (4)



Plant room above toilets, will be aircondition the medical centre, restaurant gymnasium, aerobics and spinning hall and office space.
Rock store for auditorium.

Airconditioning plant rooms in HPC Fig.67

The rock store underneath the auditorium stores the cool night air during the night. The cool air is then blown through the auditorium during the day.



Rock storage underneath the auditorium Fig.68

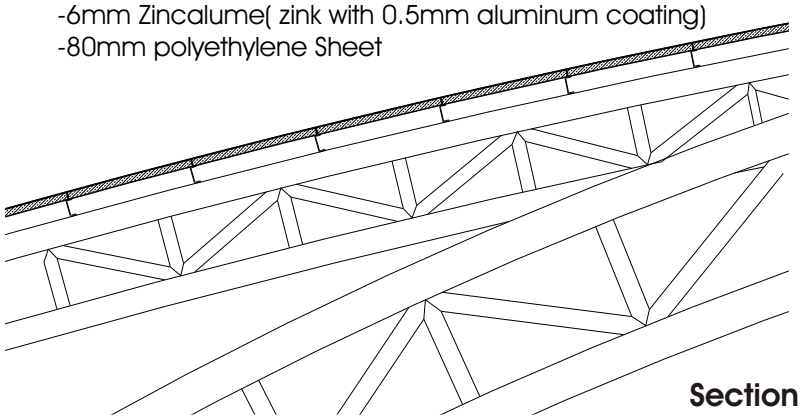
The indoor open space will be precooled during the night time when cool air infiltrates the building through the 1128m² window openings.

Thermal conductivity of materials

To keep the heat of the building inside in the winter and outside in the summer the thermal mass of building envelope plays an important role.

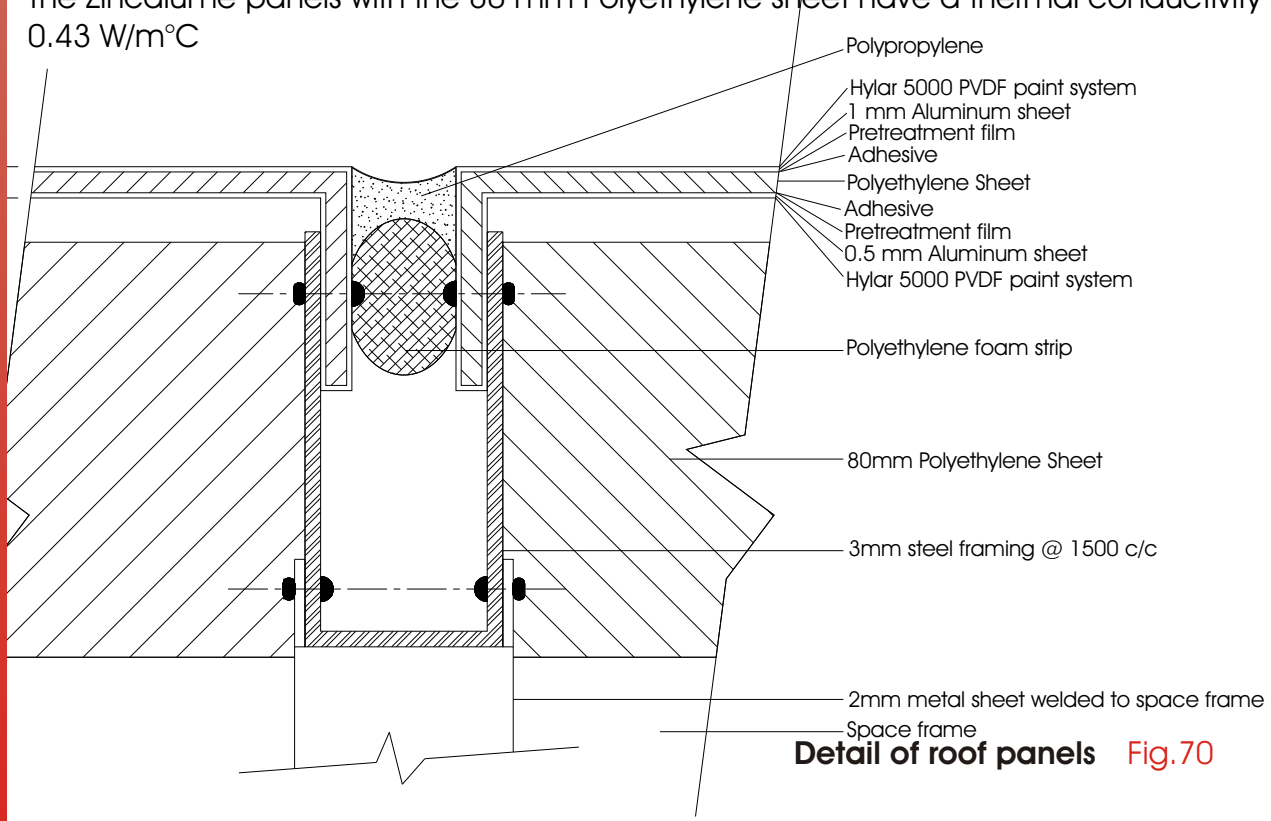
Material	Bulk density kg/m³	Thermal conductivity W/m²K	Thermal resistance W/m²K	
Brickwork 240mm	1700	2.08	0.48	
Glass(Le-glazing)6mm	2520	1.9	0.52	
Zincalume 6mm	2700	5.6	0.17	25 % Reflection
Concrete 240mm	2260	2.9	0.34	
Aerated concrete 240mm	700	1.25	0.8	
Transparent membrane 4.8 mm	840g/m²	2K/W m²		
Polyethylene 80 mm	25	0.38	2.6	

-6mm Zincalume(zink with 0.5mm aluminum coating)
-80mm polyethylene Sheet



Section through roof Fig.69

The Zincalume panels with the 80 mm Polyethylene sheet have a thermal conductivity of 0.43 W/m°C



Detail of roof panels Fig.70

- Noise

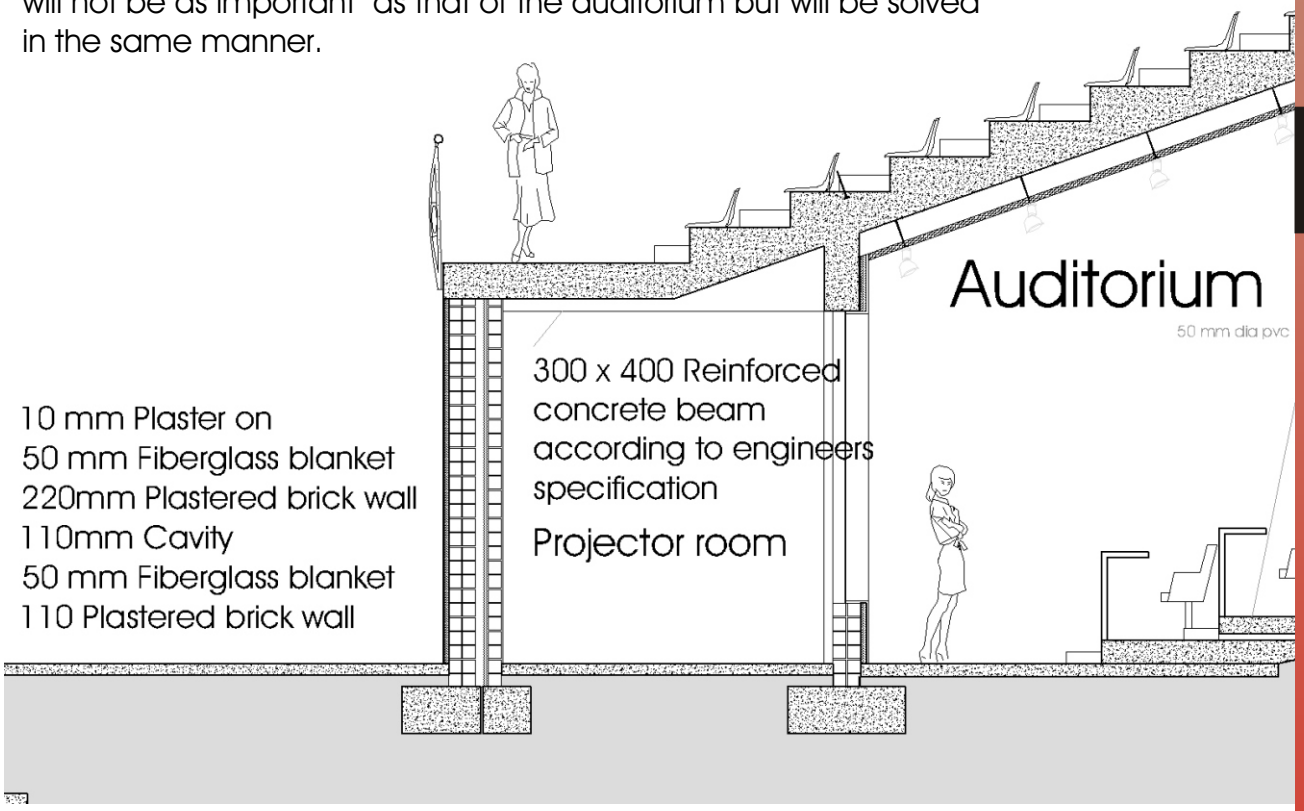
Noise levels are limited in work and living environments to acceptable levels.

Target (3)

The only noise problem that may occur is the noise caused by the indoor open area that may have an influence on the nearby auditorium and the medical centre. These two spaces must be isolated so that the noise levels don't disturb these spaces with their activities. The reverberation time for the auditorium should not exceed 1,2 s at 500Hz.

Assessment (4)

To achieve optimal sound insulation in the auditorium it must consist of a fibreglass blanket and a cavity wall filled with another layer of fibreglass blankets. The cavity wall thickness must differ to overcome the ground frequency that walls of the same thickness have. Two doors in tandem with a min space of 2m between the two doors will also contribute to the sound insulation of the auditorium. The insulation of the medical area will not be as important as that of the auditorium but will be solved in the same manner.



Section through auditorium wall with sound insolation Fig.71

The outer skin of the auditorium is isolated well as seen in Fig 71. The interior wall finish of the auditorium is 25mm Mahogany strips with 20mm spacings mounted on open-cell polyurethane foam with an air-gap between the panel and the wall to absorb the sound and minimize sound reverberation. The ceiling tiles contribute to the sound absorption.

SOCIAL

- Views

All living and work areas have access to a view. Humans all have an internal clock that is synchronized to the cycle of day and night. From a psychological standpoint, windows and skylights are essential means of keeping the body clock working properly.

Target (3)

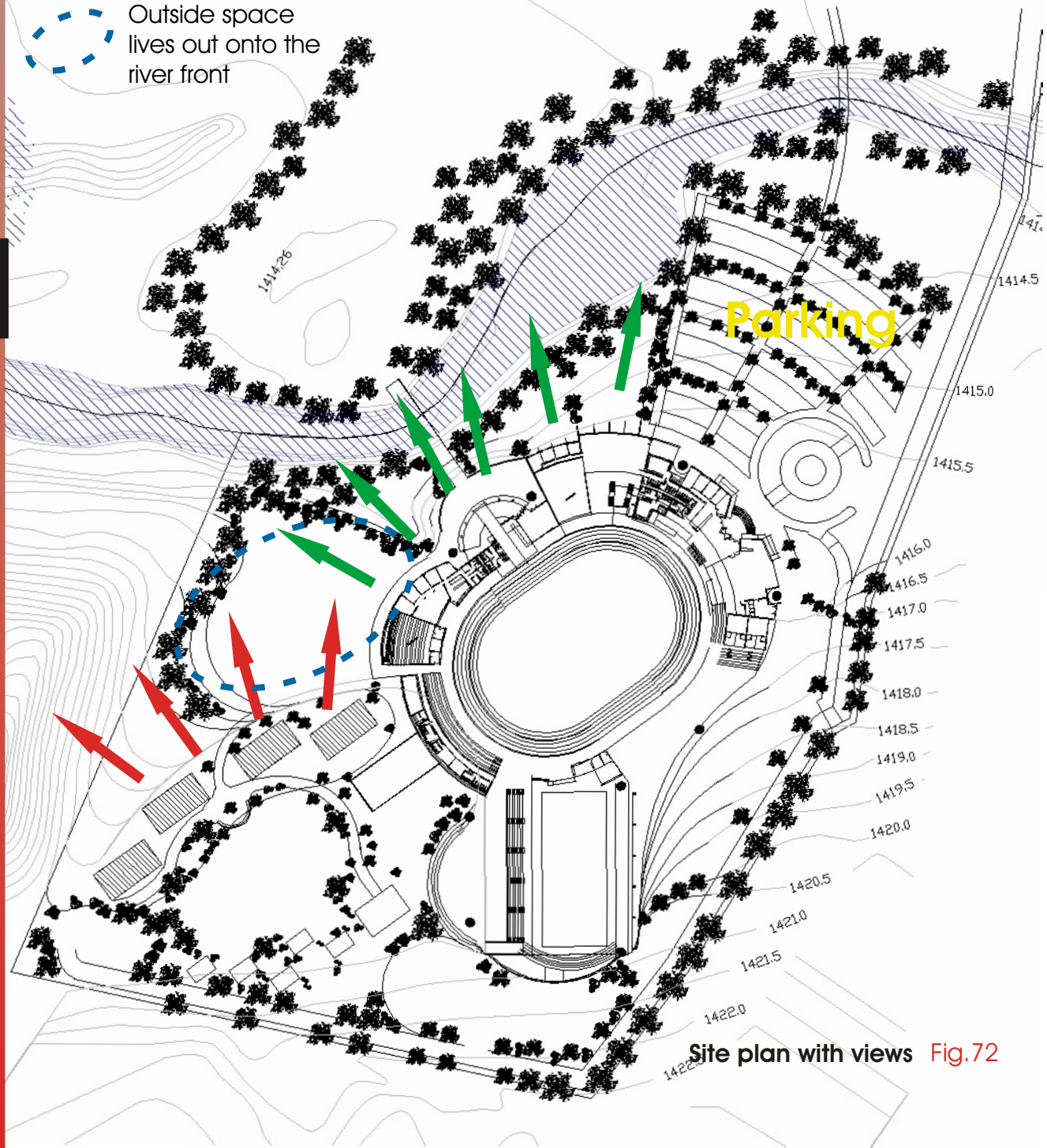
All people that work in the HPC will not be further than 6m away from connection with the outside. 40% of the building opens up to the Hennops River.

Assessment (5)

Medical centre, restaurant, and gymnasium view on to river front

View of hostels onto river front

Outside space lives out onto the river front



Site plan with views Fig.72

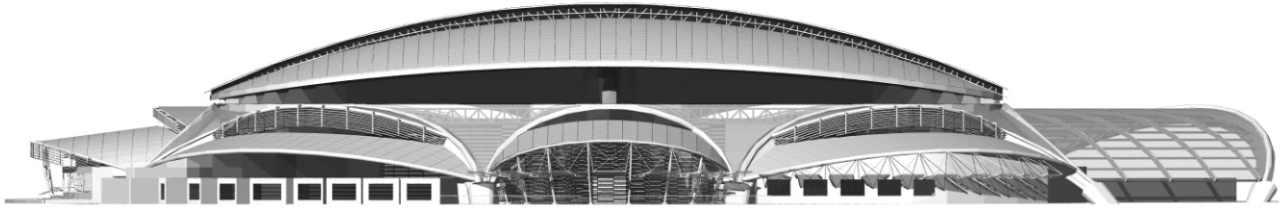
Fig.73

Fig.74

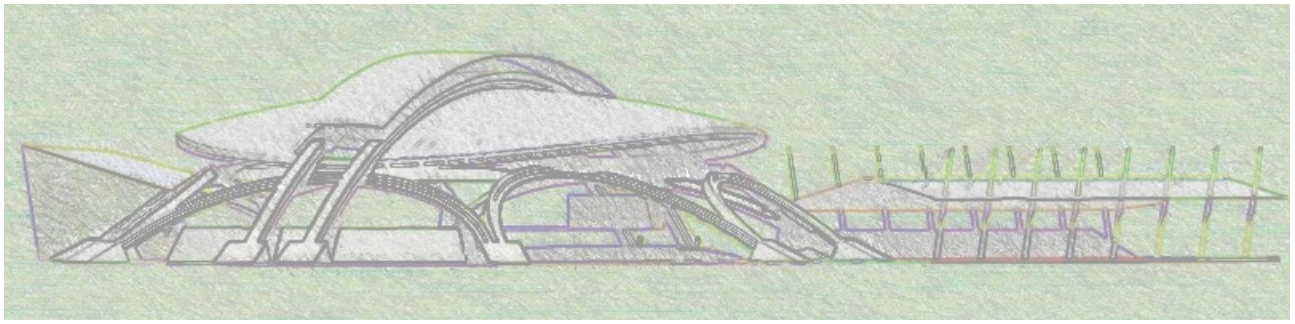
Photos of river front Fig.75

Fig.76

Fig.72-75 shows some of the views onto the riverside of the Hennops River. More than 45% of building lives out to the Hennops River, 30% live out to Southstreet which is the main street passing the site. All the offices and consultation rooms have an outside view and are not deeper than 6m.



Northern facade facing Hennops river. Fig.77



2.2.2 Inclusive Environments

Buildings can be designed to accommodate everyone, or specially designed buildings need to be provided. Ensuring that buildings are inclusive supports sustainability as replication is avoided and change of use supported.

- Transport

Sustainable architecture on an urban scale must be designed to promote public transportation. Thousands of individual vehicles moving in and out of area with the daily commuting creates congested smog, congested traffic, and require parking.

Target (4)

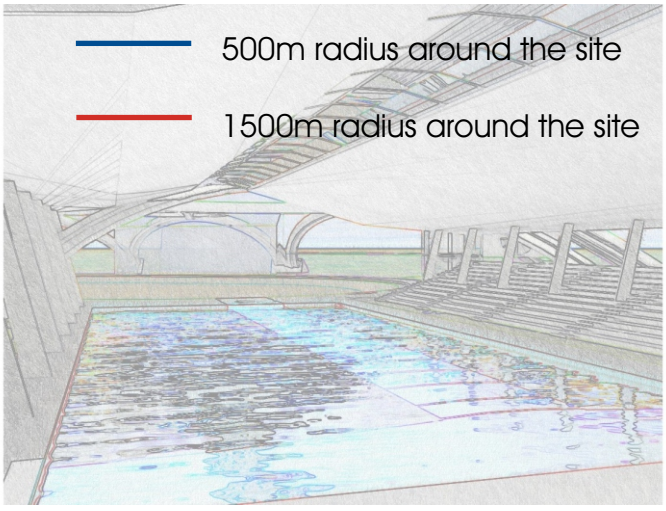
The building must be located in a radius of 500m from public transport. The design must be pedestrian friendly and be easily accessible for bicycles.

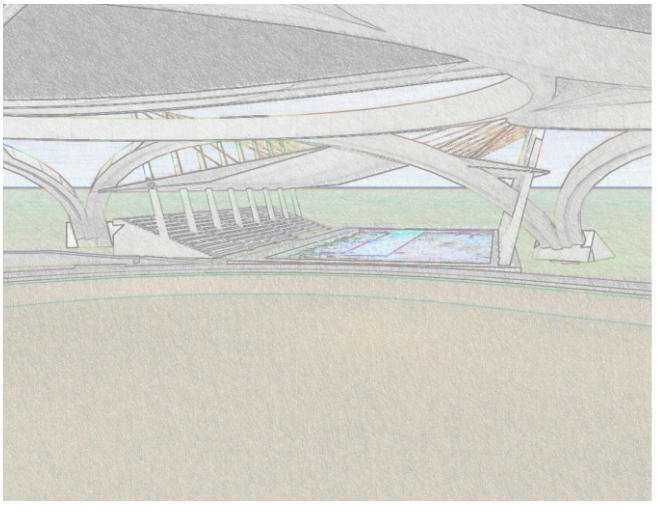
Assessment (5)

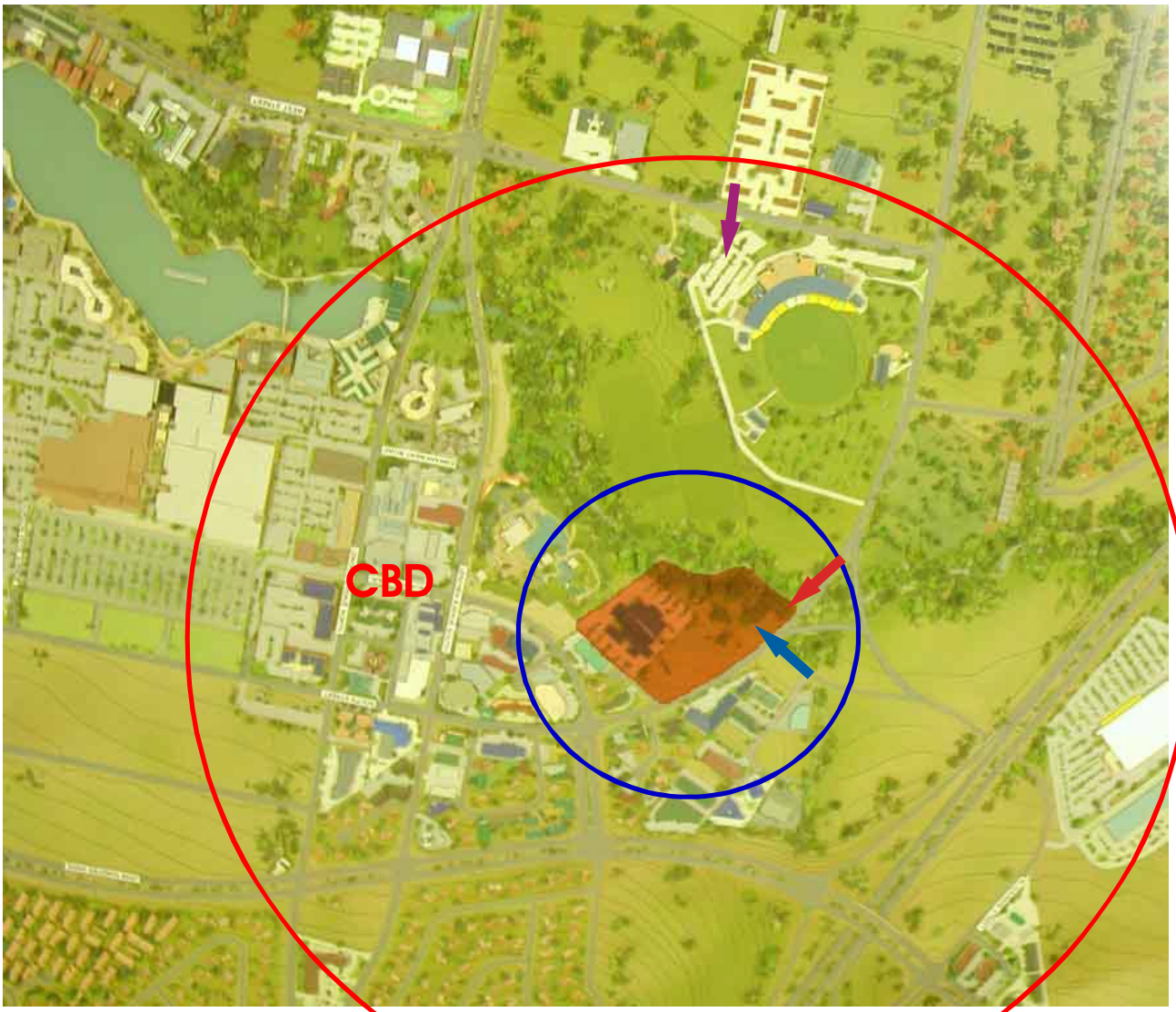
A bus terminal is allocated 700m from the site in John Voster Drive (see fig Fig.56). There is also a taxi drop-off point at the Pannevis and Southstreet T-junction. The HPC will also have a shuttle service from the HPC to desired destinations for the visitors. This shuttle service can also be used for the transportation of disabled workers from the transportation node to the HPC. The Gautrain Station is preposed to be situated on the northwestern side of SuperSport Park.

Access to the site is from:

- South Street and Pannevis T-junction,allocated for pedestrian access for people using public transport or bicycles
- Main entrance to site: South Street
- Primary entrance to developing sports hub: West Avenue







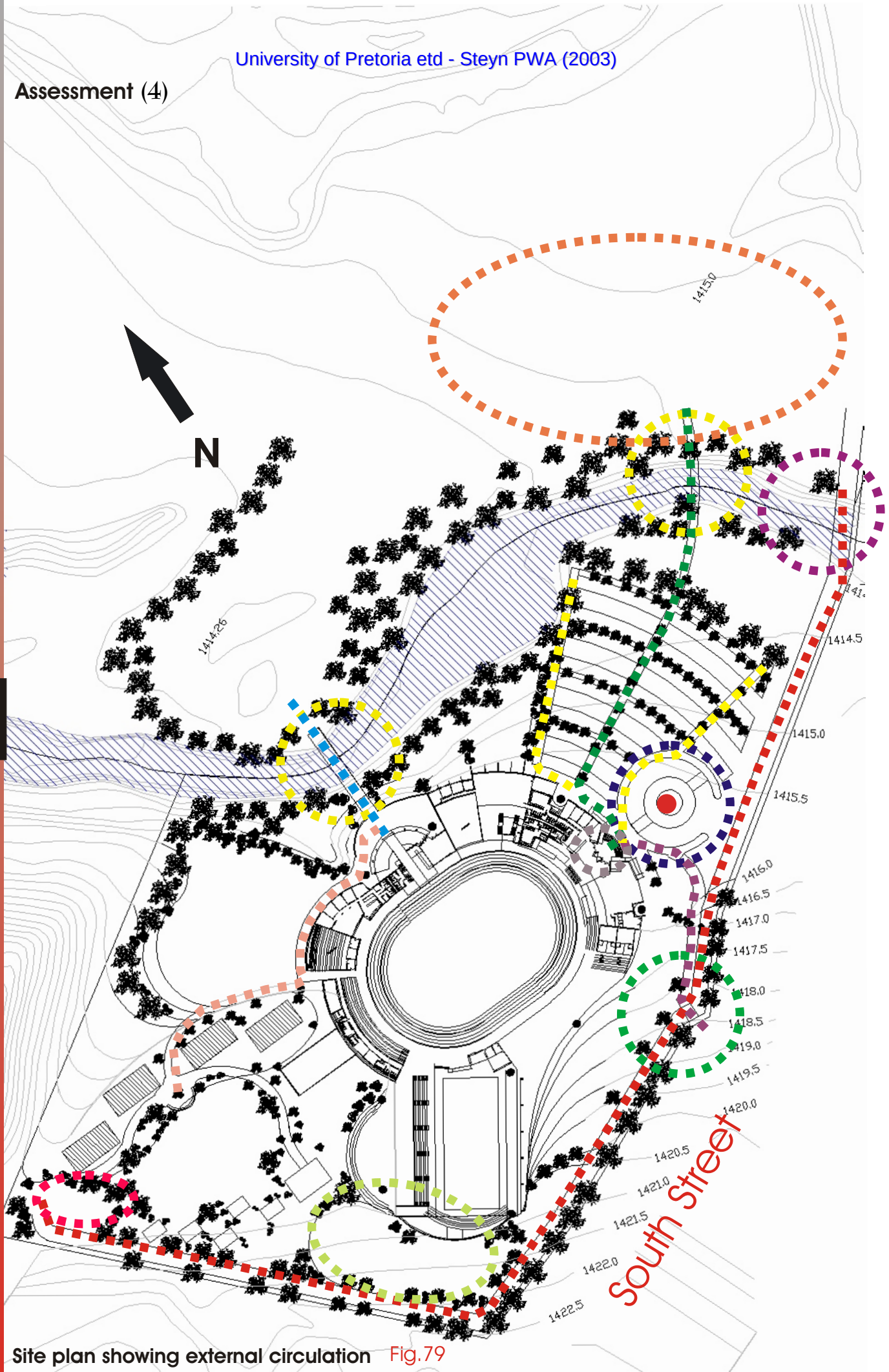
Site map with distance and access indicators. Fig.78

- Entrance and external circulation

Target (4)

An entrance of the building must be designed in such away that it is visible from the street and connects with the parking. Adequate ramps and access for disabled is of critical importance.

The distance between the disabled parking and the building should not exceed 20m. Adequate parking must be provided for bigger events like a swimming gala, athletic meetings and concerts. Spaces provided within the site for school buses to drop-off and pick up must be provided. Services parkings for restaurants, shop and garbage disposal must be provided. Pedestrian footways with occasions of interest along them must be provided between sports hub, parking and HPC combined with a cycle track. Secure bicycle sheds must be provided near the building for cyclists.



Site plan showing external circulation Fig.79

Main entrance for vehicles, busses, shuttles service, delivery. The HPC entrance is visible when the site is entered.

Proposed parking for further development of the sports hub. This parking is in the centre of the sports hub and will be used by the HPC when bigger events(athletics, swimming gala, concerts) are taking place in the HPC. (Parking for ± 1600)

These two pedestrian bridges link the HPC to the sports hub. These bridges are 4m wide and will be used for pedestrians, the wheelchair users and cyclist.

A pedestrian and cyclist entrance at the Pannevis and South Street T-junction where a taxi drop-off point is allocated.

Parking bay for school. This parking bay will be used for pickup and drop-off of school children. Parking is also available for swimming galas. (Parking for ± 72)

Parking bay for hostels. This parking bay will be used for pickup and drop-off of school children and athletes. (Parking for ± 15)

Main road entering HPC from sports hub.

Secondary entrance for HPC from sports hub and hostels.

3m wide walkways from parking bay to HPC. Parking for 170 cars is provided, five fo disabled. Disabled parking within 20m of HPC.

Turning circle for busses and shuttle service for pickup and drop-off of athletes.

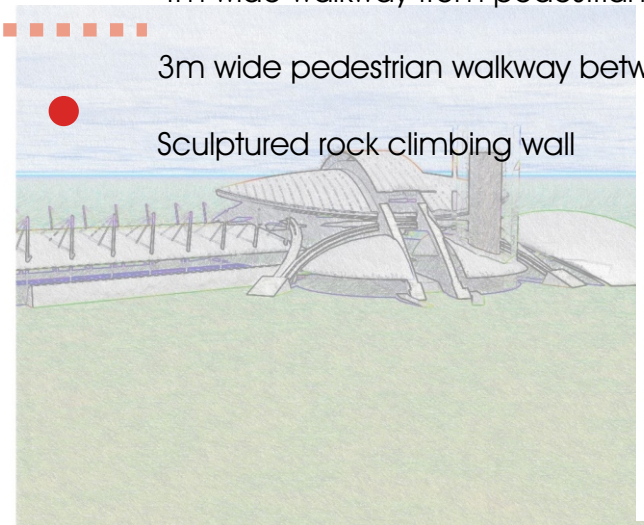
4m wide walkway from sports hub to HPC. Adequate benches and trees are provided along all pedestrian walkways.

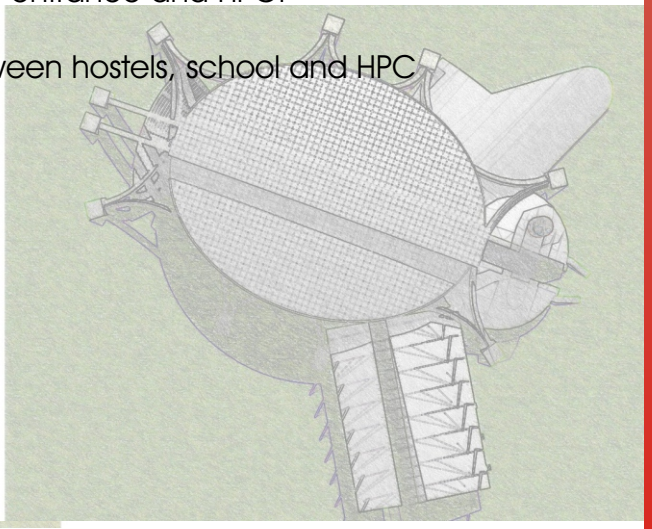
The main entrance to HPC which is visible from South Street and parking bay. The entrance is provided by adequate ramps for disabled.

4m wide walkway from pedestrian entrance and HPC.

3m wide pedestrian walkway between hostels, school and HPC

Sculptured rock climbing wall





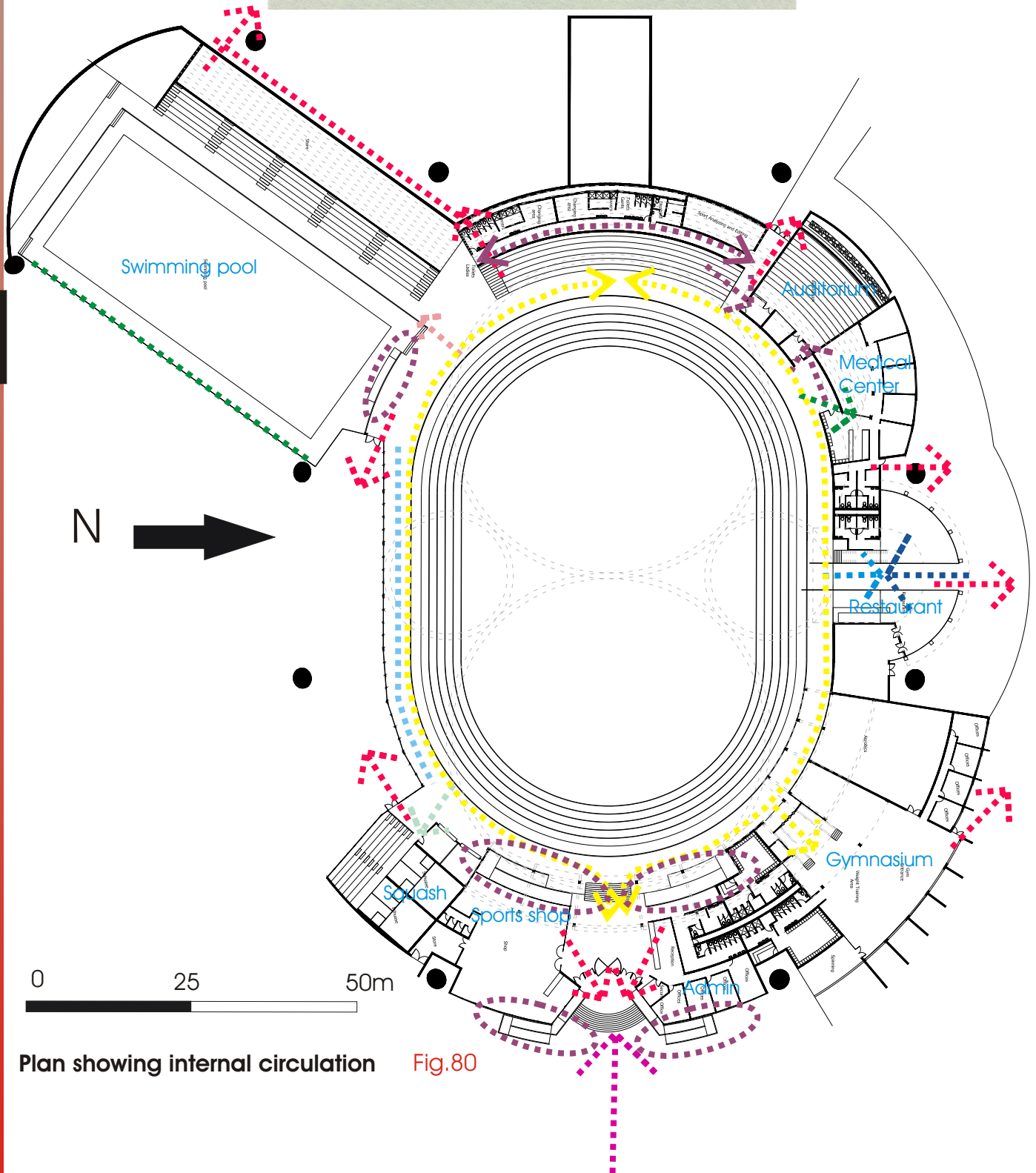
- Internal Circulation

Many aspects of internal circulation are dependent on regulations and controls arising from the fire safety considerations.

Target (3)

The HPC must comply with the SABC section TT16 fire regulations that require that any occupant must be in a radius of 45m to the nearest emergency exit. Internal circulation must be easy to understand and adequate ramps must be provided for the disabled.

Assessment (4)



Plan showing internal circulation Fig.80

The main entrance of the HPC is on the eastern side connecting the parking with HPC. This entrance will mainly be used by visitors to the HPC.

This is the main internal walkway surrounding the indoor open space. All of the facilities connect to this 4.25m wide walkway.

The gymnasium has one main entrance from where different activities take place. The aerobics, spinning, toilets, loose weights and offices are situated on ground floor. The VIP area is separated from the circuit and cardiovascular training area on the first floor with separate staircases.

The restaurant has two entrances, one from outside and the other from the main walkway. The kitchen, toilets and seating are on the ground floor that opens up to the outside. One stair case leads to the first floor.

The medical centre has one entrance from the main walkway with its own toilets and change room.

The auditorium has two portal entrances on both sides for sound isolation.

The path underneath the pavilion is for access to the toilets and changing rooms.

The swimming pool connects to the main walkway and opens up to the western and eastern side. The swimming pool is 500mm lower than the walkway with adequate stairs and ramp.

The squash courts have one entrance from the main walkway.

Emergency exit complying with the SABC section TT16 fire regulations. Any occupant anywhere in the building will be in less than 45m to the nearest exit.

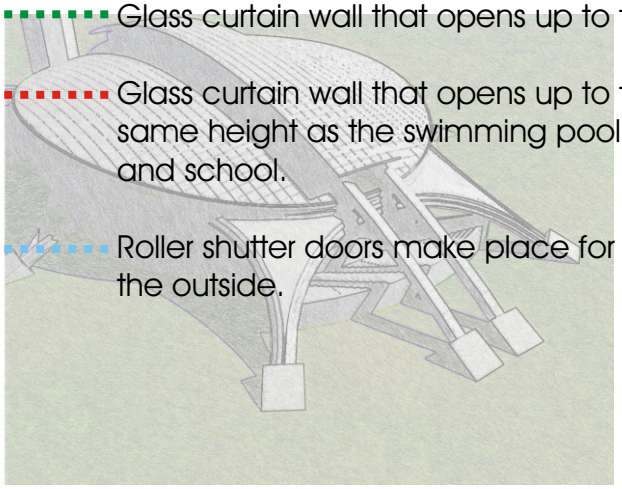
Secondary entrance from the sports hub and hostels. This entrance will mainly be used by sportsmen who stay in the hostels.

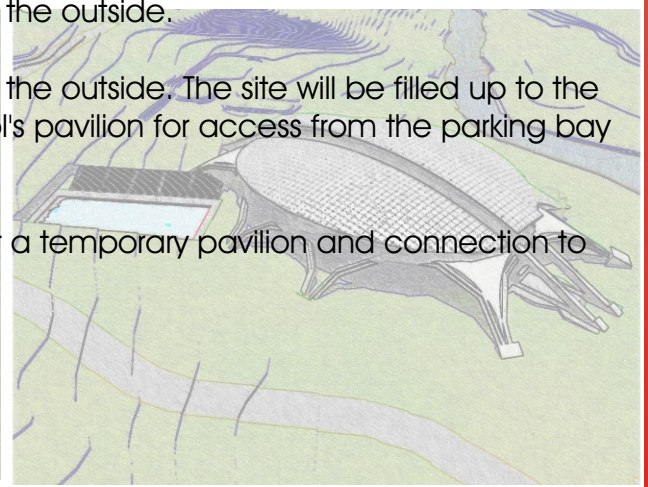
1:12 ramps for disabled to comply with SABS section SS2

Glass curtain wall that opens up to the outside.

Glass curtain wall that opens up to the outside. The site will be filled up to the same height as the swimming pool's pavilion for access from the parking bay and school.

Roller shutter doors make place for a temporary pavilion and connection to the outside.





- Furniture & Fittings

One aspect of sustainable design is longevity. Buildings that are durable and adaptable are more sustainable than those that are not. This adaptability includes accommodating people of different ages and physical conditions. The more people that can use a building, the longer the building's useful life.

Target (4)

All ramps, stairs, bathroom furniture and fittings must be designed to accommodate the disabled and elderly.

Assessment (5)

All ramps comply with SABS section SS2 for disabled people. Doorways comply with SABS section SS4 for doorways for disabled. All the toilets comply with SABS section SS5 for the disabled. The HPC has a disabled toilet for ladies and gentlemen within each toilet area. The auditorium complies with SABS section SS8 for auditoriums and SABS section SS8 for parking. All staircases are designed to accommodate elderly people with steps with 150mm rise and 300mm tread with adequate hand railings that comply with SABS section MM2 and MM3. The HPC is designed to accommodate all age groups and people with disabilities.

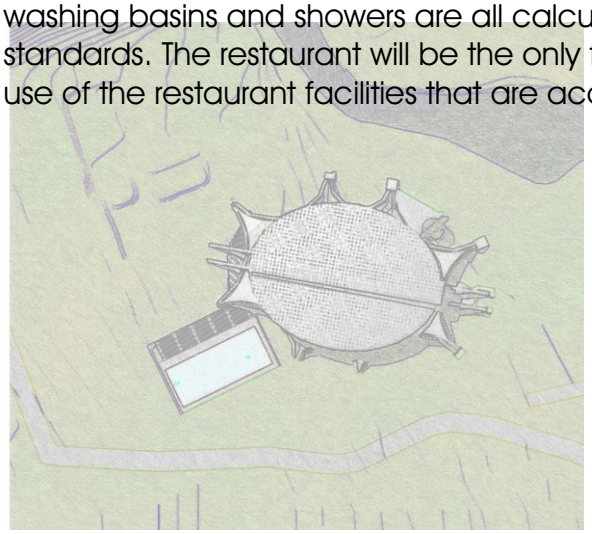
- Toilets and kitchens

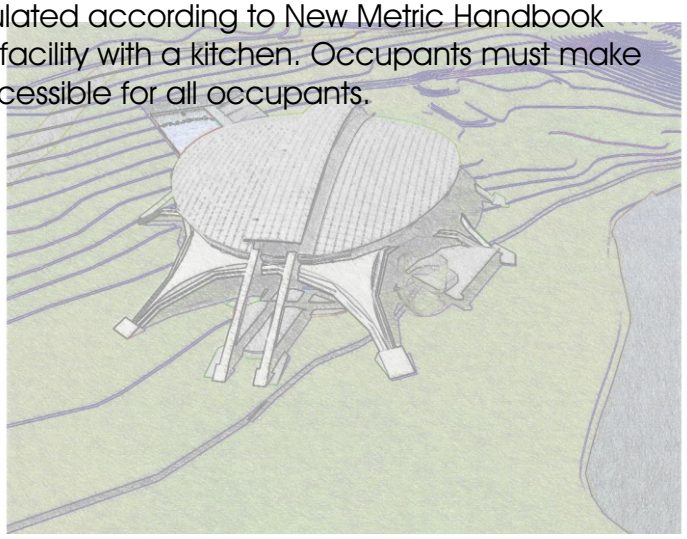
Target (4)

All occupants must have equal and adequate access to toilets and kitchen facilities in the HPC.

Assessment (4)

The entrance & reception, gymnasium, restaurant, medical centre and swimming pool are all provided with adequate toilet facilities within their respective area. The auditorium will make use of swimming pool toilet facilities. The amount of toilets, disabled toilets, washing basins and showers are all calculated according to New Metric Handbook standards. The restaurant will be the only facility with a kitchen. Occupants must make use of the restaurant facilities that are accessible for all occupants.





2.2.3 Access to Facilities

Conventional living and working patterns require regular access to a range of services. Ensuring that these services can be easily accessed in environmentally friendly ways supports sustainability by increasing efficiency and reducing environmental impact.

- Childcare

Target (2)

Childcare must be provided in the building or within 3km.

Assessment (4)

Knikkie Knakkie Nursery School & Day care centre is within a radius of 3 Km from the HPC.

- Banking and Retail

Target (3)

Banking services (i.e. ATM.) and grocery, items required on a daily basis provided in building or close by (within 3km)

Assessment (4)

The HPC will have two ATM's in the main entrance which is accessible to the public. The HPC is provided with a sports shop for state of the art sports accessories. The CBD is also within a radius of 1.5 km where a variety of banks and retail services are situated.

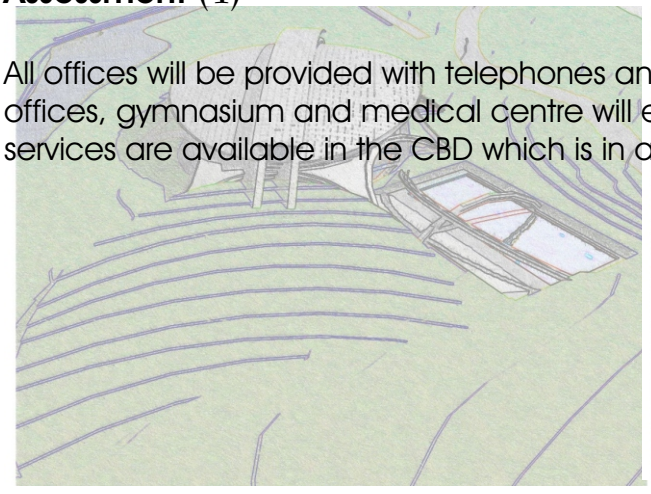
- Communication

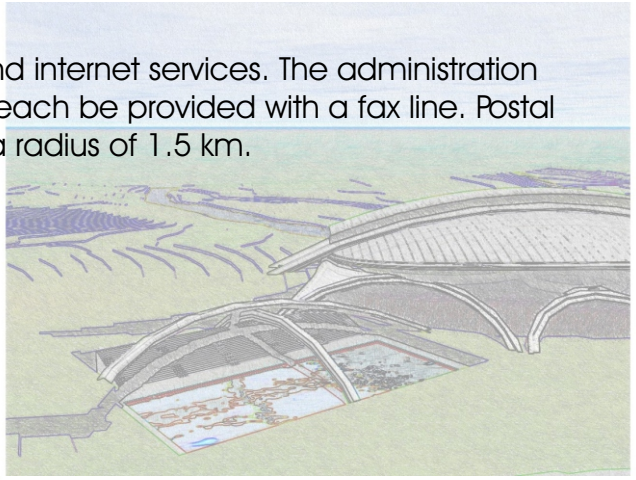
Target (4)

Postal, telephone or e-mail facilities are provided in the building or within 3km.

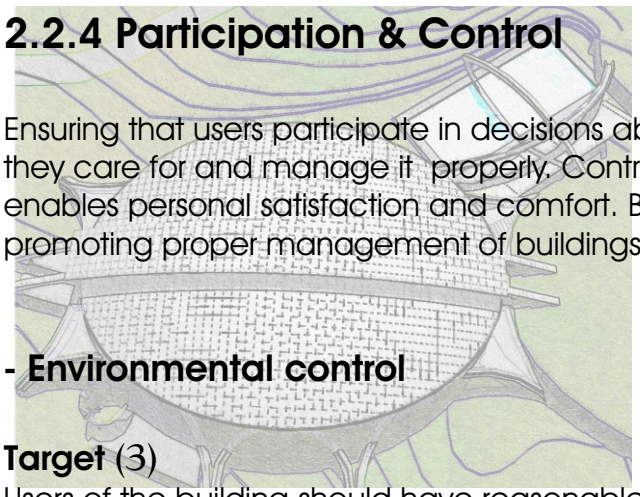
Assessment (4)

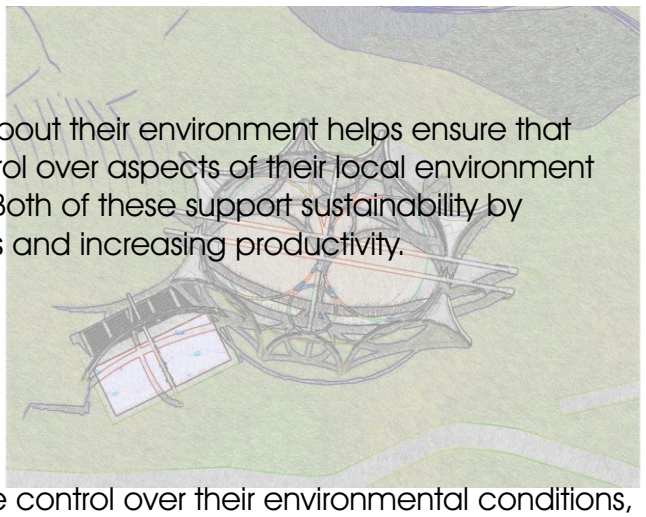
All offices will be provided with telephones and internet services. The administration offices, gymnasium and medical centre will each be provided with a fax line. Postal services are available in the CBD which is in a radius of 1.5 km.





2.2.4 Participation & Control





Ensuring that users participate in decisions about their environment helps ensure that they care for and manage it properly. Control over aspects of their local environment enables personal satisfaction and comfort. Both of these support sustainability by promoting proper management of buildings and increasing productivity.

- Environmental control

Target (3)

Users of the building should have reasonable control over their environmental conditions, this should include opening windows and adjustable blinds.

Assessment (3)

All the office window openings and internal blinds will be manually controlled according to the occupants comfort. The rest of HPC will make use of a Building Management System(BMS) that will control the lighting, windows, air vents, louvers, security systems etc. The reason for this is because the HPC makes use of different systems (airconditioning, rock storage, extractor fans and natural ventilation) and these systems must be managed to achieve the maximum efficiency in different areas. Lighting will also be controlled by BMS according to light requirements.

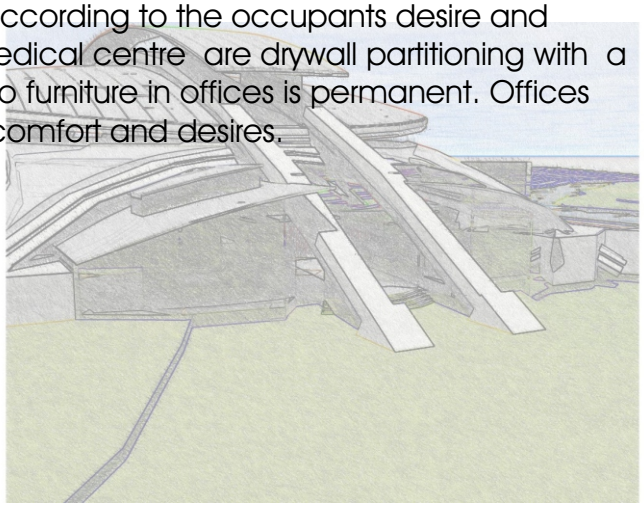
- User manual/training

Target (2)

Furniture and fittings, i.e. tables, chairs and internal partitions must be designed or specified to allow arrangement/rearrangement by the users. Provision should be made for personalisation of spaces if desired. This may include provision for pin boards, choice of colours, places for plants and personal storage.

Assessment (3)

All the office partitions in the administration and gymnasium will be drywall partitioning which allows arrangement/rearrangement according to the occupants desire and comfort. All the consultation rooms in the medical centre are drywall partitioning with a high sound isolation for increased privacy. No furniture in offices is permanent. Offices can be arranged according to occupants comfort and desires.



- Social spaces

Target (3)

Design for easy informal / formal social interaction. This could involve a tea room with comfortable seating. Seating provided along regularly used routes. Spaces shared between occupants/users (i.e. photocopying rooms etc.) Must be large enough to allow for comfortable social interaction.

Assessment (3)

The restaurant is a central social space where occupants can gather together for social interaction. The main entrance on the eastern side of the HPC is provided with touchscreen computers for the public. These computer facilities will have all the latest sports news, results, statics events and history of sports legends as well as sports entertainment for children. This space will become an important social gathering space especially for children. Seating is provided along main walkways. There are different social spaces designed around the HPC with adequate seating along walkways. The climbing wall in the parking area will also become a social gathering space.

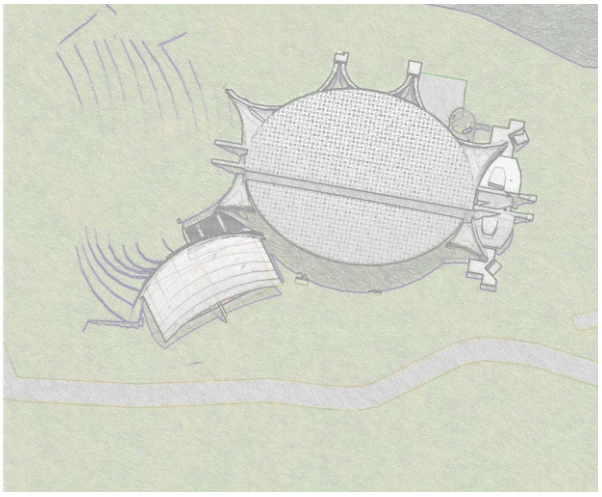
- Amenity

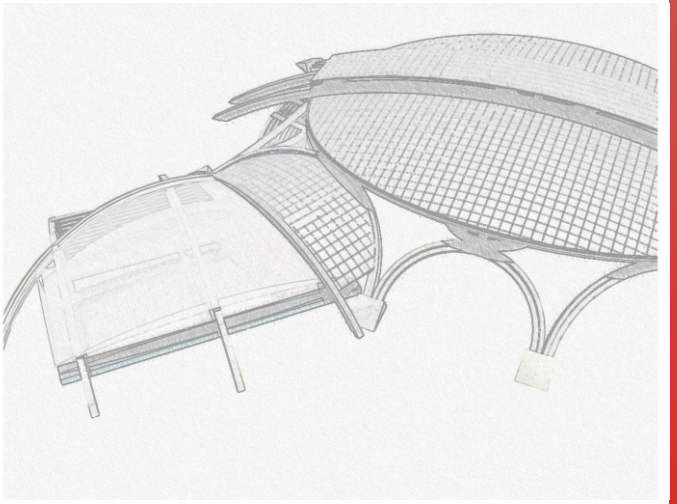
Target (3)

Easy access to refreshment facilities (tea point, kitchen, vending machines) and wc's for all users of the HPC.

Assessment (3)

The HPC is provided with vending machines, restaurant and toilet facilities. Vending machines are located in the main entrance. The restaurant is in the centre of the main walkway and is accessible to the public. Toilet facilities are accessible to all users of the HPC.





- Community involvement

Target (4)

Spaces or services must be shared or made available to local community.

Assessment (5)

The HPC is open for the whole public, all the facilities (gym, auditorium, medical centre, restaurant, squash courts, swimming pool etc.) can be used by the public according to the HPC regulations.

2.2.5 Education, Health & Safety

Buildings need to cater for the well being, development and safety of the people that use them. Awareness and environments that promote health can help reduce the incidence of diseases such as AIDS. Safe environments and first aid can help limit the incidence of accidents and where these occur, the effect can be reduced. Learning and access to information is increasingly seen as a requirement of a competitive work force. All of these factors contribute to sustainability by helping ensure that people remain healthy and economically active, thus reducing the costs (to society, the environment and the economy) of unemployment and ill health.

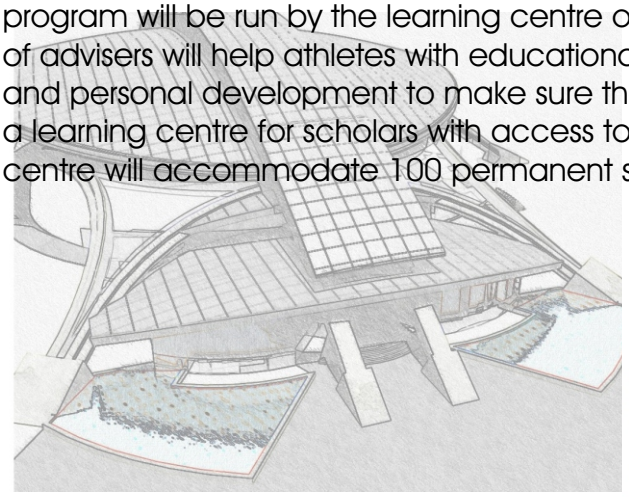
- Education

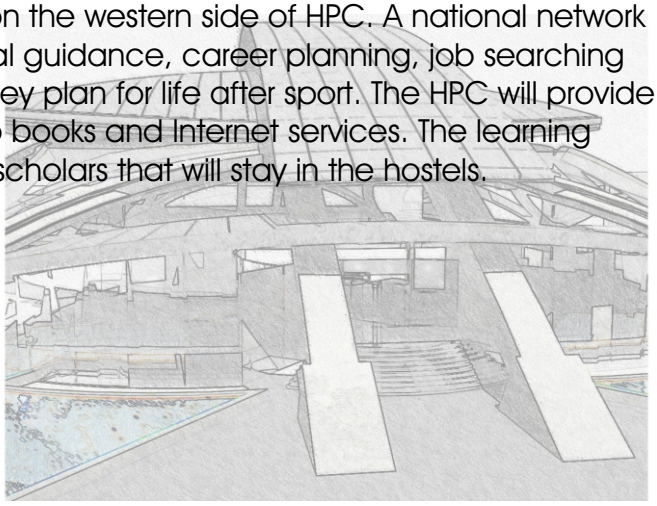
Target (4)

Access to support for learning must be provided. This can be in the form of Internet access, structured courses, or the provision of learning material such as books, journals and newspapers.

Assessment (5)

Education of athletes will play a very important role in the HPC function. An Athlete Career and Education(ACE) program, will be set up to enhance the personal development and performance of elite athletes through a number of career and education services. This program will be run by the learning centre on the western side of HPC. A national network of advisers will help athletes with educational guidance, career planning, job searching and personal development to make sure they plan for life after sport. The HPC will provide a learning centre for scholars with access to books and Internet services. The learning centre will accommodate 100 permanent scholars that will stay in the hostels.





- Safety and security

Target (5)

Measures taken to ensure that areas of the buildings and routes to and from the buildings are safe, and feel safe. Routes and occupied spaces must have clear visual links between each to secure the safety of occupants.

Assessment (5)

A security office and desk are allocated at the main entrance of the HPC to ensure the occupants safety. Access to the site is divided in two. One vehicular access point allocated on the north eastern side of the site to assure safe parking and control over vehicles. The vehicle access will be controlled by security booms that will be operated by security guards. Pedestrian access to site is minimized to three access points. The two pedestrian entrances at the riverside and the one at the Pannevis/South Street T-junction. All three of these pedestrian entrances will be guarded by security. Access at the T-junction will only be open from 6am to 6pm. The eastern, southern and western sides of the site will be fenced to control access. The HPC has an open plan which contributes to the visual links and safety of the occupants. All facilities inside the HPC are designed with an access control desk at each entrance. The HPC will therefor be a safe and secure environment.

- Smoking

Target (3)

No smoking must be allowed in public spaces. Space must be provided for smoking where it will not affect other users, i.e. away from air intakes etc.

Assessment (3)

No smoking will be allowed in the HPC because of the centre's focus on health. Outdoor smoking areas are provided in the restaurant.

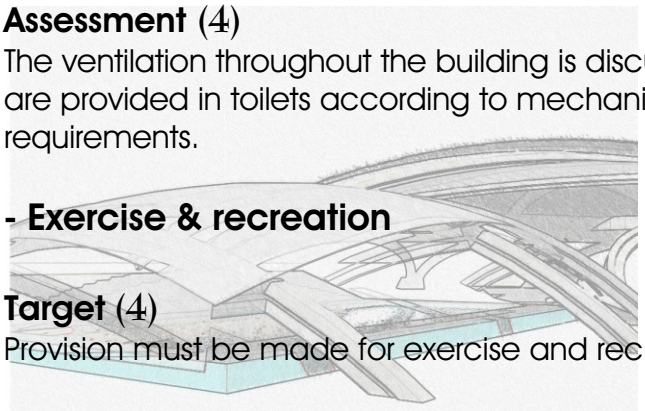
- Indoor air quality

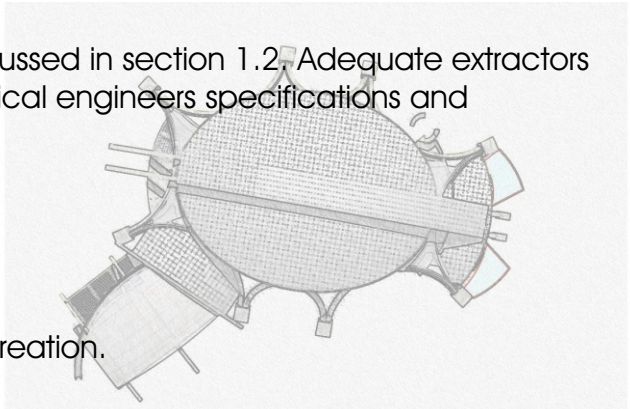
Target (3)

Adequate indoor air quality and health requirements must be obeyed.

Assessment (4)

The ventilation throughout the building is discussed in section 1.2. Adequate extractors are provided in toilets according to mechanical engineers specifications and requirements.





- Exercise & recreation

Target (4)

Provision must be made for exercise and recreation.

Assessment (5)

The HPC's main functions and goals are exercise.

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 Roofsheeting	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

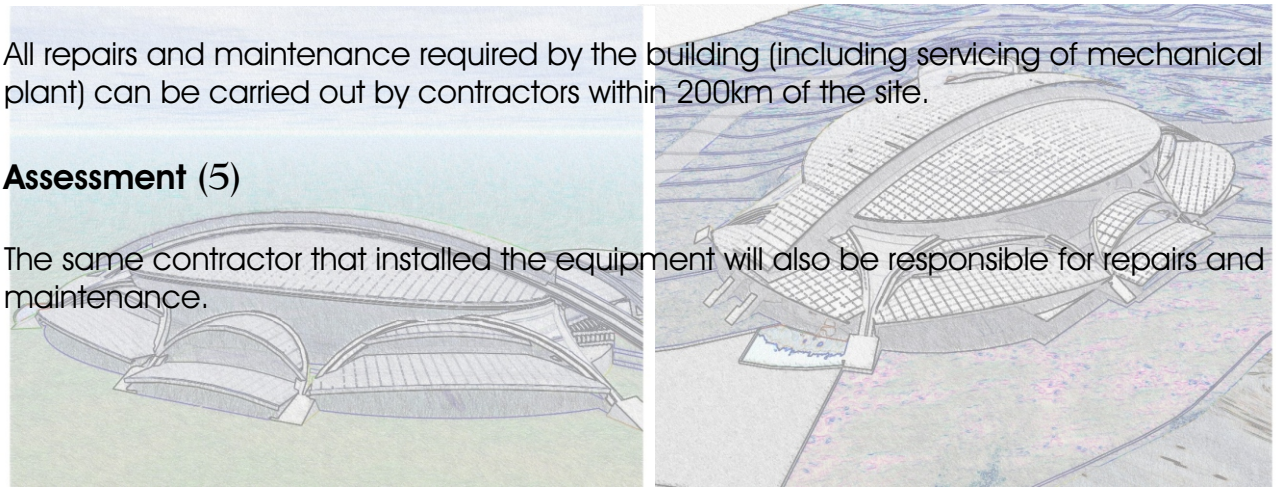
- Repairs and maintenance

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 up17.5% of the HPC total area.

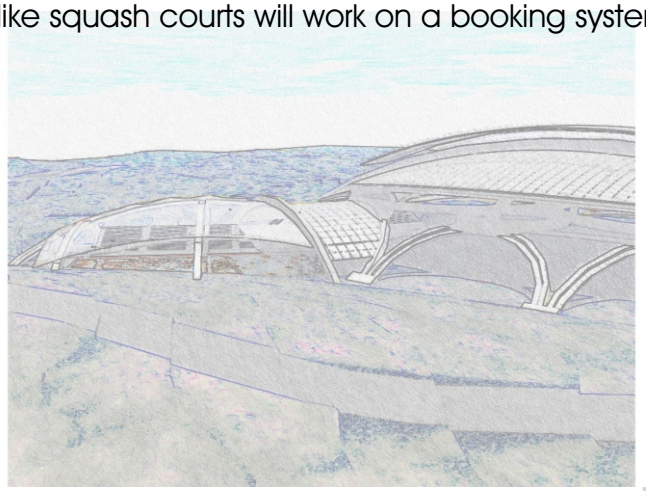
- Occupancy schedule

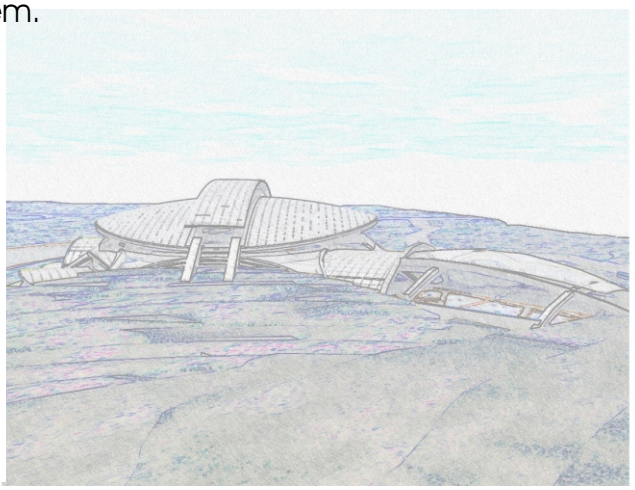
Target (4)

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.

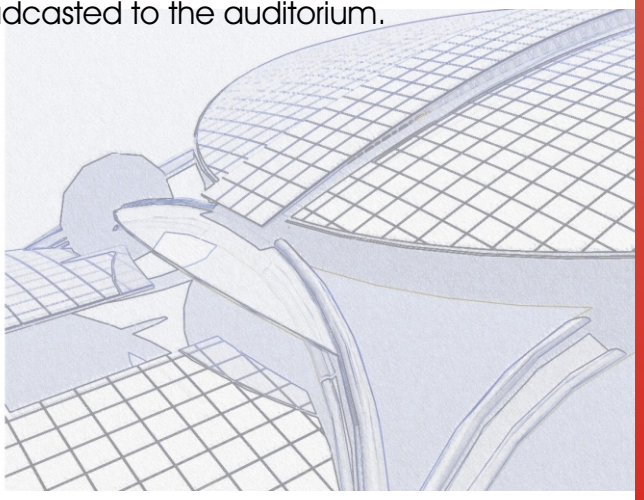
- Use of Technology

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.

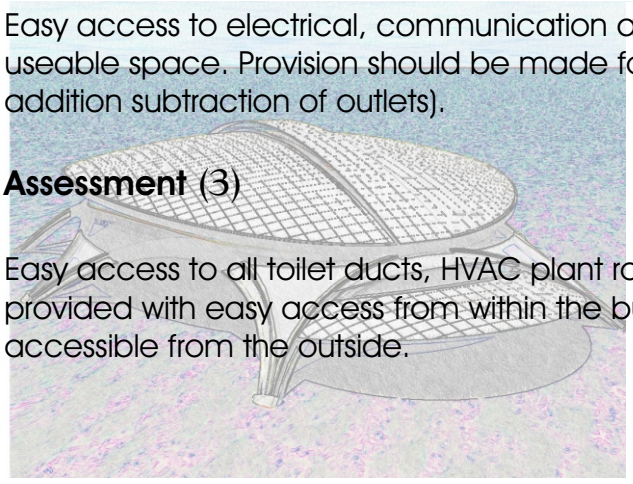
Assessment (4)

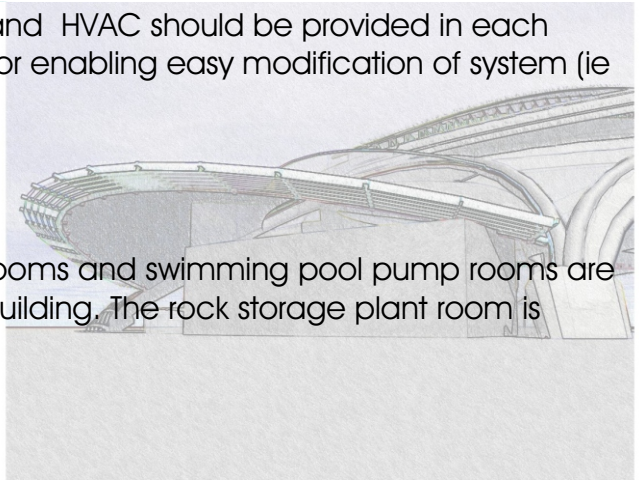
The HPC is an open plan design with minimum internal walls. The only area which is divided is the medical centre and the office space that have internal partitions for flexibility and adaptability. The sports shop and gymnasium has a glass curtain wall that can easily be removed for adaptability.

- 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.

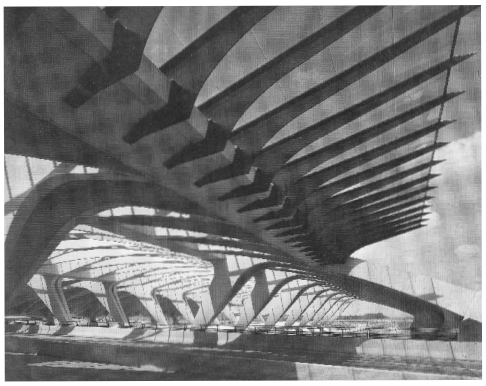


Fig.83

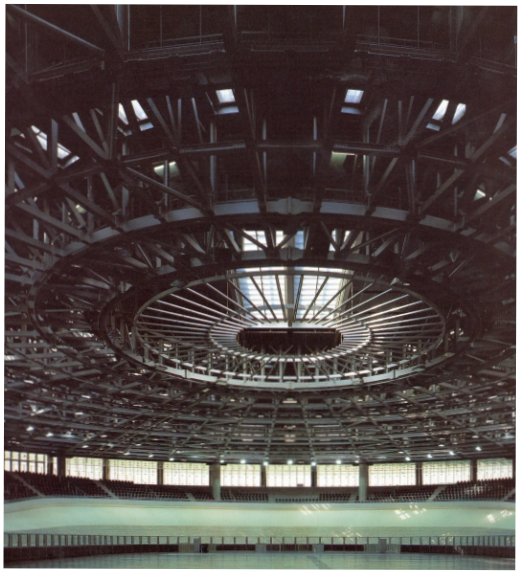
CARE DE SATOLAS TGV, Lylon , France !989-94

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.

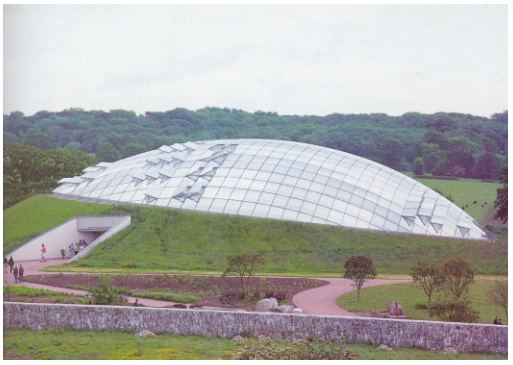
Photos of Calatrava's work Fig.84



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

The ring structure used in the Olympic veledrome 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.

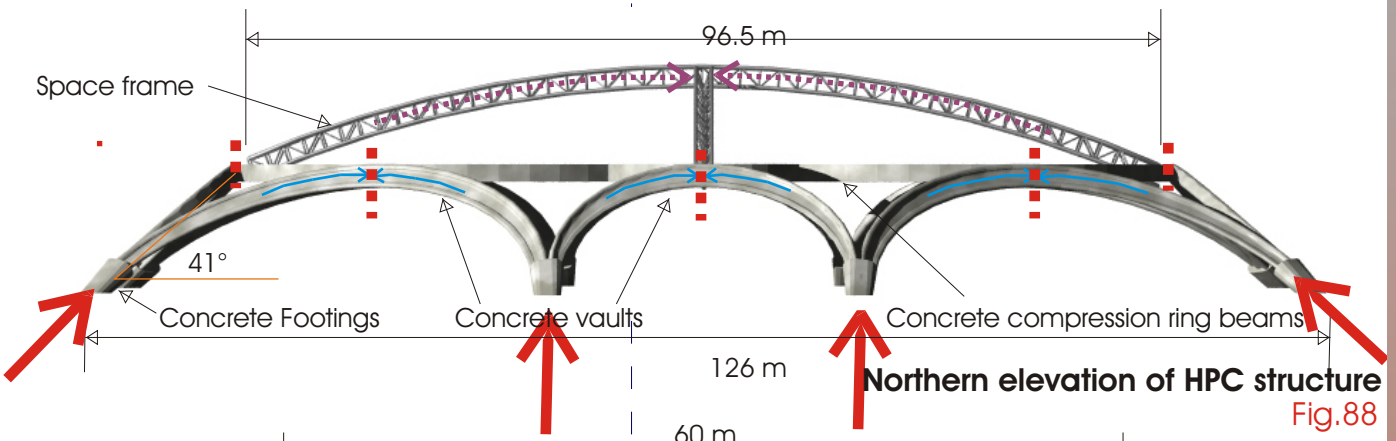
GREAT GLASSHOUSE Fig.86

Assessment (4)

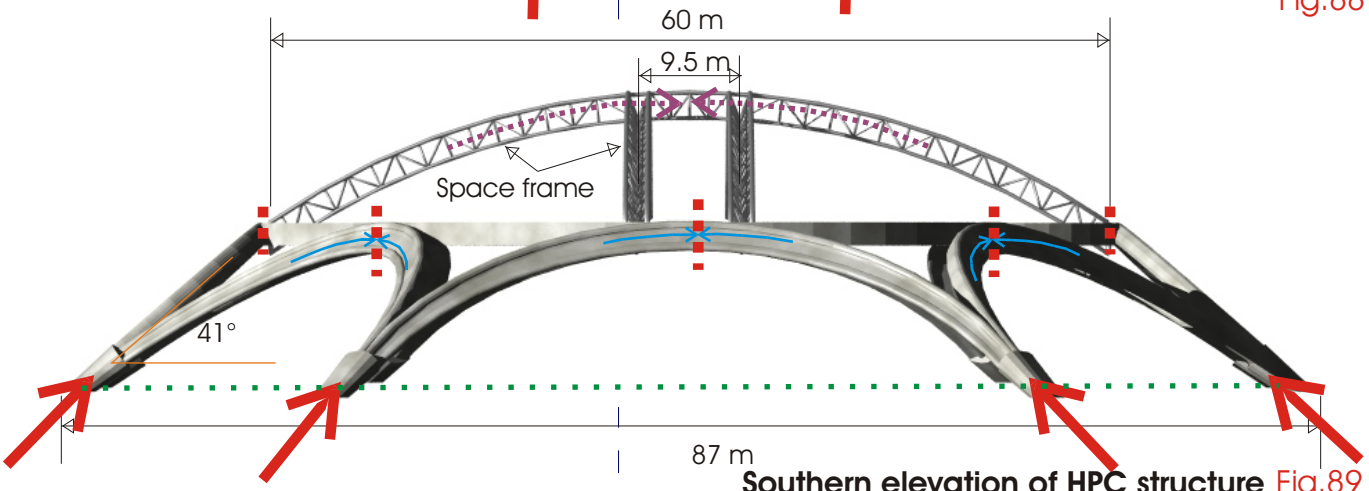
The HPC structure

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.

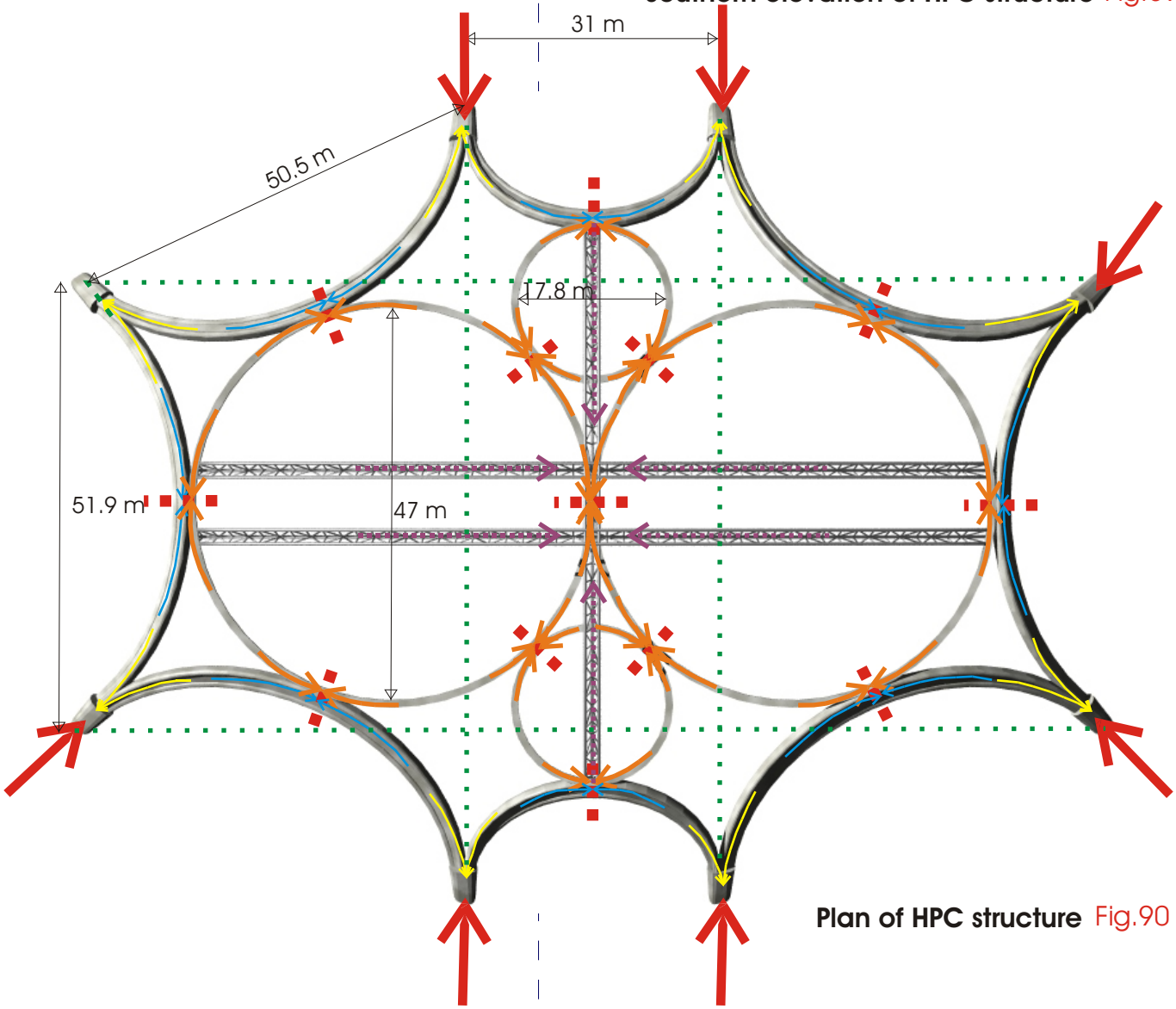
HPC Structure Fig.87



Northern elevation of HPC structure Fig.88



Southern elevation of HPC structure Fig.89



Plan of HPC structure Fig.90

Economical

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.

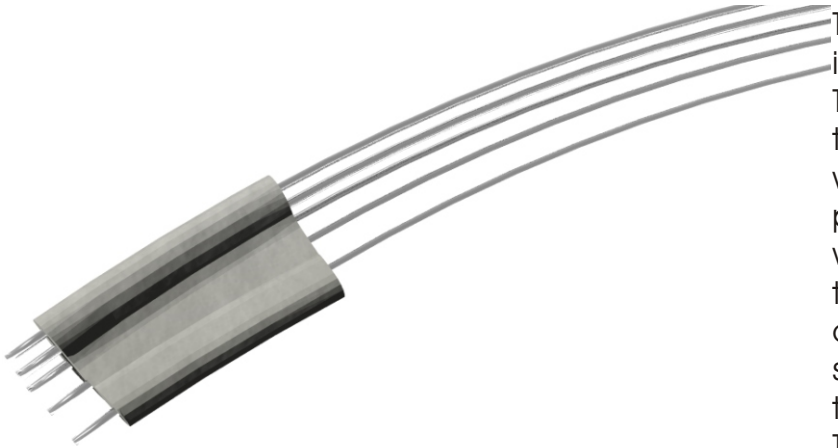
The vaults are angled at 41° to transfer the compression forces of the rings straight into the ground. The vaults have a high pressure point where the vaults meet the rings. At this point the bending moment of the vaults will be at its highest. The vaults are a sculptured structural element that will 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. Therefor is the vault depth is only 1.28m where the vault connects with the footing. The vaults' compression forces are transferred directly onto the footings.

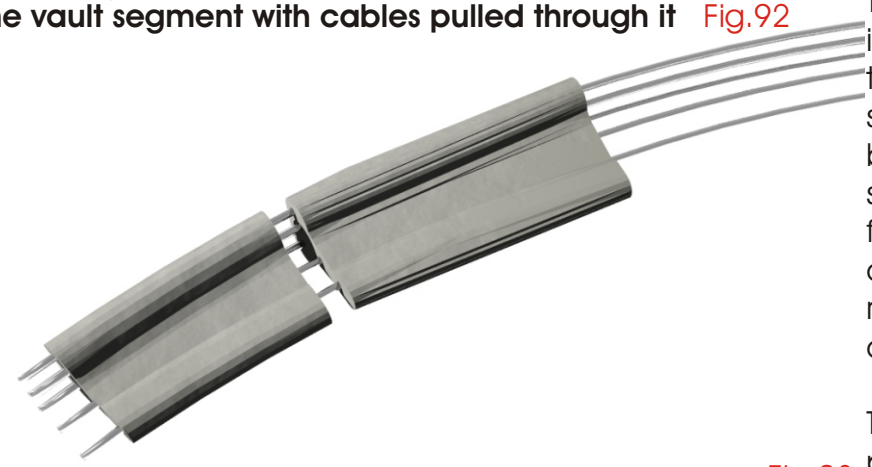
The concrete footings are pilled into the ground according to the engineer's specification. The footings will be connected to one another with underground cables to make sure the structure will be kept together.

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



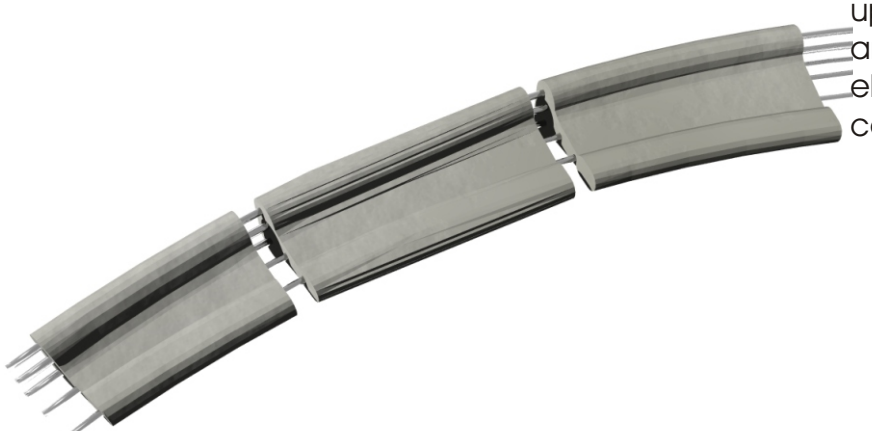
One vault segment with cables pulled through it Fig.92



Two vault segments with cables pulled through it Fig.93

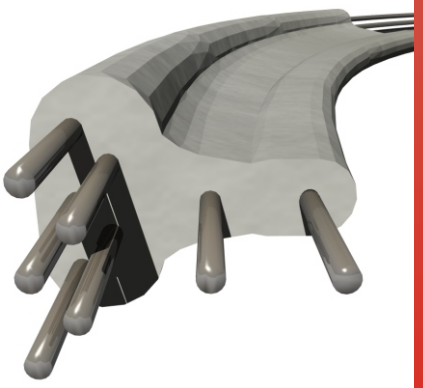
The whole concrete structure is precast in 5m lengths. These segments are then transported to site where they will be pulled togther. The precast segments are cast with seven 80mm holes through segments where the cables will fit through. All the segments are then pulled together with the cables. These 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.



Three vault segments with cables pulled through it Fig.94

Three vault segments pulled together with cables Fig.95



Vault section Fig.96

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 m^3 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 m^2 (fig.97)
A 791m^3 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 m^2 (fig.97)
A 613m^3 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 m^2(fig.97)

A total of 9764m^2 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.

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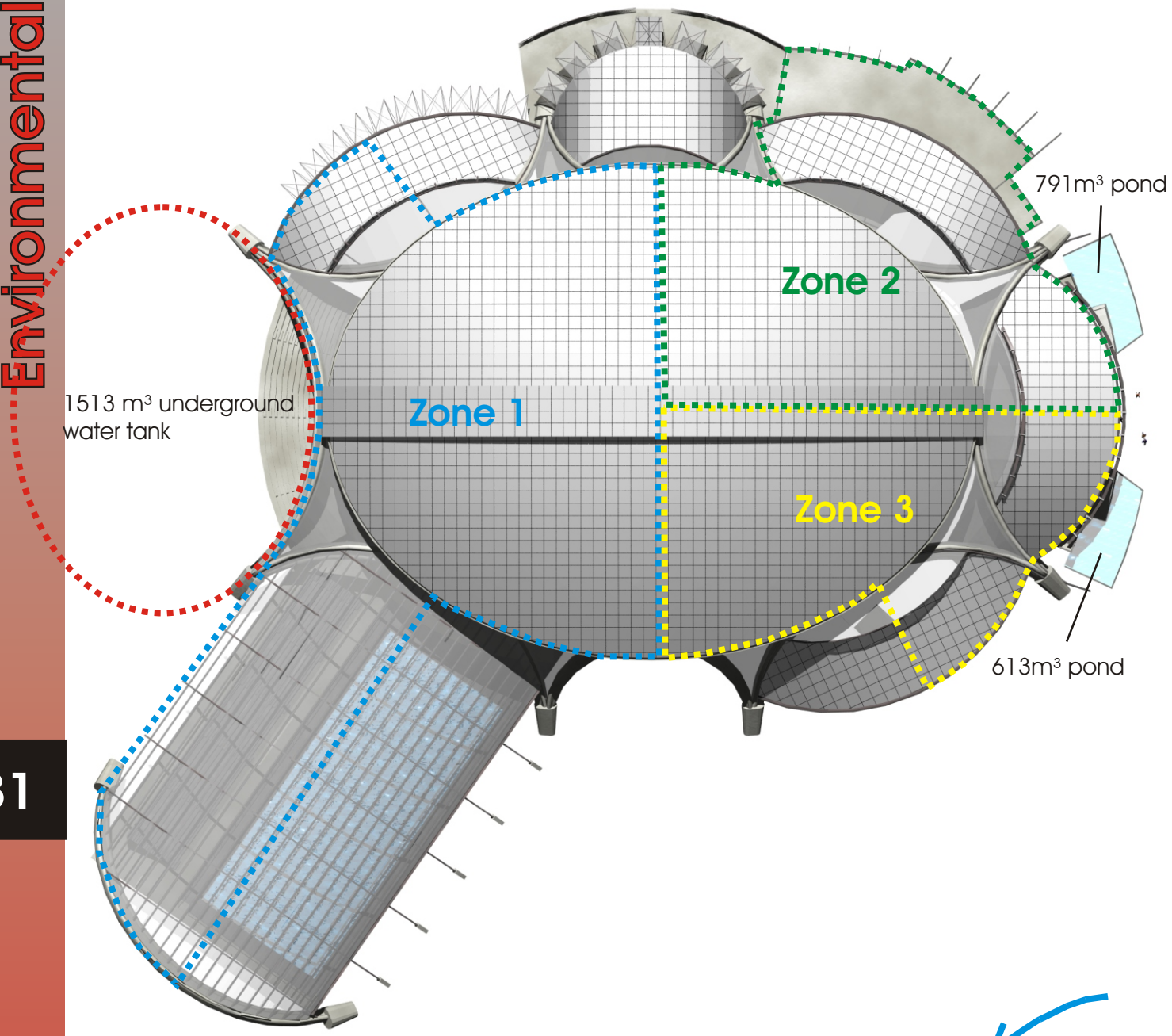
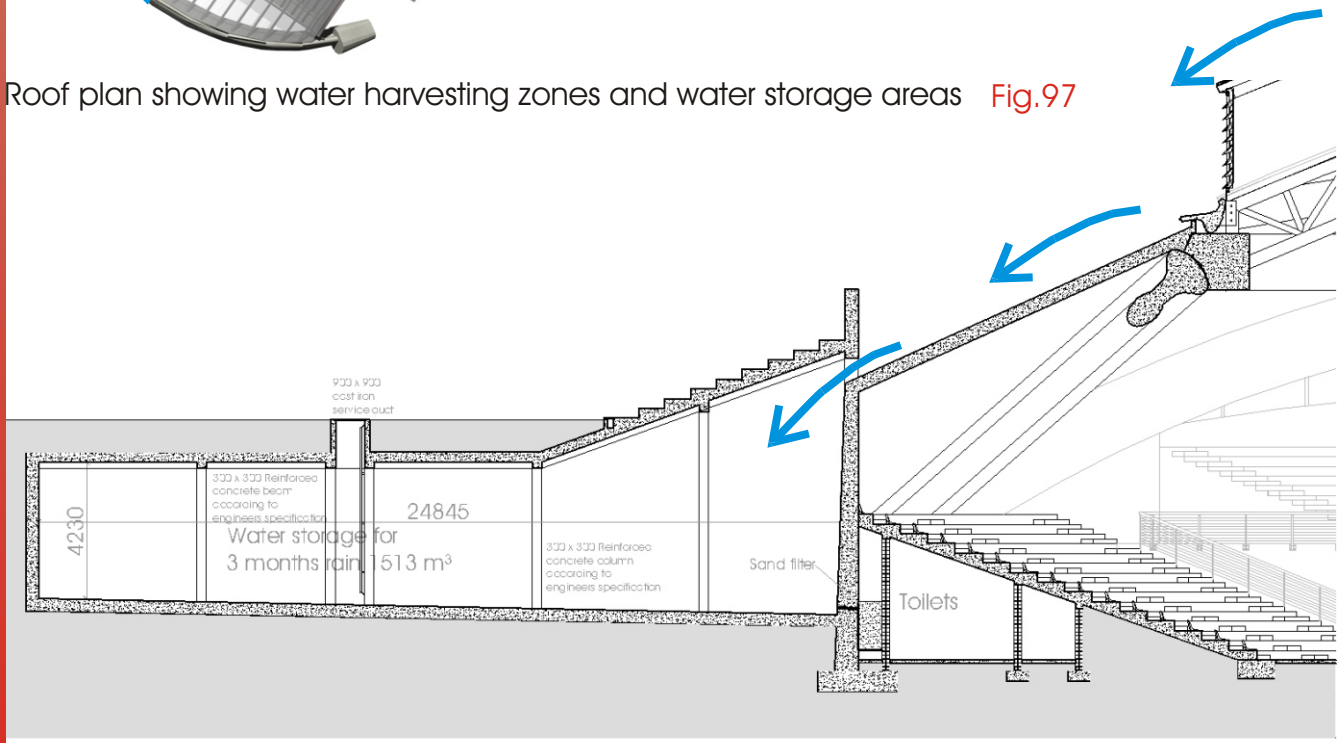


Roof plan showing water harvesting zones and water storage areas Fig.97



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.

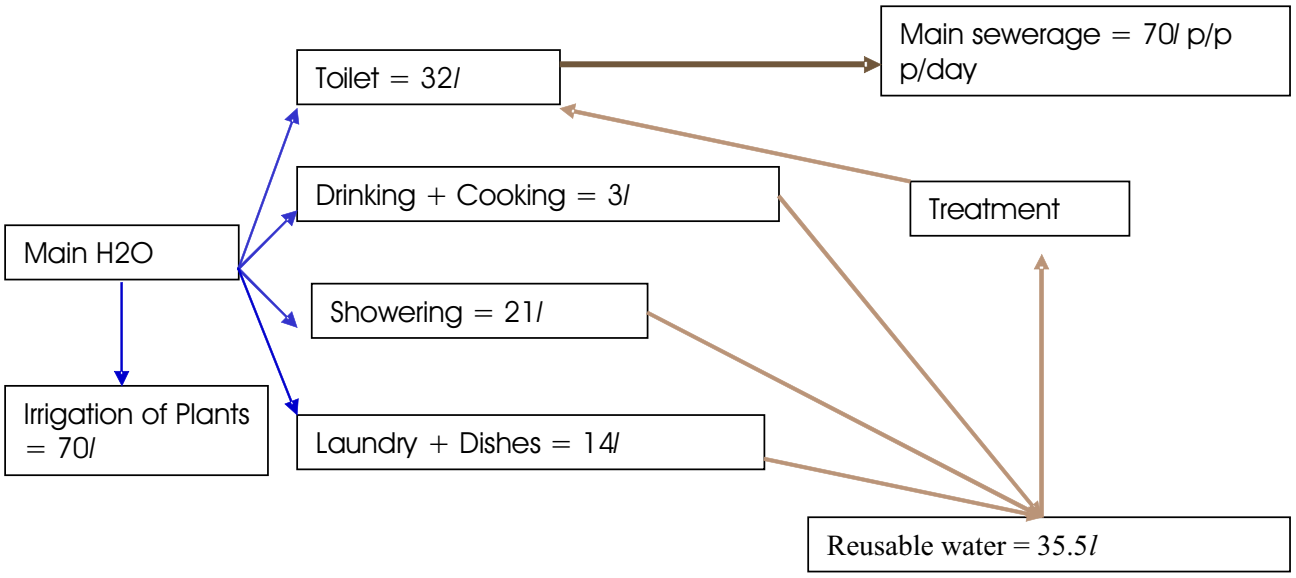
- Grey water

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 = 140 *l*

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.

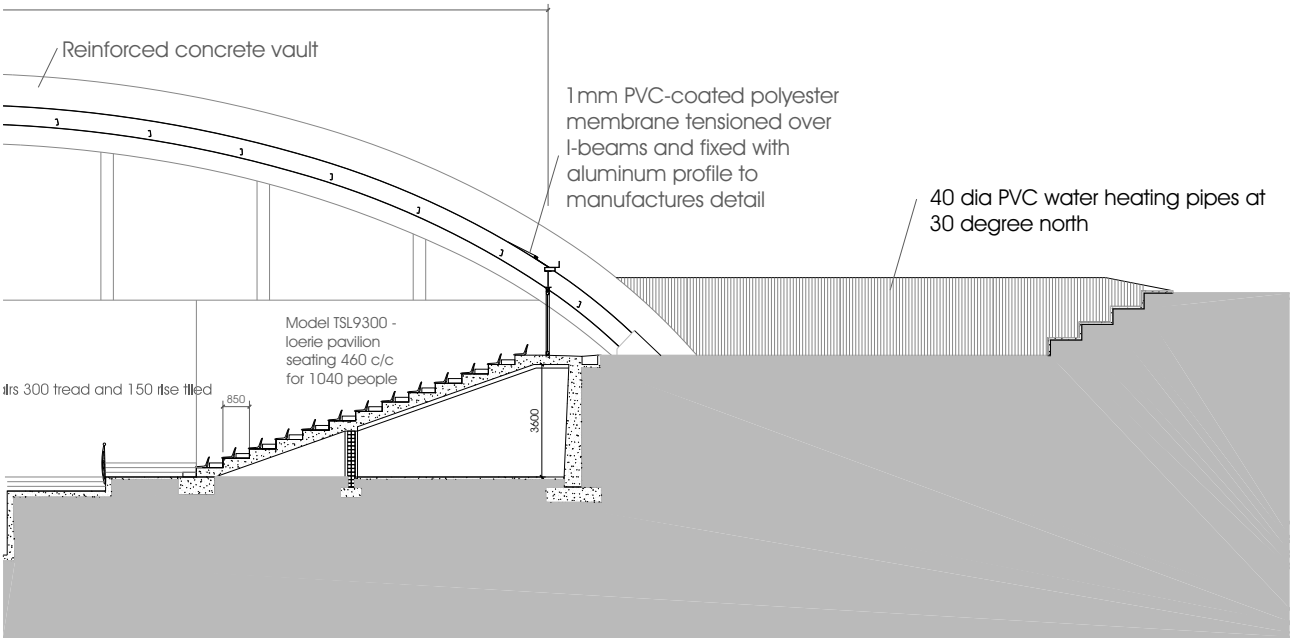
- Heating and Cooling System

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 pools 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 flourescent 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 instillation 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.

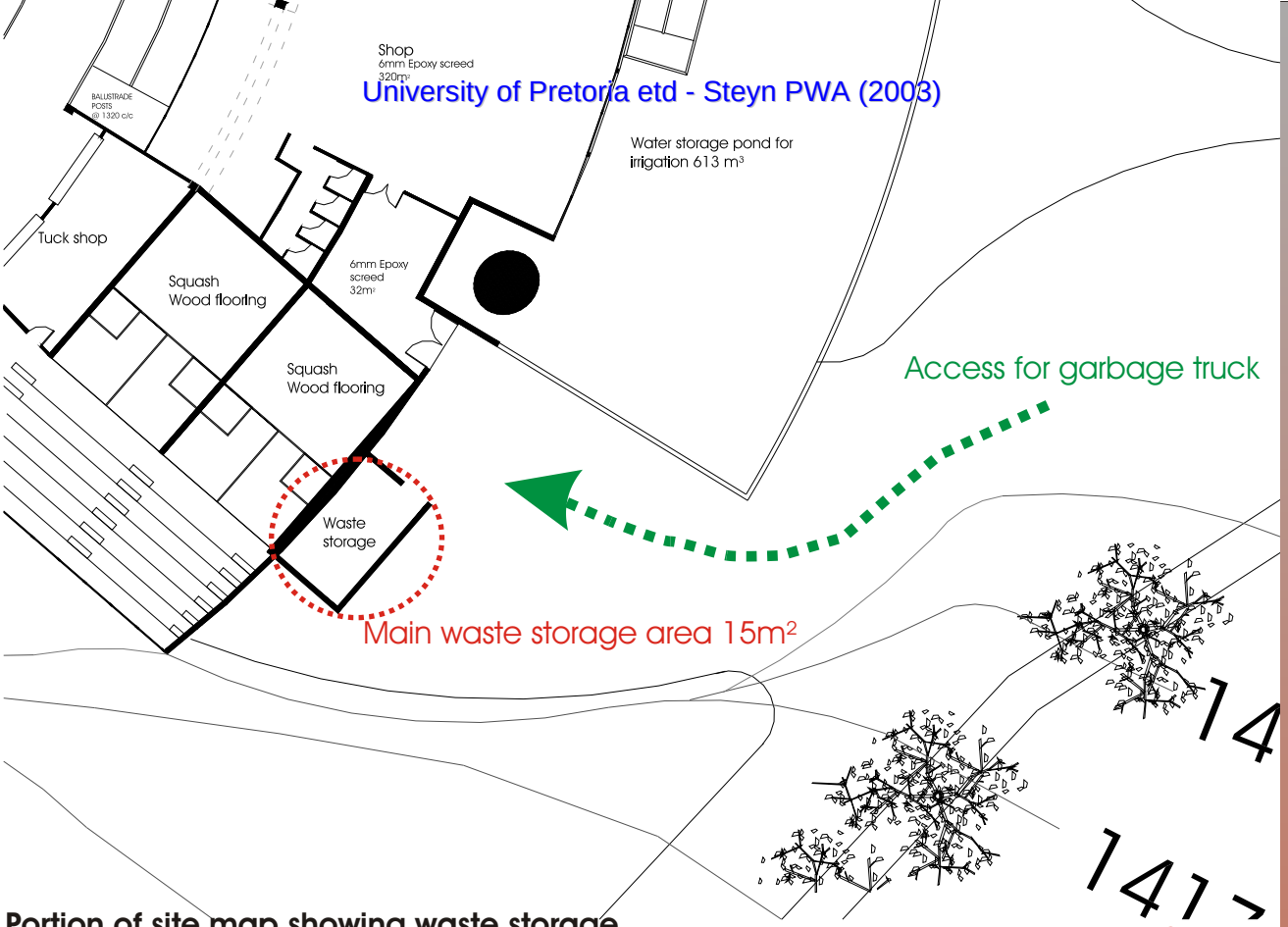
- Inorganic waste

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

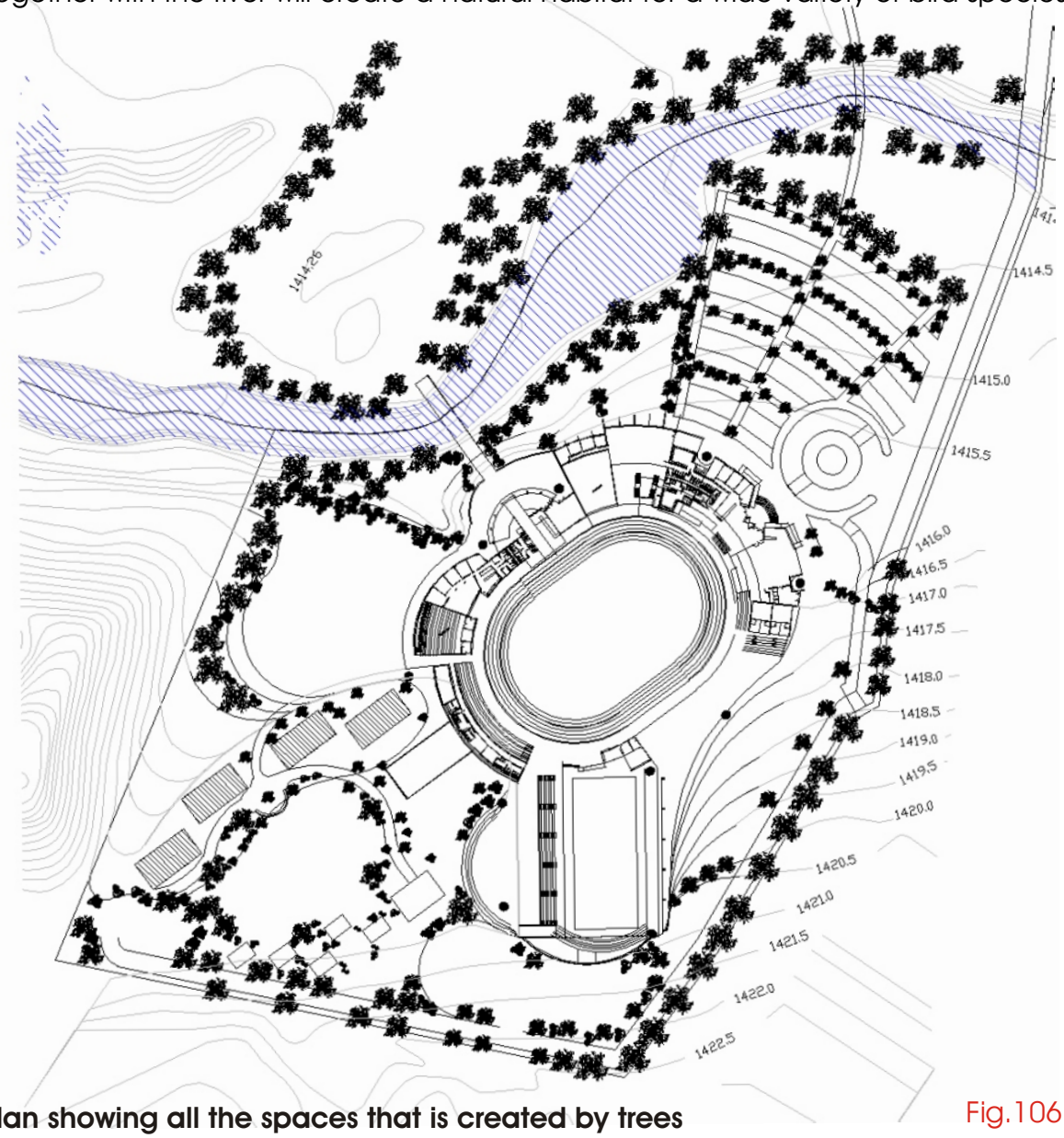
- Vegetation and Habitat

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

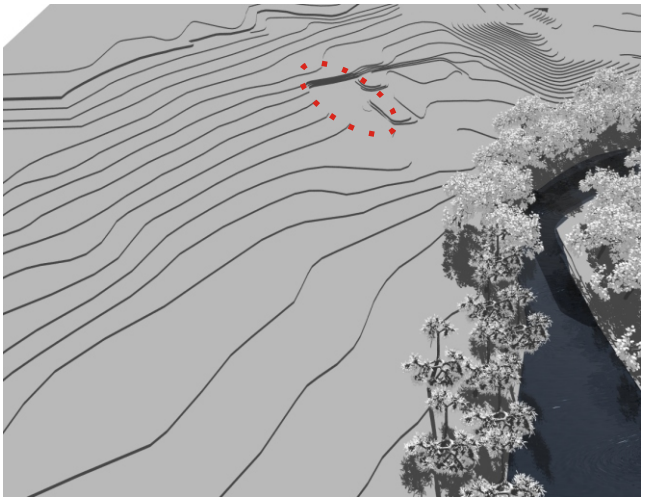
- Landscape inputs

Target (4)

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

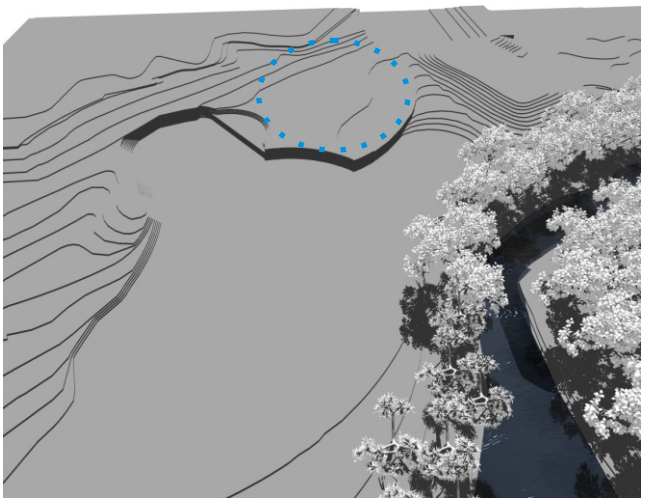
Assessment (3)

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.



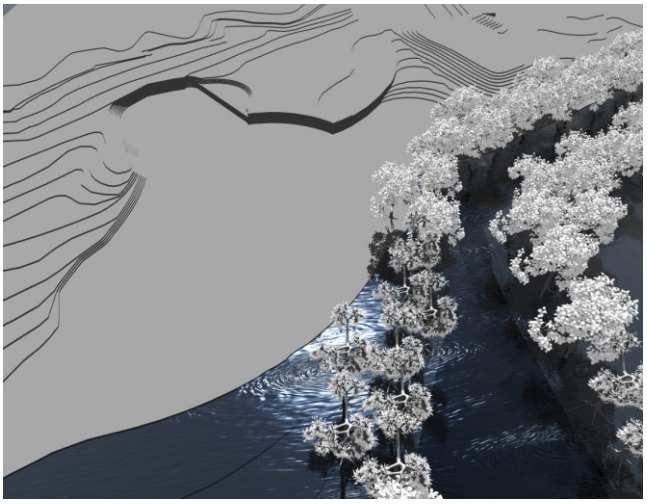
The site fall 6.5° to the river side. The HPC is designed that the underground water catchment tank fit into the landscape. Topology is discussed more in detail on p.19

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 fil 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.

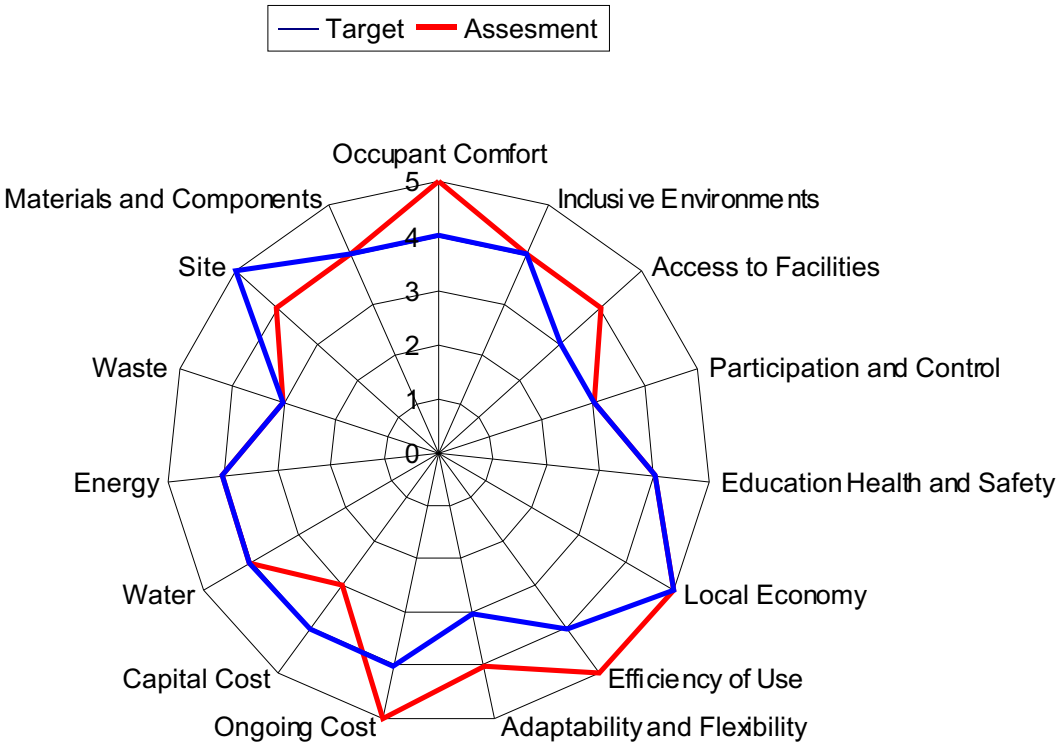
Assessment (4)

Materials	Use	Embodied energy MJ/kg	Thermal resistively 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/m^3 and galvanised steel 7850 kg/m^3. Aluminium recycles much easier than galvanised steel, it is maintenance free and are a very flexible material to use in complex designs. It is therefor 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 ads 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 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.

Chapter 3

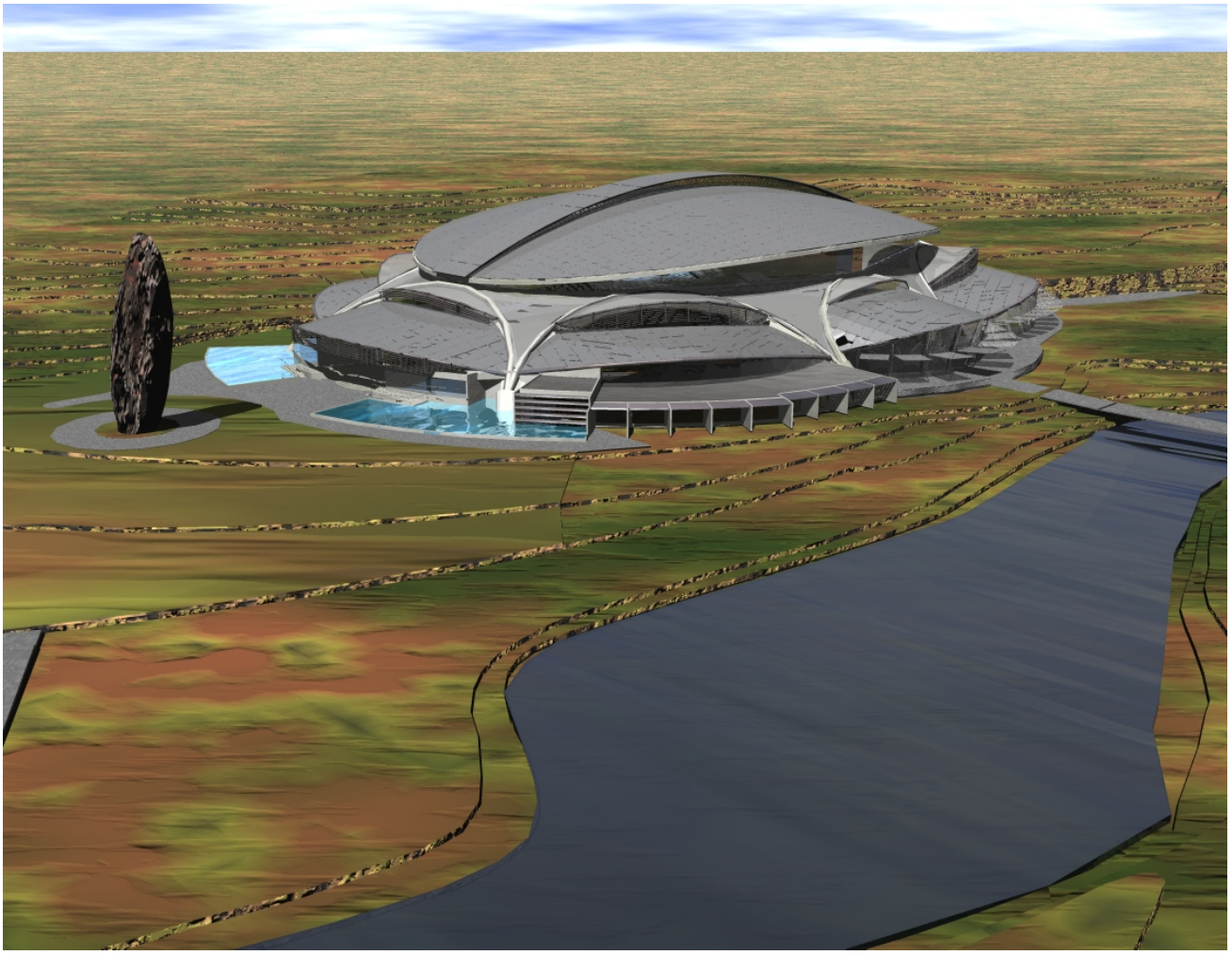
Design discourse

3.1 Hi-Performance sport centre

The Hi-Performance Sport Centre introduces a way of thinking about the profession of sport development that transcends the practical considerations of training and performance by refining them into a way of life. The Hi-Performance Sport Centre in Centurion will be the manifestation of this philosophy.

This landmark of sport will signal the culmination of extensive research into the sports industry, consideration trends and forecasts worldwide and the beginning of a long-term investment into the expertise, infrastructure and branding under the banner of the Sports Institute of South Africa.

Against the backdrop of a fragmented and subjective Sport Science Industry, the HPC aims to provide an objective and unbiased sport science product that will serve high performance athletes, the professional sports market, corporate markets and the public. The HPC will provide a holistic and integrated approach that embraces a fusion between advanced technology and a philosophy backed by science, and the support of exceptional service, dedication, personal attention and extraordinary hospitality.



View of the HPC from SuperSport park cricket stadium Fig.111

3.2 Site selection

The site selection and location for the HPC was a complex and important decision requiring extensive research. Criterion were set up to select a unique site for the HPC:

The HPC should be:

In a province that will benefit from the facility and will support its function

In a radius of 50 km from an airport

Visible from main public routes but still private

In a radius of 10 km of retail facilities

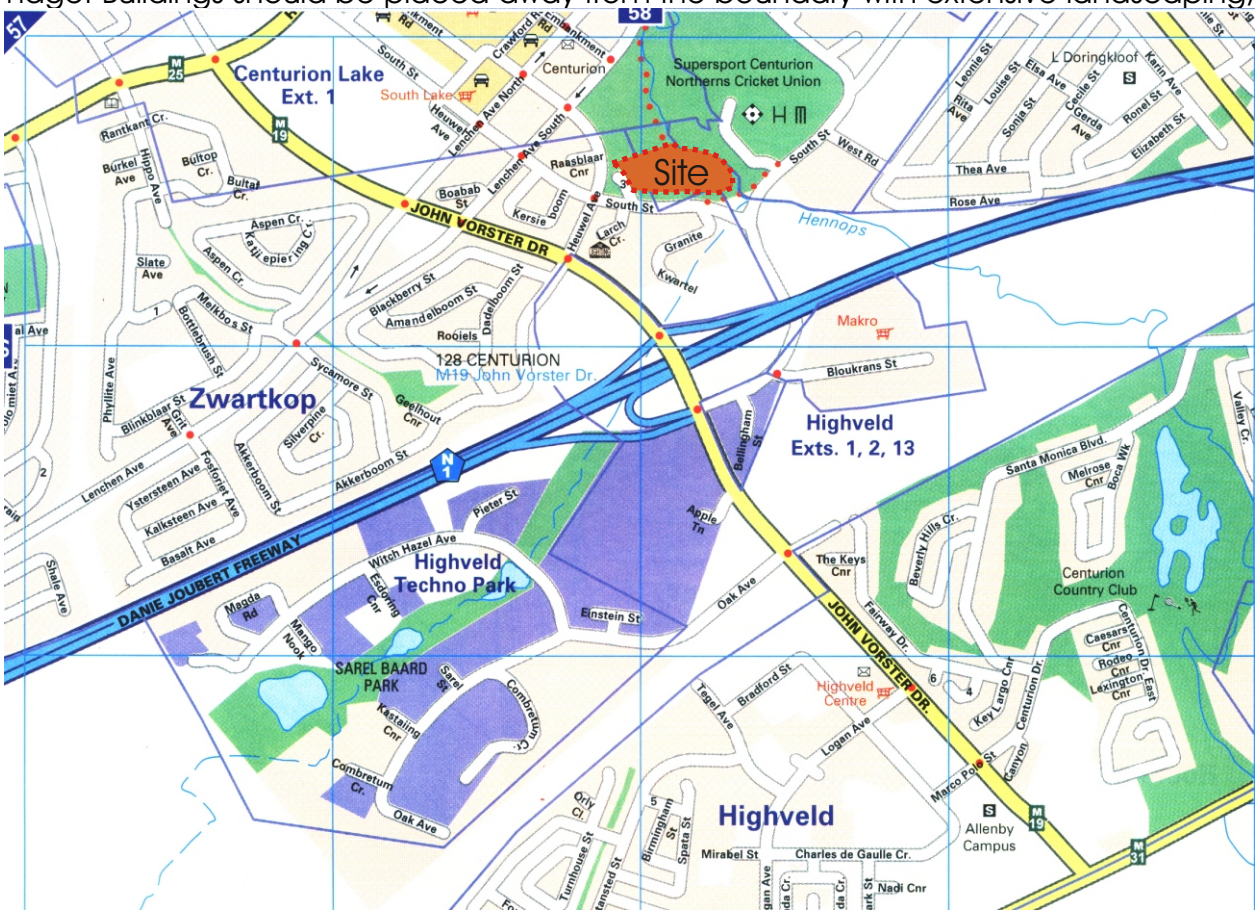
In a radius of 1 km of public transport

In area with existing sports facilities which will support the HPC's function

On a site which is easily accessible for the public

In area with a tranquil environment

According to these criteria the site next to the SuperSport park cricket stadium in Centurion was ideal. The IDP of Centurion proposed that this zone should focus on sporting activities and facilities(indoor and outdoor, formal and informal, competitive and leisure). A recreational destination supporting the pedestrian network should be established in this zone. Large sport facilities should ensure an appropriate interface on the waters edge. The IDP also propose that the strip along the N1 conveys a hi-tech image. Buildings should be placed away from the boundary with extensive landscaping,



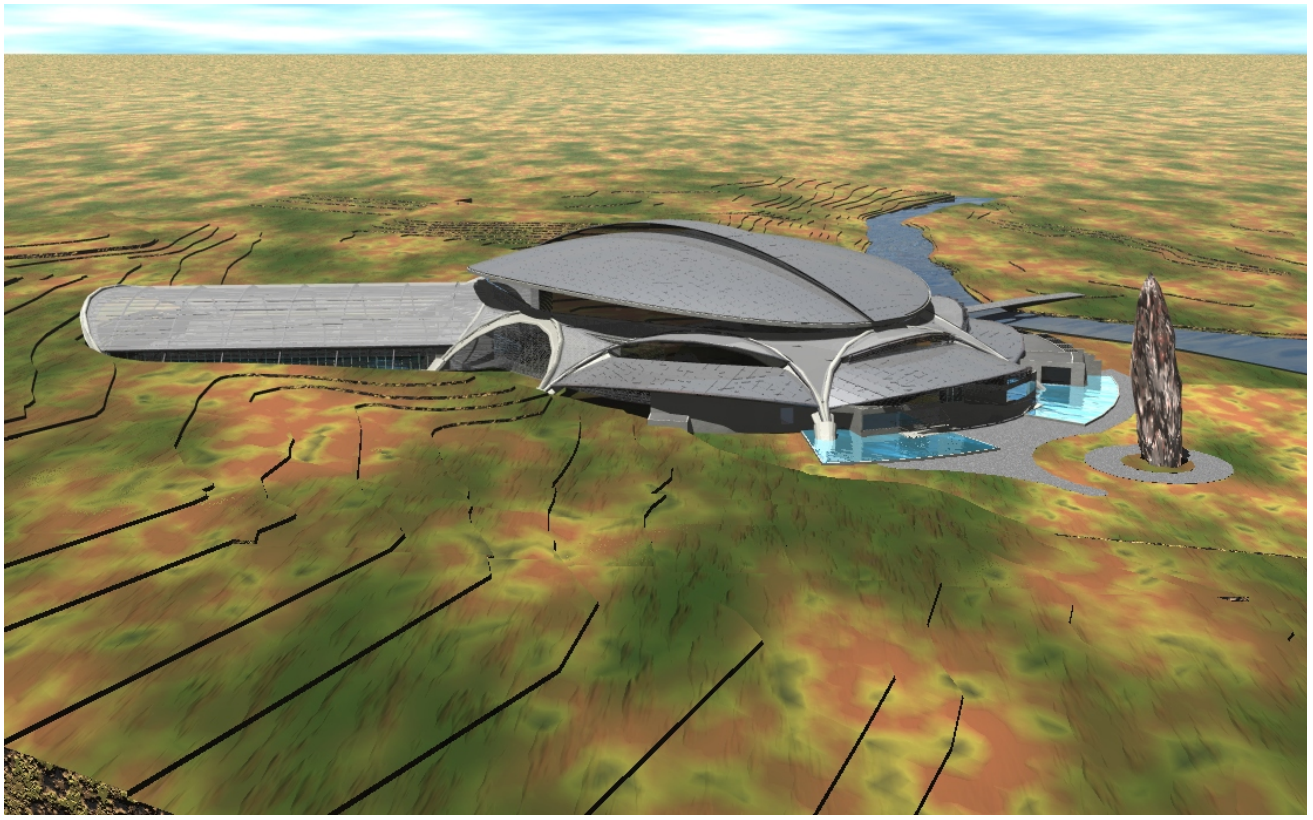
Centurion map with site indication Fig.112

establishing a strong park like character through well landscaped soft open spaces adjacent to the N1. This will also produce low coverage's and a coarse grain of building. Exploit the potential for the establishment of unique precincts enhancing legibility, but also marketability, with potential precincts such as the agglomeration of sport fields and other outdoor and indoor recreational activities around the Centurion Cricket Stadium could promote the establishment of a "fitness Precinct."

The site is 45km from Johannesburg International Airport and adjacent to the N1 highway. A public transport node for taxis is situated on the site with the Centurion CBD 1.5 km from the site. The site will be part of a sports hub development in Centurion that will host a wide variety of sports. A wide variety of sport facilities already exist in the sports hub such as a karate club, gymnastics hall, action cricket courts, cricket stadium, rugby club and netball courts. Rietvlei Dam is situated 11km northeast of the site that will be used for rowing and canoeing. The Centurion country club is situated 3.5 km from the site with golf and tennis facilities which will be used by the HPC. This unique site was the ideal location where high performance athletes have access to a wide variety of sport facilities with the Hennops River as a tranquil backdrop.

3.3 The HPC as landmark

Due to the high traffic on the N1 there is an opportunity to create a landmark, increasing legibility to the road. The HPC with its sculptural concrete structure molded into the sloping landscape, dressed with a lightweight membrane and aluminum cladding roof panels are a landmark that will fit into the prestige corporate and high tech use along the N1.

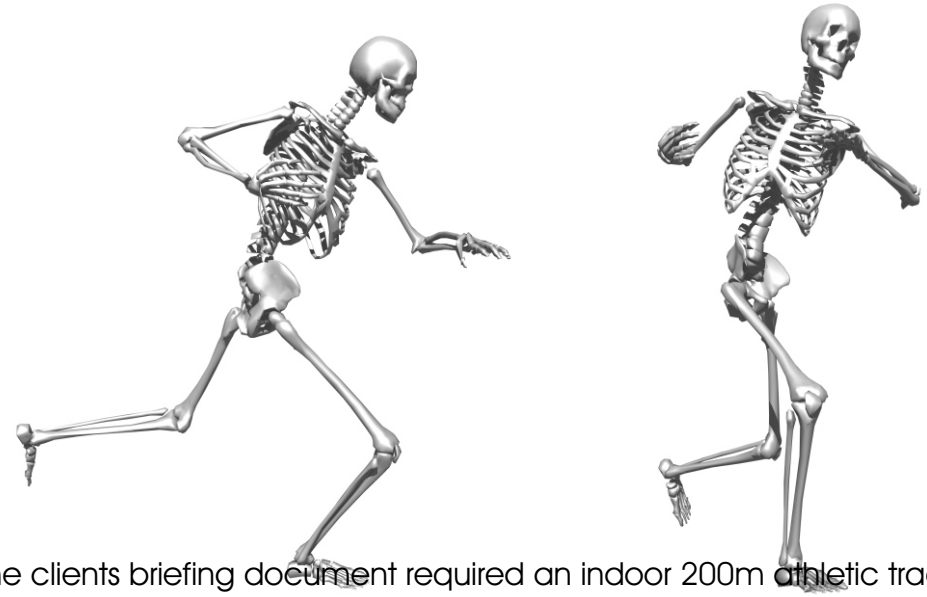


View of HPC from N1 highway Fig.113

3.4 Athletic structure of HPC

Architecture not only fulfills a function, but also carries social meaning which is conveyed by its formal and structural properties. The architecture used in the HPC produce an sensual environment in a place designed for bodily activities. The HPC presents itself aesthetically ambitiously and clinically clean, thus corresponding to the concepts of perfection and purity conveyed by the staging of the female body in this sport.

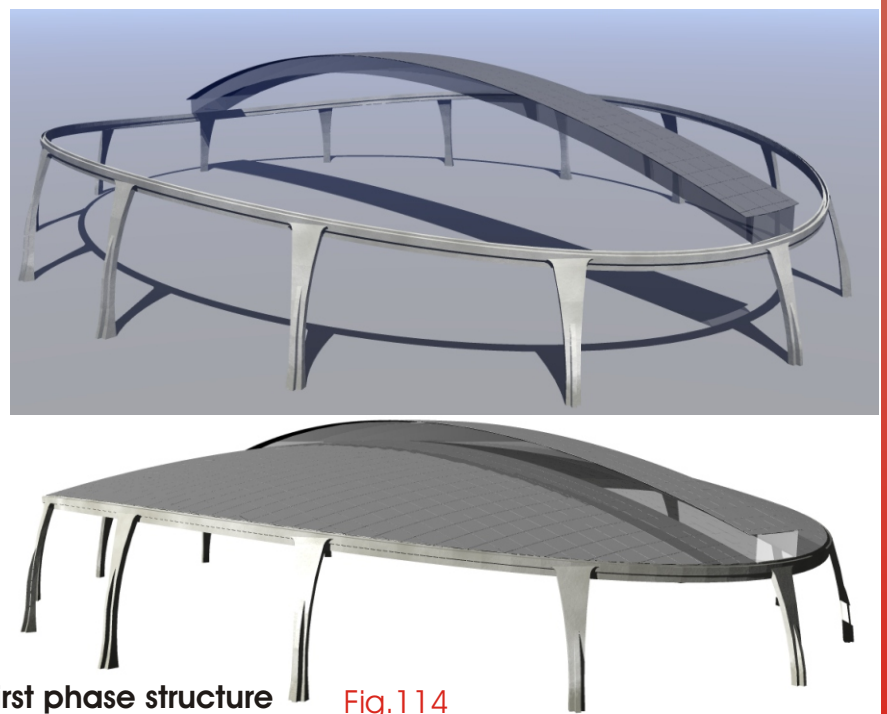
The sculptural structure of the HPC is based on the human skeleton. The bone structure of the human body is formed according to its function, thicker and stronger bones where impact is higher.



The clients briefing document required an indoor 200m athletic track that spans approximately 100m. The only way that this span could be achieved is through an arch structure. The HPC's structure went through three phases of structural refirment.

First phase

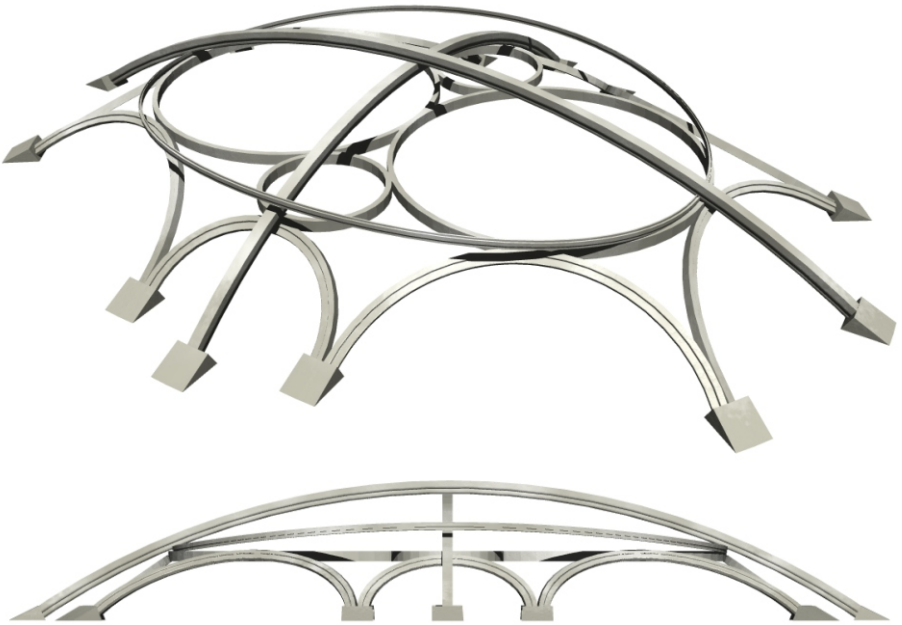
The fist attempt was aesthetically a success but structurally unsuccessful. The slightly angled columns will not be capable of transmitting the horizontal structural loads of the dome structure safely to the ground. The columns have to be angled with the same angel of the axial forces of the dome structure so that forces will be transmitted in a straight line.



First phase structure Fig.114

Second phase

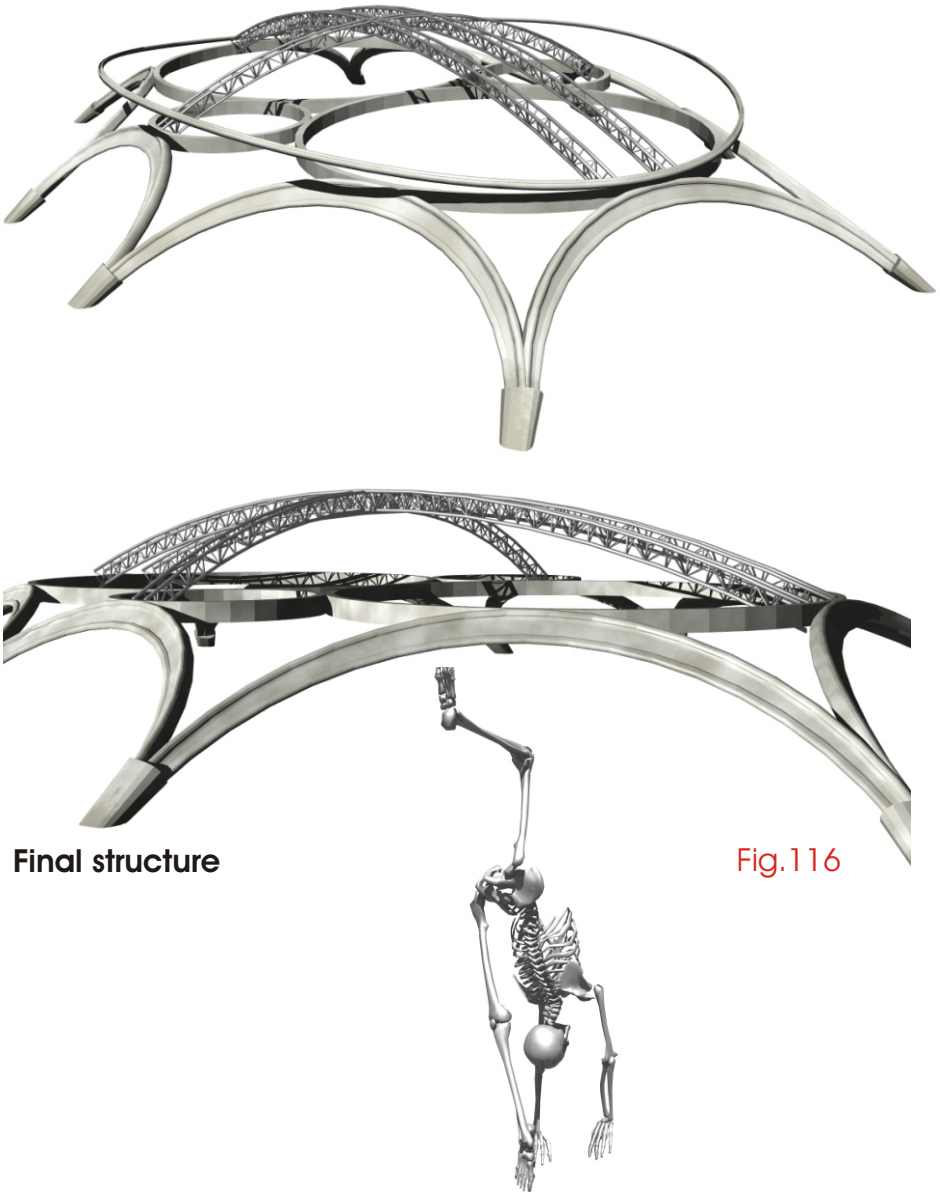
The forces of the dome structures are transmitted directly to the ground in a straight line. The structure consists of eight concrete vaults that are in compression with four concrete ring beams which obey simple geometry. The structure is a combination of compression forces working against each other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



Second phase structure Fig.115

Third phase

In the third and final phase the vault and footings are sculptured in a more elegant, athletic and functional form to perform as an athletic structure. A lightweight space frame structure replaces the concrete arch as thbackbone for the sculptural structure. The concrete structure is made visible from both the inside and the outside of the building and symbolizes the bone structure of an athlete with the lightweight space frame as backbone. The combination of the concrete and space frame structures become a high performance structure that contributes to the function of the buildings athletic feeling.

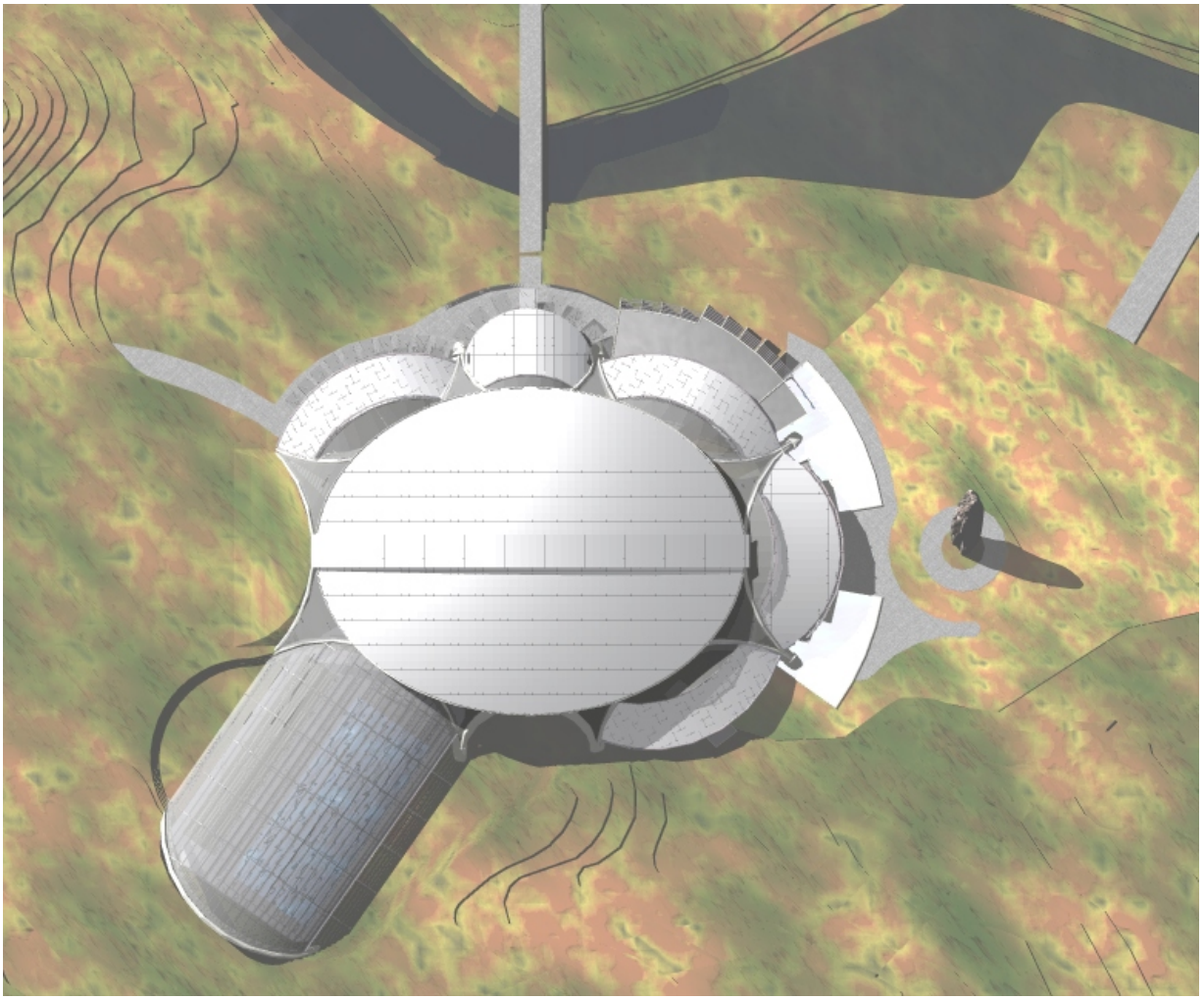


Final structure Fig.116

3.5 Function and form of the different facilities in the HPC

3.5.1 Indoor open space

The 5312 m² indoor open space underneath the dome structure links all the surrounding facilities to an environment of sport, training and assessment. This space with its tartan finish

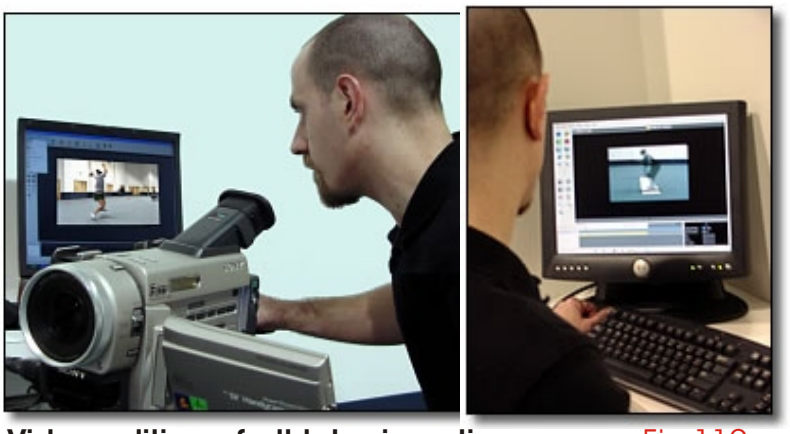


Arial view of HPC Fig.117

is there for high performance athletes; analysing the athlete in motion- running, kicking, bowling, jumping, throwing etc. Motion sensors will be attached to the athlete, these actions will be recorded with video cameras that will follow the movement of the athlete. These cameras that run on a rail system are fixed to the roof structure as well as rails on the ground. This video footage is then edited and analysed which will indicate the cause of an injury or what part of specific motion in the action must be worked on to perform on a higher level etc. This facility will also be used by the CSIR Sports Technology Centre for research on athletes.

Some video editing showing athletes in action Fig.118

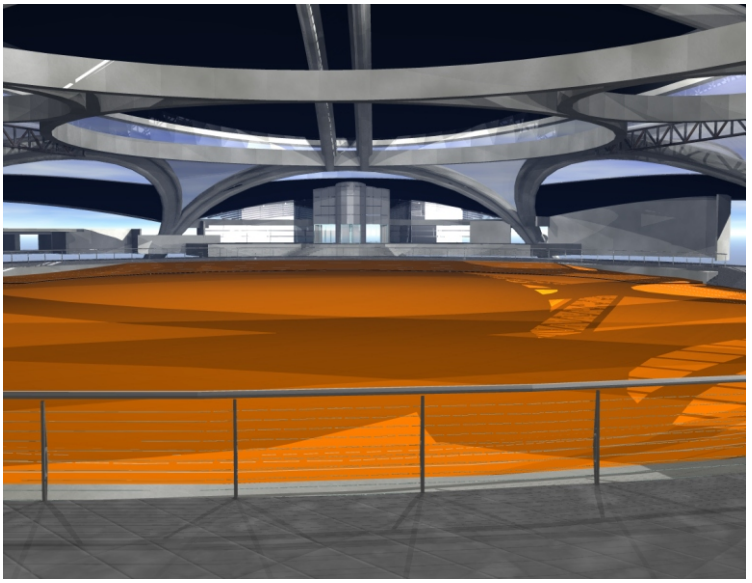
All the video editing takes places in the video editing room situated underneath the pavilion. All video footage is edited and analysed where it is then played in the auditorium to assist the athletes on their performance. These video assessments will takes place on a regularr bases to see how the athletes are improving.



Video editing of athletes in action Fig.119

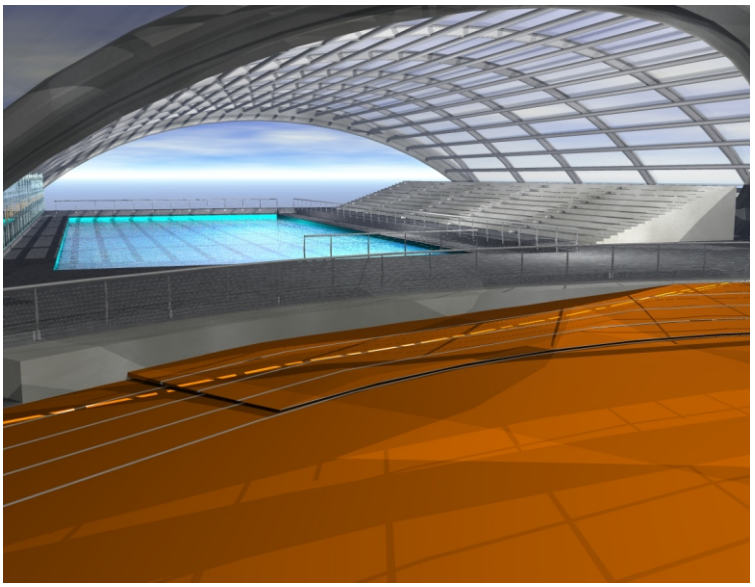
The main purpose of the indoor open space is where high performance athletes can train in an environment that is naturally ventilated but is still protected from the sun and rain to prevent overheating, dehydration and injuries. This indoor facility gives the athlete a training facility that could be used 24 hours a day all year regardless of the weather conditions.

The indoor open space with its 12.8m high structural clearance is a multipurpose area where all indoor Olympic events can take place ranging from basketball, hockey, volleyball, tennis to five-a-side football, gymnastics, athletics and a lot more. The floor finishes will be changes according to the sports requirements. The pavilions situated on the western side of the indoor open space can cater for 3200 people. Temporary pavilions will be put up on the southern side of the HPC when big event's take place.



Indoor open space Fig.120

The open link between the indoor open space and the swimming pool enhance the feeling of integration between the different spaces that flowing into other spaces. This open link also contributes to the visual link between different spaces that bind it all together as a sports environment with integrated functions.



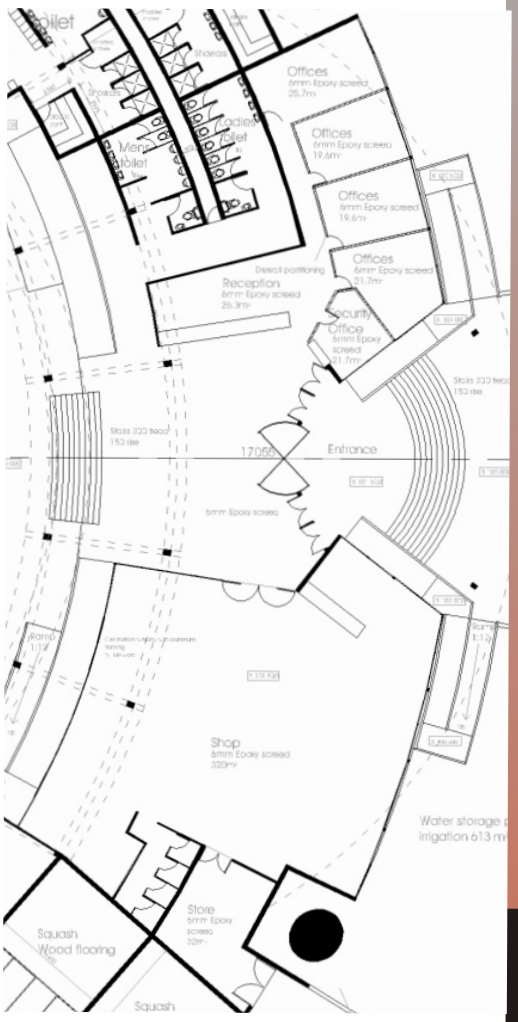
Indoor open space showing connection between swimming pool and indoor open space Fig.121

3.5.2 Administration and sports shop

The main entrance of the HPC situated on the eastern side of the HPC divides the administration area and the sports shop. The entrance is clearly visible from the N1 highway as well as South Street passing the site. The entrance foyer that is 1.5m above the ground level steps down into the indoor open space which is provided with adequate ramps and stairs. The active cardiovascular bridge suspended over the entrance foyer is clearly visible when entering the HPC which will convey the atmosphere of fitness and training. The main vision of the administration offices is to be a state of the art leader in revolutionizing the management of sport performance and sport development in the HPC.

The sports shop will supply sport accessories from rugby balls to studs, clothing and all other sports gear. This wholesale business will be accessible to the public giving students and visitors direct access to their supplies.

The main entrance on the eastern side of the HPC is provided with touchscreen computers for the public. These computer facilities will have all the latest sports news, results, statics events and history of sports legends as well as sports entertainment for children. This space will become an important social gathering space especially for children.



Plan of administration, entrance Foyer and sports shop Fig.122

Outside view of the main entrance with administration and sports shop Fig.123

3.5.3 Gymnasium

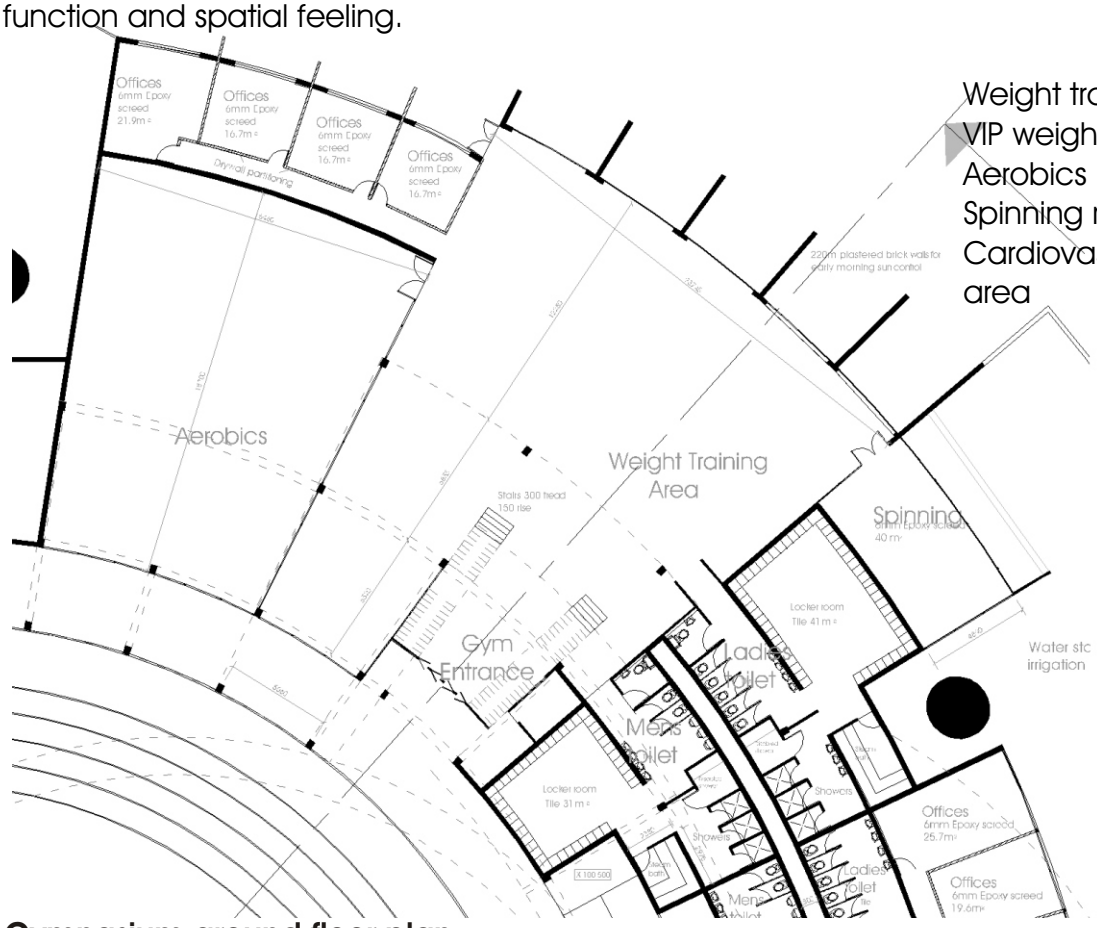
The sport science gym is set to revolutionize the health and fitness industry in South Africa by:

Using advanced training technoloy
Outcomes-based measurement and reporting on multi disciplinary intervention strategies
Networking and initiating synergistic relations with other role players in the Industry

Sport Science Gymnasium uses the most advanced equipment and technology currently available in the fitness industry using SmartTechnology®, which provides an outstanding way to manage exercise and training. This is integrated with other software programs to provide a comprehensive member management system.

The Smart Key® is a computerized key that is assigned to each member once they have been through a health and fitness assessment. The key stores all personal data and is used to log training sessions. For each training session it is inserted into the control panel of the TechnoGym®System equipment, where it directs and controls the workout intensity and records all the information from the session. The Wellness Expert® is an interactive touch screen computer console providing feed for members to view work-out details for the day, test results, previous training results and performance indices, and to download the information saved from a completed workout onto the central database.

The 1707 m^2 gymnasium situated on the northern side of the HPC has a spectacular view over the Hennops river. The gymnasium is divided into four areas, each with a different function and spatial feeling.



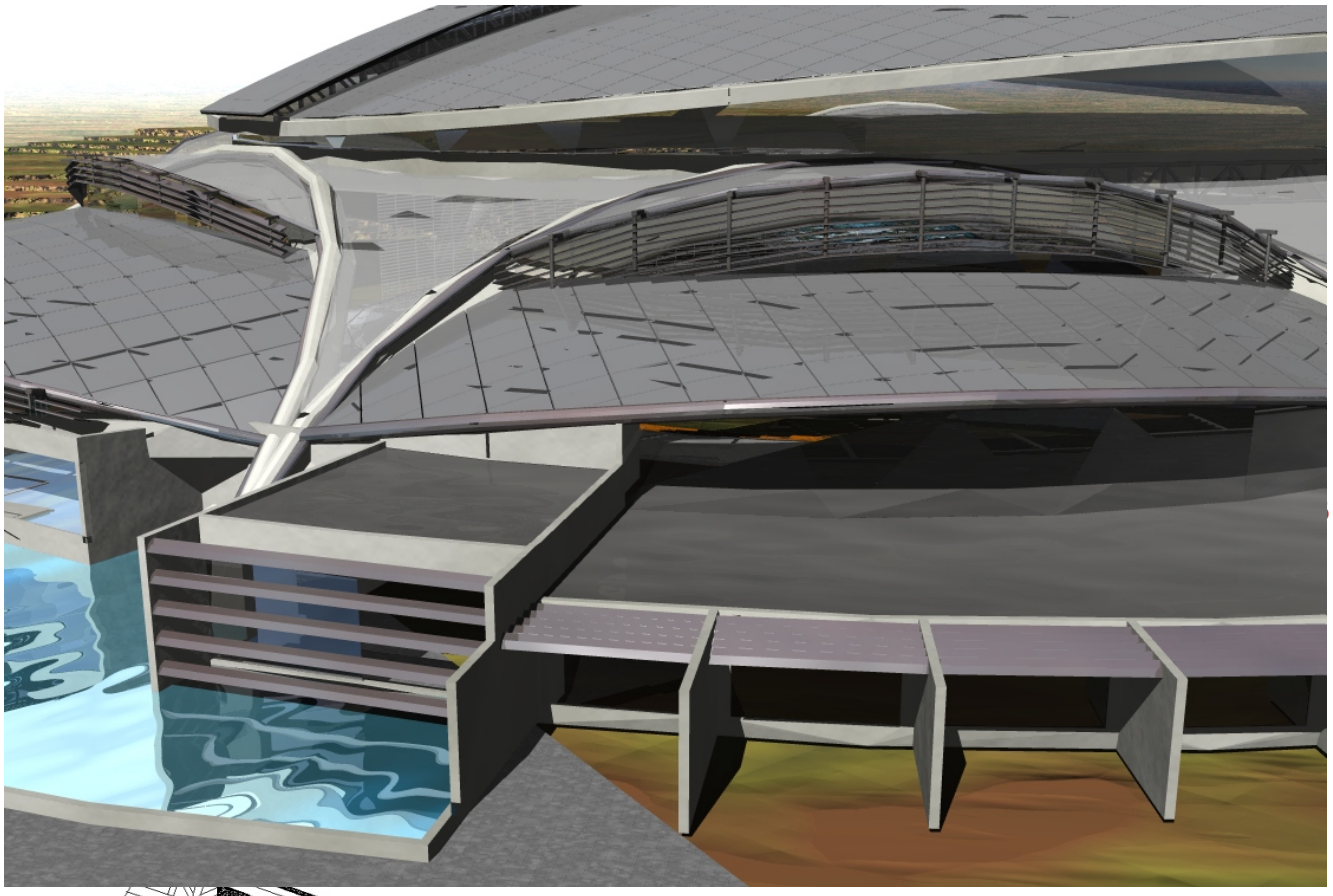
Weight training
VIP weight training
Aerobics hall
Spinning room
Cardiovascular training area

Gymnasium ground floor plan

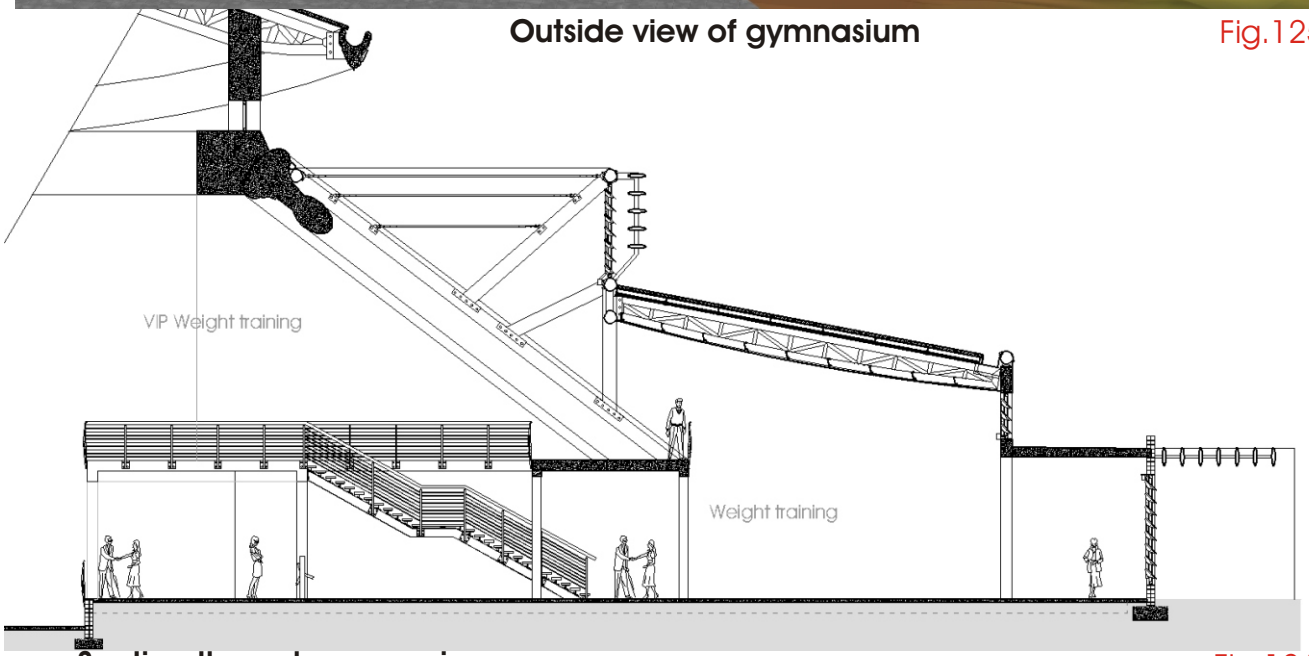
Fig.124

Weight training

The 362 m^2 weight training facility situated on the ground floor will mainly be used by private. This open plan layout with its large northen windows overlooks the Hennops river and is visually linked with the aerobics hall, spinning area, and indoor open space through glass curtain walls. This visual interaction between the different spaces gives this area a much more dynamic feeling. The fin walls that extrude from the gymnasium facade are controlling the sun movement to block the early morning sun which will be crucial for the temperature management in the gymnasium. The adjustable horizontal louvers between the fins will control the northen sun movement.



Outside view of gymnasium Fig.125



Section through gymnasium Fig.126

VIP weight training

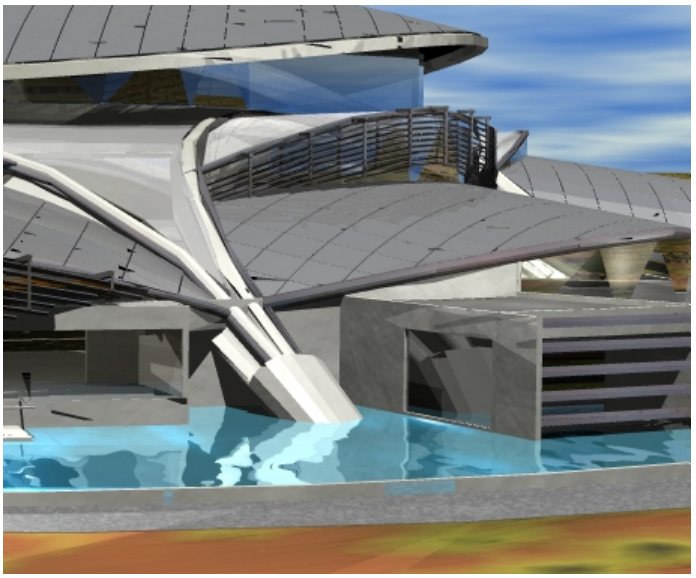
The 275 m² VIP section situated on the first floor is for sportsmen who stay in the hostels. This area overlooks the Hennops river, weight training area, aerobics hall and the indoor open space which makes it a focal point in the building where high performance athletes can be seen in action. The VIP section has a balcony overhanging into the indoor open space which contributes to the visual and interactive link between the indoor open space, restaurant and the VIP section. The VIP area is provided with a clerestory window with a transparent membrane covering for addition light infiltration and ventilation in the VIP section.

Aerobics hall

The aerobic hall situated on the ground floor has a transparent wall between the indoor open space and the aerobics hall that contributes to the visual link between the different facilities. Its double volume makes it a multi-functional hall that can be used for a variety of activities.

Spinning facility

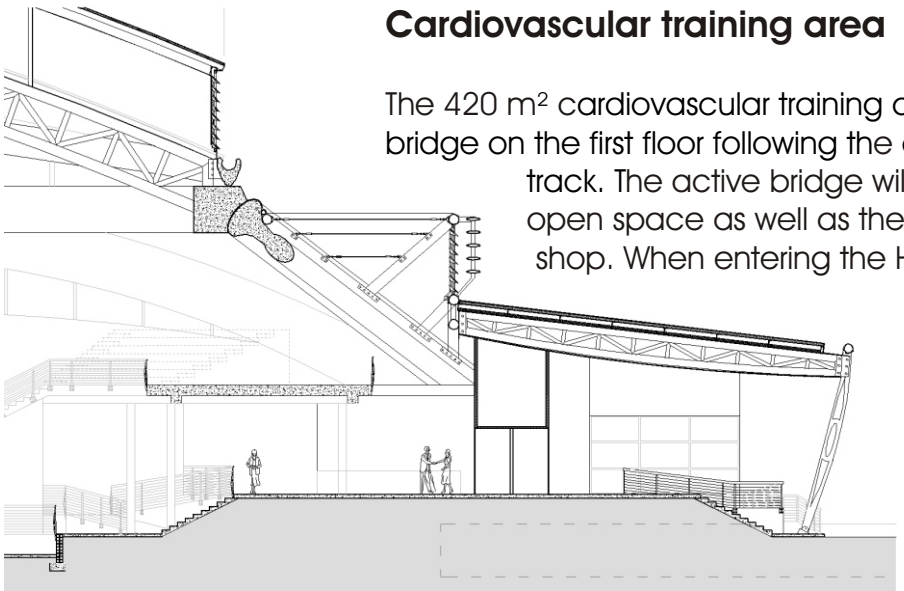
The spinning facility situated on the north-eatern side of the HPC has a glass facade that opens up onto the rainwater catchment pond. A spinning room is usually airconditioned so that cool air is blown into the room from the ceiling. This Cool air could cause injuries to the spinners if not correctly controlled. The pond will therefor cool down the spinning room with airconditioning that is blowing cool air slowly from the floor surface. The Eastern facade is provided with horizontal Louvers that will control the early morning sun.



Outside view of spinning room Fig.127

Cardiovascular training area

The 420 m² cardiovascular training area is a eight metre wide bridge on the first floor following the curve of the 200m athletic track. The active bridge will be visible from the indoor open space as well as the entrance foyer and sports shop. When entering the HPC the spirit of training would be enhanced by this cardiobridge with it's active vibe. This area of the gym will be used by a variety of people because of it's cardiovascular

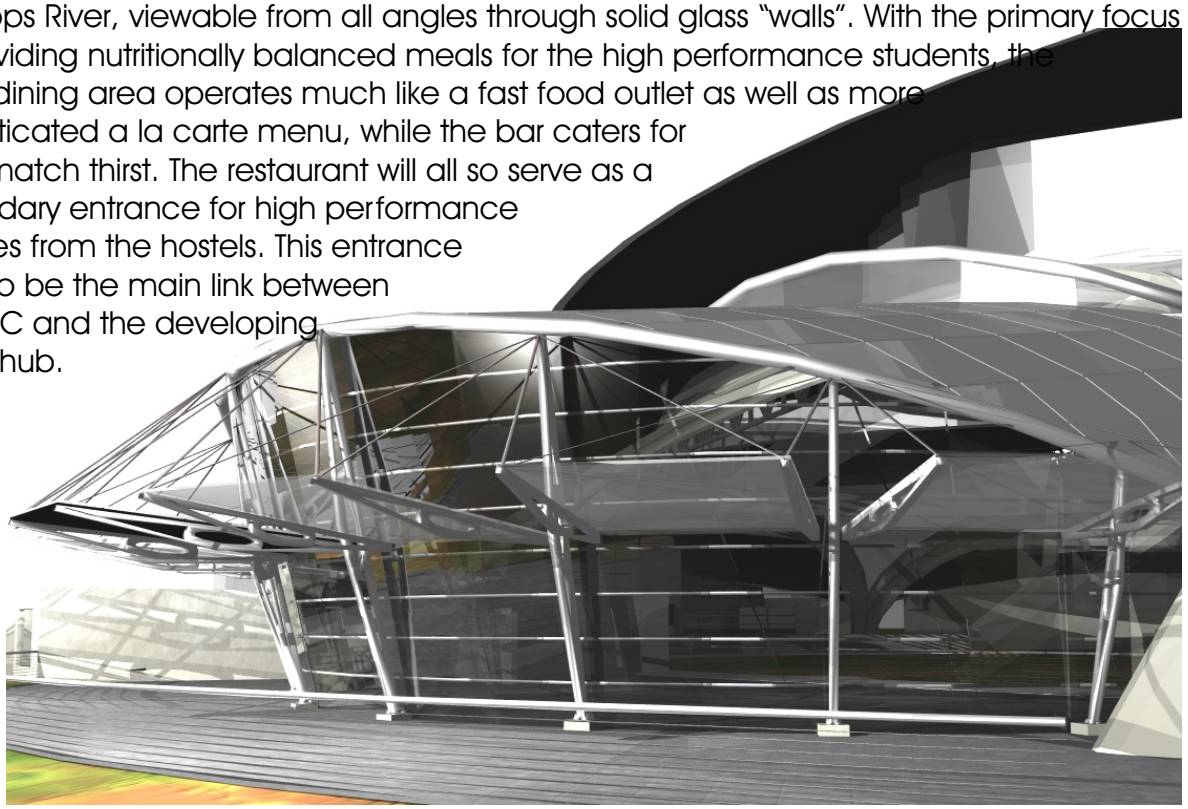


Section through entrance foyer showing cardiovascular bridge Fig.128

equipment. This area is also provided with a clerestory window covered by a transparent membrane roof cover for additional lighting and ventilation.

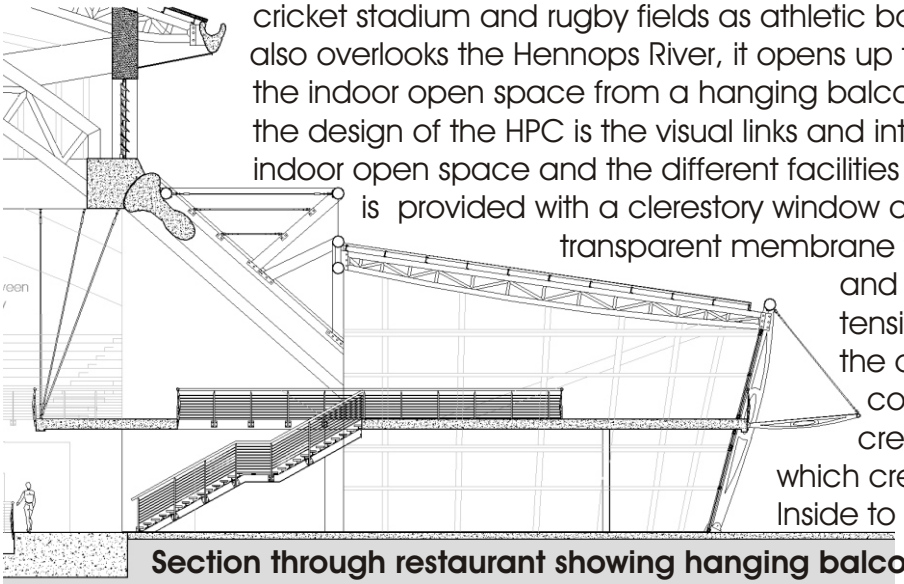
3.5.4 Restaurant

The high performance centre challenges the traditional view of residential dining facilities, and combines the fine dining experience with that of a refined canteen. Situated on the northern side of the building, the dinning facility has an idealistic view opening on to the Hennops River, viewable from all angles through solid glass "walls". With the primary focus of providing nutritionally balanced meals for the high performance students, the main dining area operates much like a fast food outlet as well as more sophisticated a la carte menu, while the bar caters for after-match thirst. The restaurant will all so serve as a secondary entrance for high performance athletes from the hostels. This entrance will also be the main link between the HPC and the developing sports hub.



Outside view of the restaurant overlooking the Hennops River Fig.129

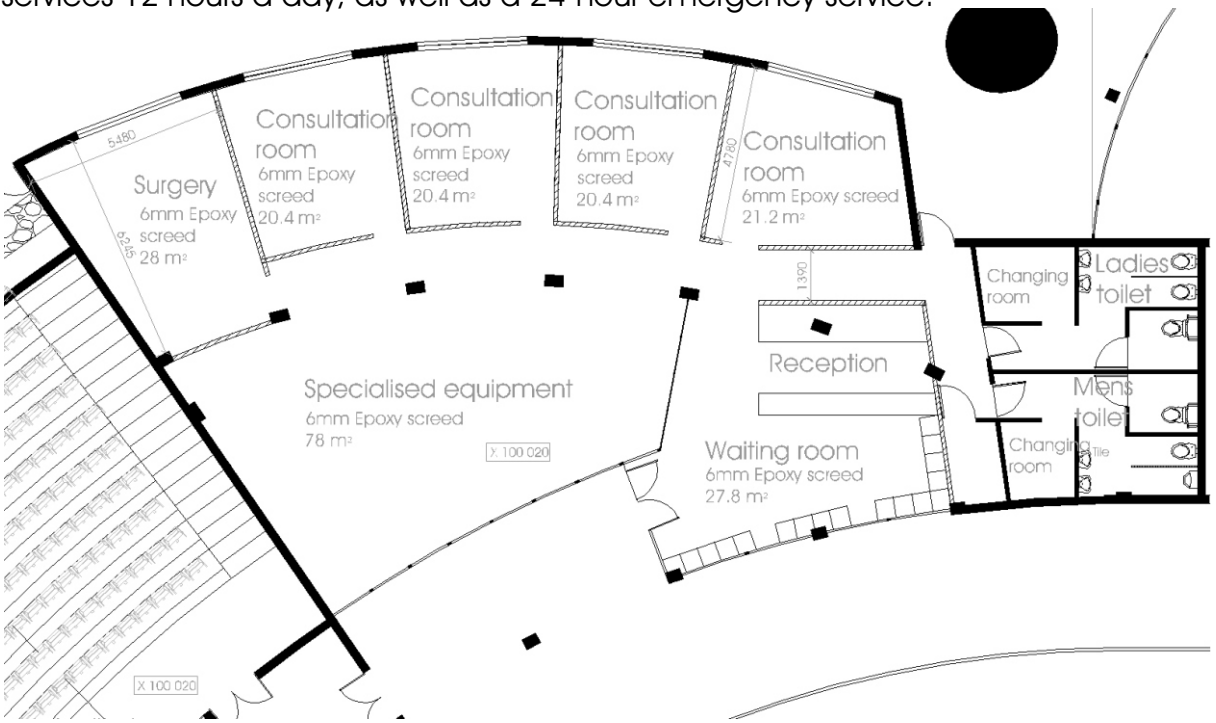
The restaurant is situated in the middle of the HPC which will serve as a central social area where athletes relax with a nutritional meal after practice. The 462 m^2 restaurant which can cater for 330 people consists out of two floors. The ground floor opens up to a patio overlooking the Hennops River with the stimulating sound of the rippling water and the cricket stadium and rugby fields as athletic background. The first floor also overlooks the Hennops River, it opens up to the inside overlooking the indoor open space from a hanging balcony. A strong concept in the design of the HPC is the visual links and interaction between the indoor open space and the different facilities around it. The restaurant is provided with a clerestory window covered with a transparent membrane for addition light infiltration and ventilation. Transparent tensile structures are fixed onto the outside of the restaurant covering the patio and creating a sense of place which creates a transition from the Inside to the outside.



Section through restaurant showing hanging balcony Fig.130

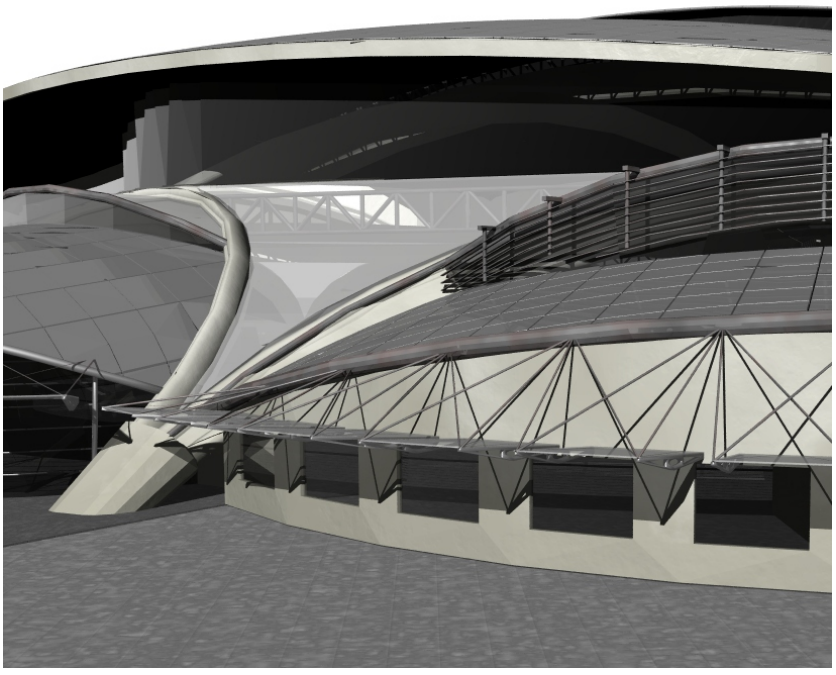
3.5.5 Medical centre

The medical centre will provide an all-encompassing medical service specialising in sports medicine. A variety of doctors will be brought together to form an unusual pool of talent - including a physiotherapist, chiropractor, sports dentist, a number of sports physicians, an orthopaedic surgeon and a radiologist, all focussed on the world of sports medicine. Students, guests and members of the public will all have access to their services 12 hours a day, as well as a 24-hour emergency service.



Medical centre layout Fig.131

The 308 m² medical centre situated on the northern side of the HPC is an open plan layout with internal partitioning. The consultation rooms overlook the Hennops River while the specialised equipment area has a visual link with the indoor open space through the glass wall. The specialised equipment area together with the indoor open space will be used for scientific analysing and measurement of athletes potential in specific sports and sports rehabilitation. The consultation rooms windows have a transparent tensile structure above it to control the northern and western sun movement.

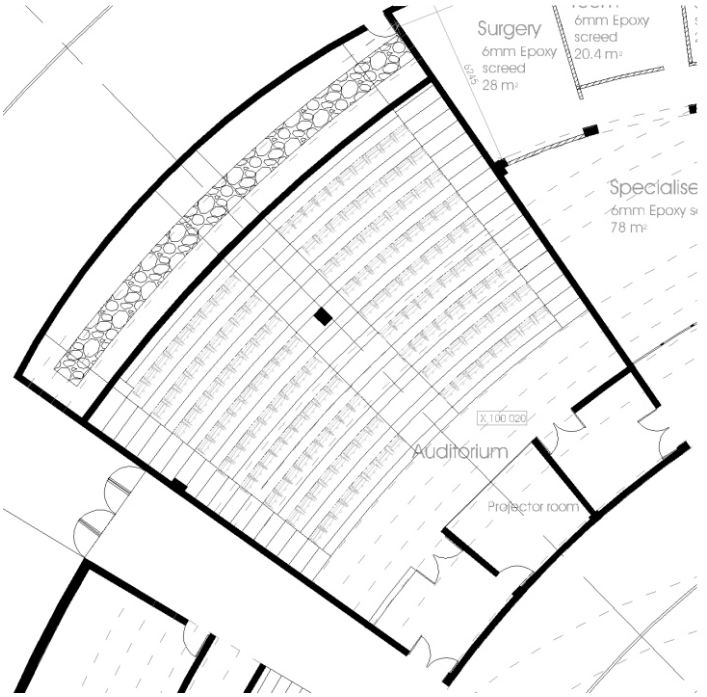


Outside view of medical centre Fig.132

3.5.6 Auditorium

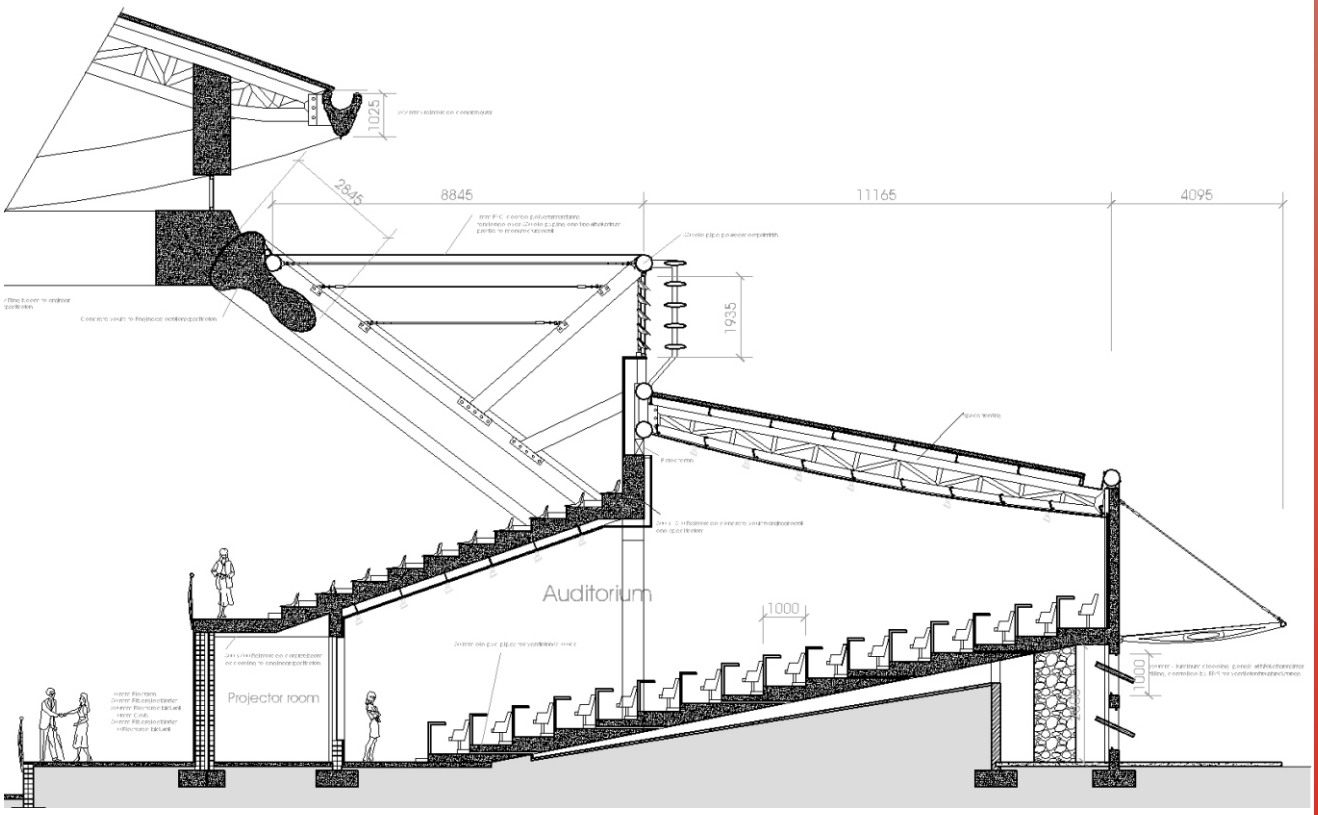
The 192 seater auditorium provides a high-tech environment focussing on comfort with ergonomically designed chairs, and is enhanced by state of the art audiovisual equipment.

The auditorium is available for hire to groups and also screens movies and sporting footage at regular intervals for individuals and groups to enjoy. The auditorium is also available for hire for conferencing and lecture purposes. Opening out onto the indoor open spaces, this facility also offers alternative catering and function facilities as well as being vital to the education of high performance athletes.



Plan of auditorium Fig.133

The auditorium situated on the north-western side of the HPC is naturally ventilated with a rock storage system. The cool air of the night enters the building through the openings on the north western side which cools down the rocks. In winter time the transparent tensile structures are pulled up so that the warm afternoon sun heat up the rocks for the next day. The openings in the wall will be controlled by the building management system according to the requirements. The space above the auditorium is used for a pavilion for the indoor open space.



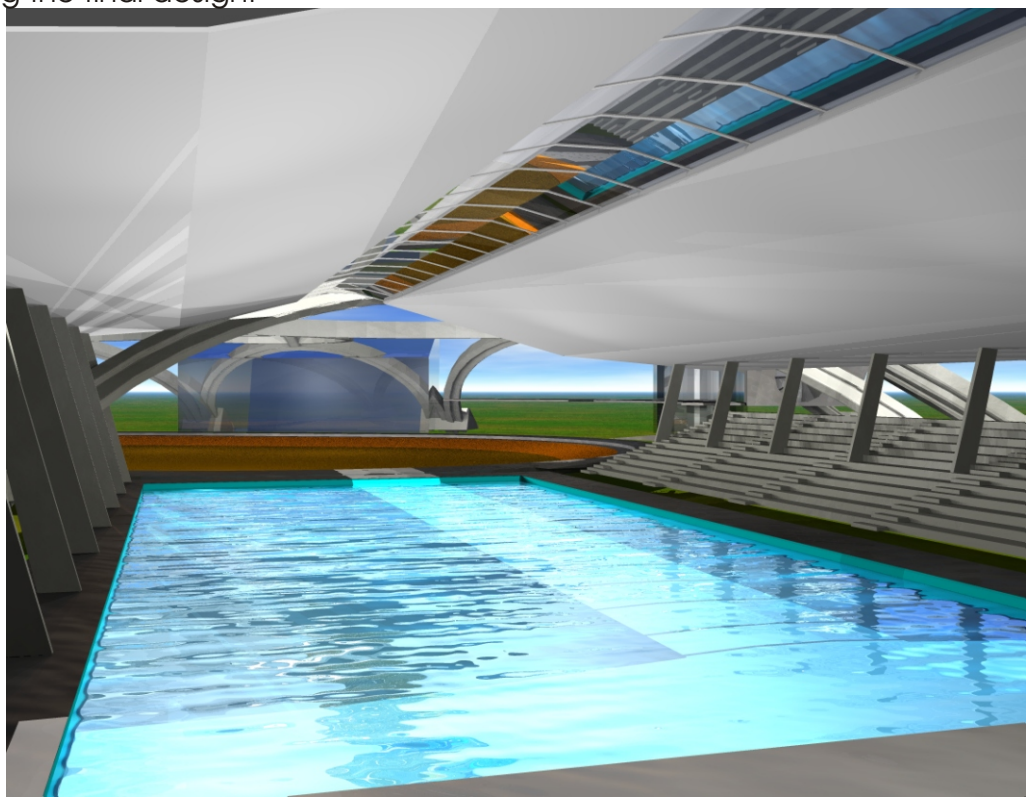
Section trought the auditorium showing part of pavilion on top Fig.134

3.5.7 Swimming pool

According to the clients brief an indoor Olympic size swimming pool where athletes could train in perfect conditions. The swimming pool will be used for training, gala events, water treatment rehabilitation, lifesaving and scuba courses. The swimming pool will be provided with under water and roof mounted cameras that run on a rail for reacher on athletes in action incorporation with the CSIR. The Olympic size swimming pool went through three design phases before reaching the final design.

First phase

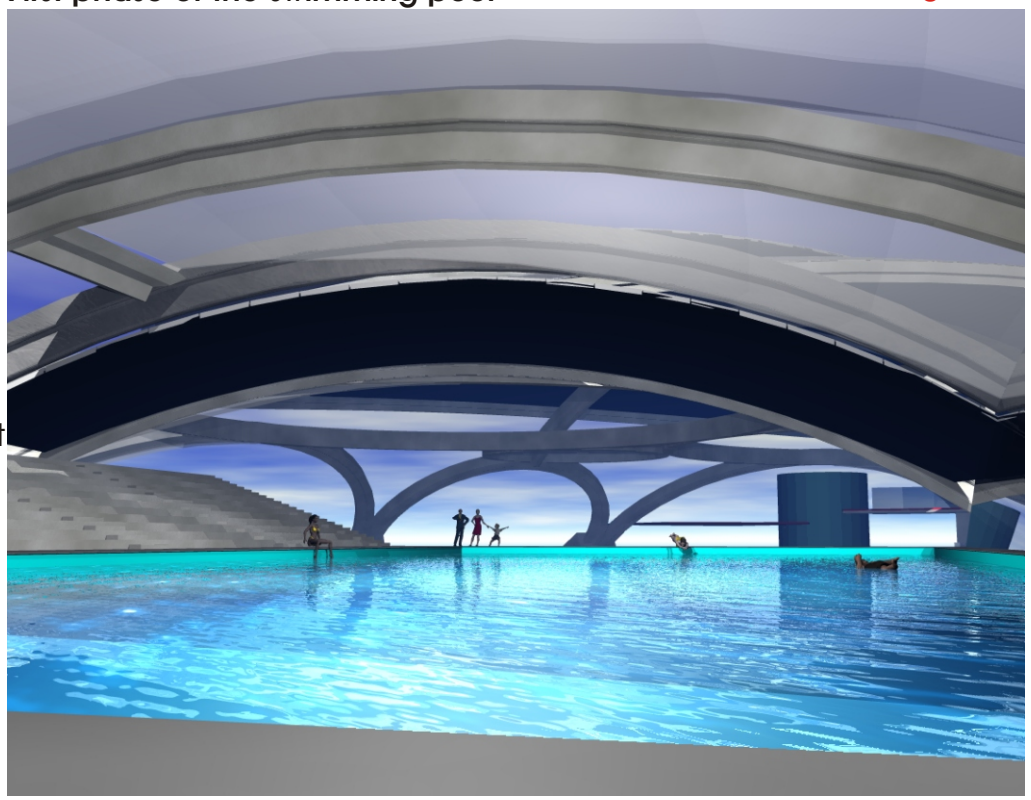
In the first phase the swimming pool situated on the southeastern side of the HPC had a solid roof cover with a skylight for light infiltration. The square form of the roof construction did not fit into the organic design of the HPC. The light requirement also did not live up to the expectation.



First phase of the swimming pool Fig.135

Second phase

In the second phase the swimming pool was moved to the southwestern side of the HPC where the pavilion will form part of the embankment. The roof structure becomes a concrete structure suspended over the width of the pool with a transparent roof cover. This structure was too heavy for its function and the structural connection between swimming pool roof structure and dome became too complex and expensive.



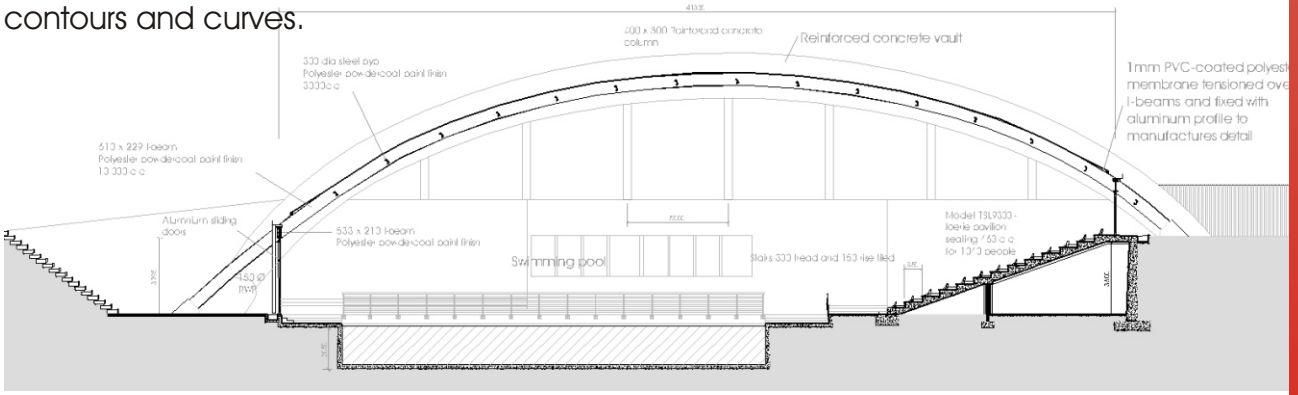
Second phase of the swimming pool Fig.136

Third phase

The final solution was an elegant lightweight steel construction suspended over the swimming pool. This lightweight transparent roof cover encloses the indoor swimming pool that creates an all year round training facility. The open connection between the indoor open space and the swimming pool creates a visible link between theses two dynamic training facilities that are accessible to high performance athletes and the

Third and final phase of swimming pool with lightweight roof construction Fig.137

The indoor swimming pool is naturally ventilated with glass facades that slide open in the length of the pool. The swimming pool area is sunk into the ground so that the pavilion could open up on ground level at the top of the pavilion. The elegant lightweight steel construction that is partly moulded into the ground became part of the landscape with its contours and curves.



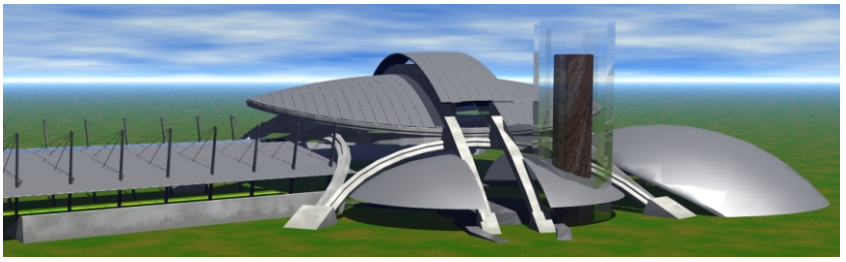
Section through swimming pool Fig.138

3.6 Final development

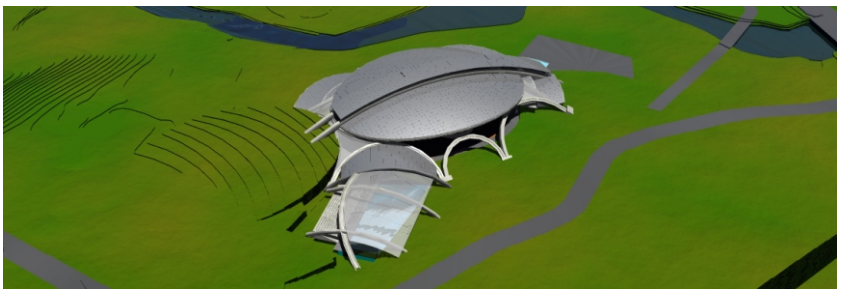
The Hi-Performance Sport Centre is a functional design that must be appealing to the high performance athletes who belong to the higher echelons of their national, provincial, club or school structure. These performance enhancers who want to improve their performance, health and fitness enthusiastic, and patients requiring rehabilitation and intervention who are required by virtue of an injury or illness to frequent a curative service before returning to one of the above customers group. The design went through a few design decisions and phases before a final product could be finalised.

The elegant dome structure covering the indoor open space was the form to work from. All the facilities that are attached to this structure must form an integrated whole that will complement the dome structure. An option was to design smaller buildings around the dome with connections between the dome structure and these buildings around it. This approach was called because of the decision that the HPC must have integrated facilities that could interact with one another, visually and functionally. In the first attempt the dome structure was not structurally effective and the facilities around did not integrated with the dome structure. The structure changes to a high performance structure with facilities that became more integrated with the dome structure but still not efficient enough. To design the facilities around the dome structure as an integrated whole was quite a complex process. A solution was to fill the openings between the vaults with a transparent membrane for additional lighting in the indoor open space and to create a simple elegant transition between the dome structure and roof structures that will be attach. The smaller aluminium roof structure grew out of the vaults that are aesthetic more acceptable and legible.

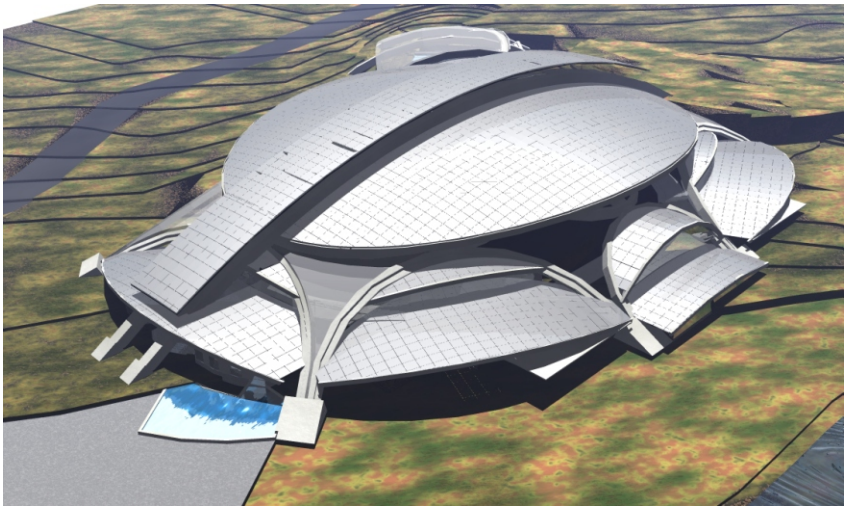
First attempt for HPC design Fig.139



Second attempt for HPC design Fig.140

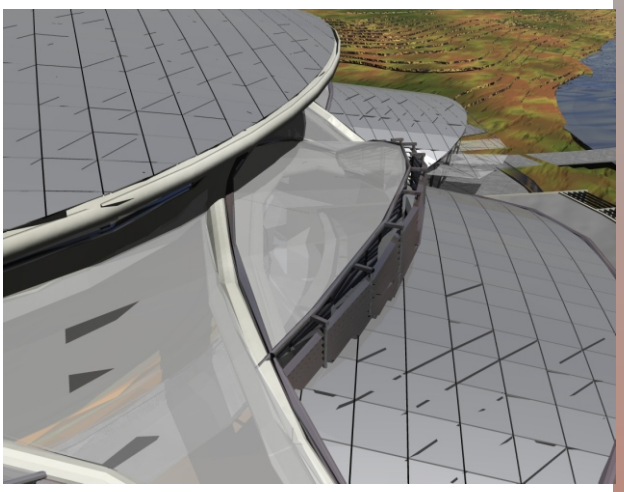


Third attempt for HPC design with southern view Fig.141



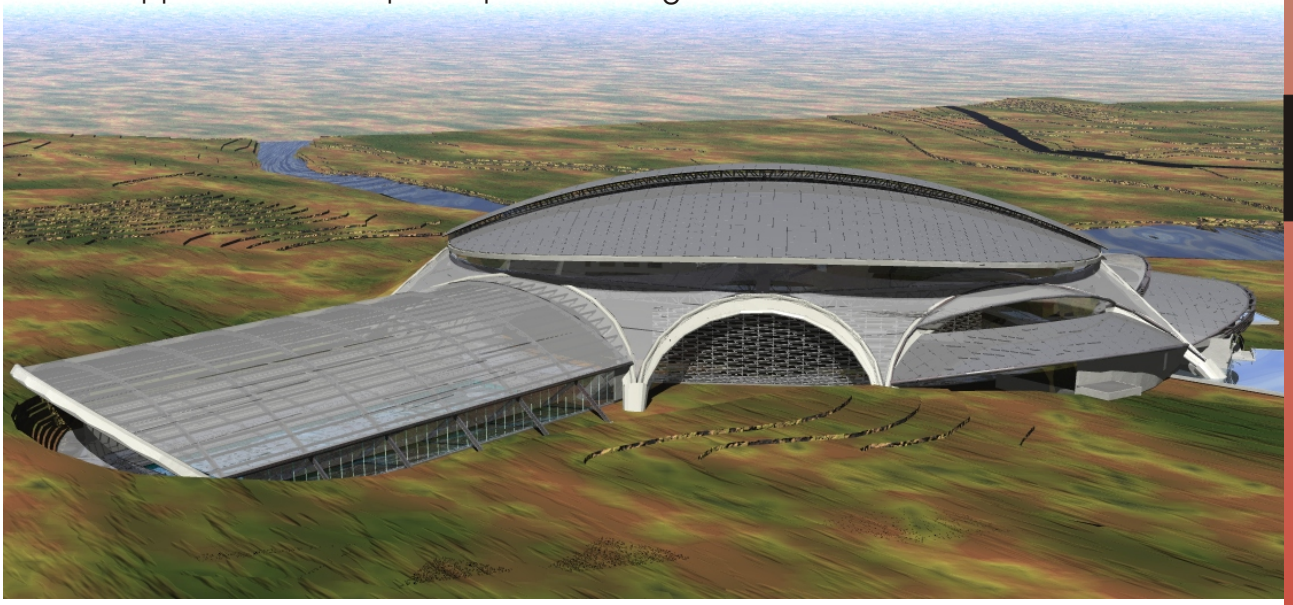
Third attempt for HPC design with norteast view Fig.142

The clerestory windows on top of each roof structure are provided with a transparent membrane roof cover for additional lighting in the HPC. This roof cover is also used as an elegant transition tool between the dome structure and the additional smaller roof structures. The smaller roof structures have become much more integrated with the dome structure and still it provides the interactions between the different facilities in the HPC.



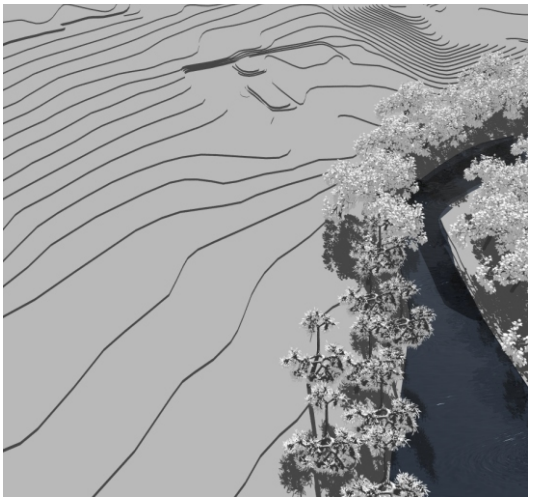
View of transparent membrane roof covers Fig.143

The indoor open space approach is an indoor facility that can open up to the outside and that is naturally lighted and ventilated. The high roof, transparent membrane roof covers, and southern facade with its roller shutter doors, opens the building up as an indoor outdoor space that is an all year round training facility. The louver windows situated between the dome and sub roof structure are controlled by the building management system according to the ventilation requirements of the indoor open space. This louver windows contribute to the indoor outdoor approach which opens up the building.



Southern view of HPC showing the translucent roller shutter doors Fig.144

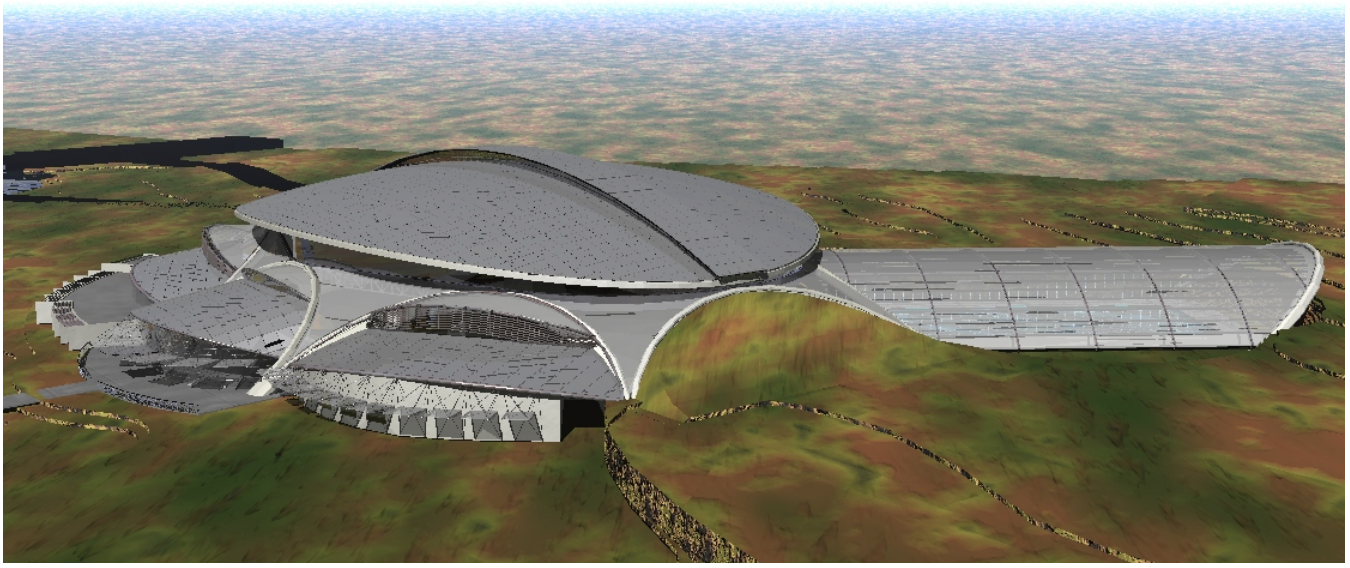
The HPC is designed and paced into the site according to the flood line and the landscape's topography. The underground water tank fits into the site without major excavations. All excavated soil will be used to fill the site up in the western site of the HPC to mould it into the site. The flowing lines of the landscape become part of the HPC's flowing forms that make it part of the site as well as part of the integrated environment and habitats. The flowing lines of the HPC that moulds it into the site contribute to the flowing spaces in the building.



Site contours Fig.145

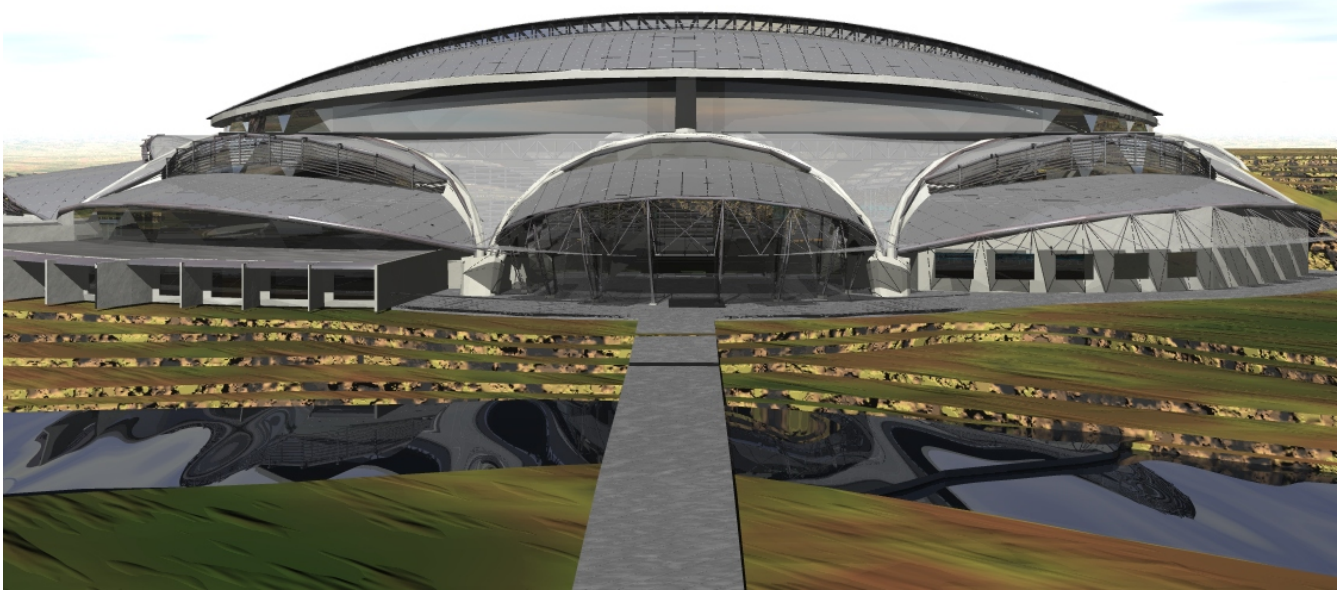
3.7 To conclude

The HPC achieves the hi-performance look with its hi-performance structure that is moulded into the site. The indoor, outdoor feeling is created successfully with the large openings and transparent membranes that connects the building with the outside. The building functions as a whole with integrated facilities and function, looking out on one another with the Hennops River as tranquil backdrop. The HPC provides a holistic and integrated approach in the



Northwestern view of HPC Fig.146

Developing sports hub that embraces a fusion between advanced technology and performance backed by science. This landmark of sport science provides an objective and unbiased sport science product that will serve high performance athletes, the professional sports market, corporate markets and the public.



Nothern view of HPC Fig.147

Project Cost Estimation

Hi-Performance Sport Centre

		No	Area per space	Total area	Total area m	Cost	Total cost
Administration area		1	639		639	R 3,100.00	R 1,980,900
	Entrance	1	151	151			
	Reception	1	30	30			
	Administration offices	4	22	88			
	strong room	1	5	5			
	Security office	1	12	12			
	Shop	1	341	341			
	Circulation	1	12	12			
Gymnasium			1707		1620.4	R 3,100.00	R 5,023,240
	Control desk/supplements	1	24.6	24.6			
	4 Consultation rooms	4	16.25	65			
	Circuit training and cardio equipment	1	420	420			
	Weight training	1	361	361			
	VIP weight training	1	275	275			
	Aerobics	1	245	245			
	Toilets	1		0			
	Male	1	83.8	83.8			
	Female	1	101	101			
	Circulation	1	45	45			
Restaurant					701	R 3,300.00	R 2,313,300
	Restaurant	1	462	462			
	Kitchen	1	101	101			
	Circulation	1	115	115			
	Toilets						
	Male	1	11.5	11.5			
	Female	1	11.5	11.5			
Medical			308.3		308.3	R 3,100.00	R 955,730
	Reception	1	20	20			
	Storeroom	1	3	3			
	Waiting room	1	27.8	27.8			
	5 Consultation room	5	22.6	113			
	Specialized equipment	1	76.2	76.2			
	Circulation	1	30.9	30.9			
	Toilets						
	Male	1	17.9	17.9			
	Female	1	19.5	19.5			
Auditorium		1	275.9	275.9			
Swimming		1			2337	R 2,900.00	R 6,777,300
	Swimming pool	1	1512	1512			
	Pavilion for 1200 people	1	610	610			
	Pump and service	1	95	95			
	Office and administration	1	120	120			
	Circulation	1					
Squash					219.6	R 3,300.00	R 724,680
	Courts	2	63.8	127.6			
	Pavilion for 132 people	1	71	71			
	Circulation	1	21	21			
Indoor open space					6939	R 6,600.00	R 45,797,400
	Running Track 200m	1	3987	3987			
	Pavilion for 3200 people	1	1627	1627			
	Circulation	1	1325	1325			
Total					**12764.3**	**R 3,628.57**	**R 63,572,550**

Project Budget

Hi-Performance Sport Centre

Project analysis	
Area of building	**R 12,764.30**
Estimated cost per m	R 3,628.57
Estimated building cost	R 63,572,550.00
Professional fees	R 4,049,823.00
Estimated disbursement cost	R 317,862.75

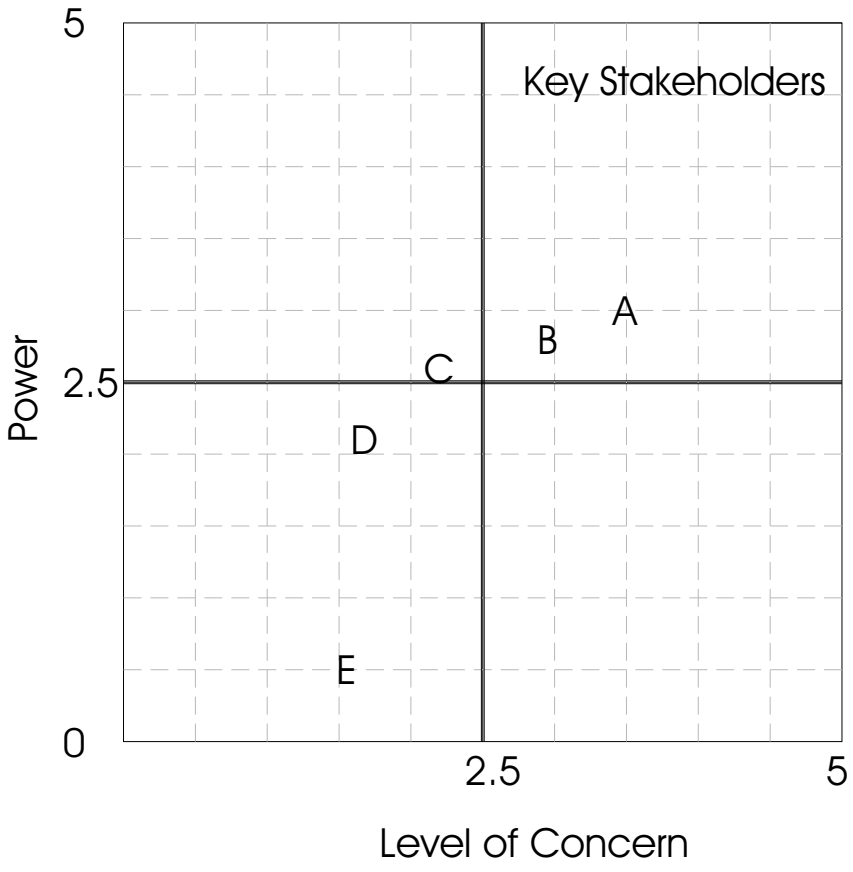
Subdivision of fee for the various stages of work

Stage	Description	Percent	Fees	Cost per man hours	Man hour budget	Used	% Used	Remaining man hours	no. of persons	Hours duration	Week duration
1	Appraisal and definition of the project	5	R 202,491.15	R 223.00	908	1000	90.80%	-92	4	227	6
2	Design concept	15	R 607,473.45	R 223.00	2724	3500	77.83%	-776	5	545	14
3	Design development	15	R 607,473.45	R 149.00	4077	4300	94.81%	-223	4	1019	25
4	Technical documentation	40	R 1,619,929.20	R 74.00	21891	25600	85.51%	-3709	12	1824	46
5	Contract administration and inspection	25	R 1,012,455.75	R 223.00	4540	5000	90.80%	-460	4	1135	28
Total week duration											119
Years required for project approval											2

Analysing Stakeholders Influence

		Power			Level of Concern		
	Stakeholder Group	Influence of others	Direct control of resources	Y-axis	Technical	Social	X-axis
		0.35	0.65		0.2	0.8	
A	Sport Institute of South Africa	0	5	3.25	1	4	3.40
B	Centurion Town Council	1	4	2.95	2	3	2.80
C	Super Sport	2	3	2.65	3	2	2.20
D	Centurion Rugby Club	3	2	2.35	4	1	1.60
E	CSIR	4	1	2.05	5	0	1.00

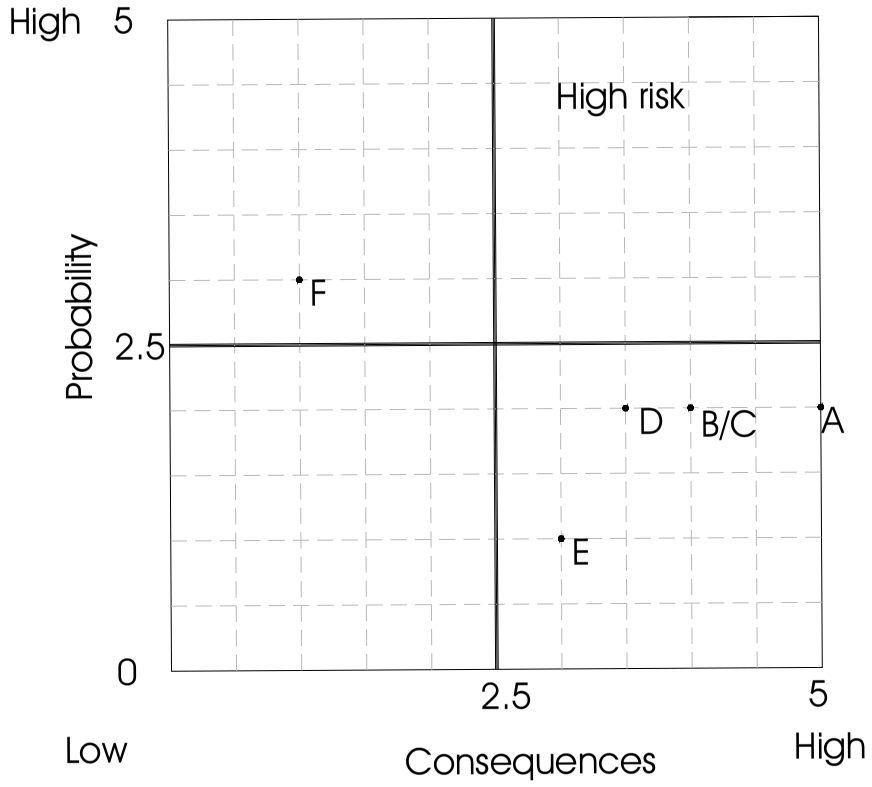
Plot results

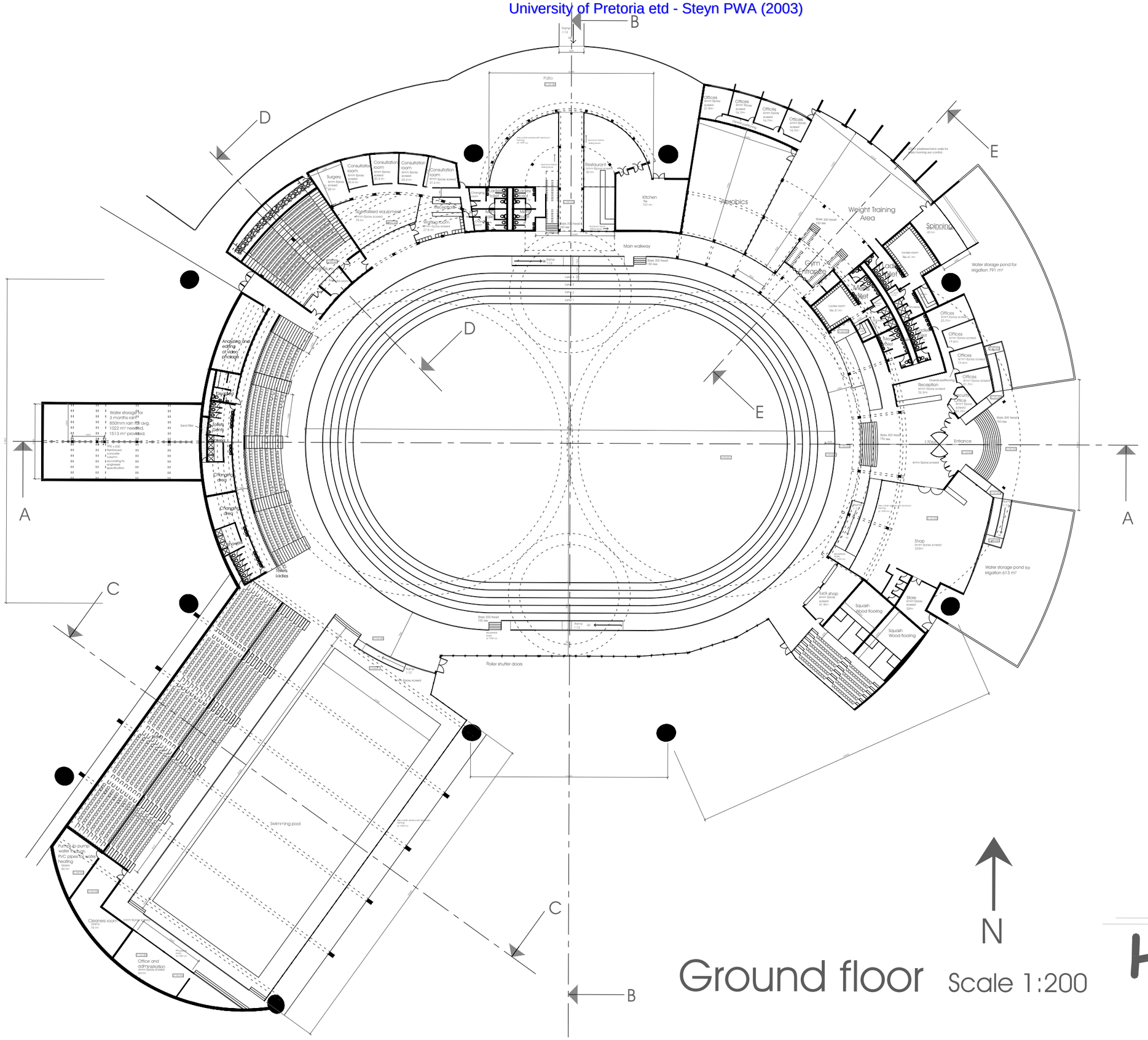


Risk Management for Hi-Performance Sport Centre

Rank	Description	Risk Self Assessment *(Consequence)*	Control Self Assessment *(Probability)*	Risk Factor	Category Ranking	Mitigation Measure
A	Management of facilities	5	2	10	Medium	Appointment of HPC manager to manage the different activities and bookings
B	Cost management	4	2	8	Medium	Ensure integration of PM and financial system and appointment of QS
C	Not enough time	4	2	8	Medium	Implementing strict adherence to tracking system and feedback
D	Material shortage	3	2	6	Low	Ensure good communication and tracking with suppliers
E	Flood	3	1	3	Low	Ensure that bridge will sustain all flood impacts with adequate preventions
F	Competition	1	3	3	Low	Ensure adequate advertising and marketing of multifunctional facilities of HPC

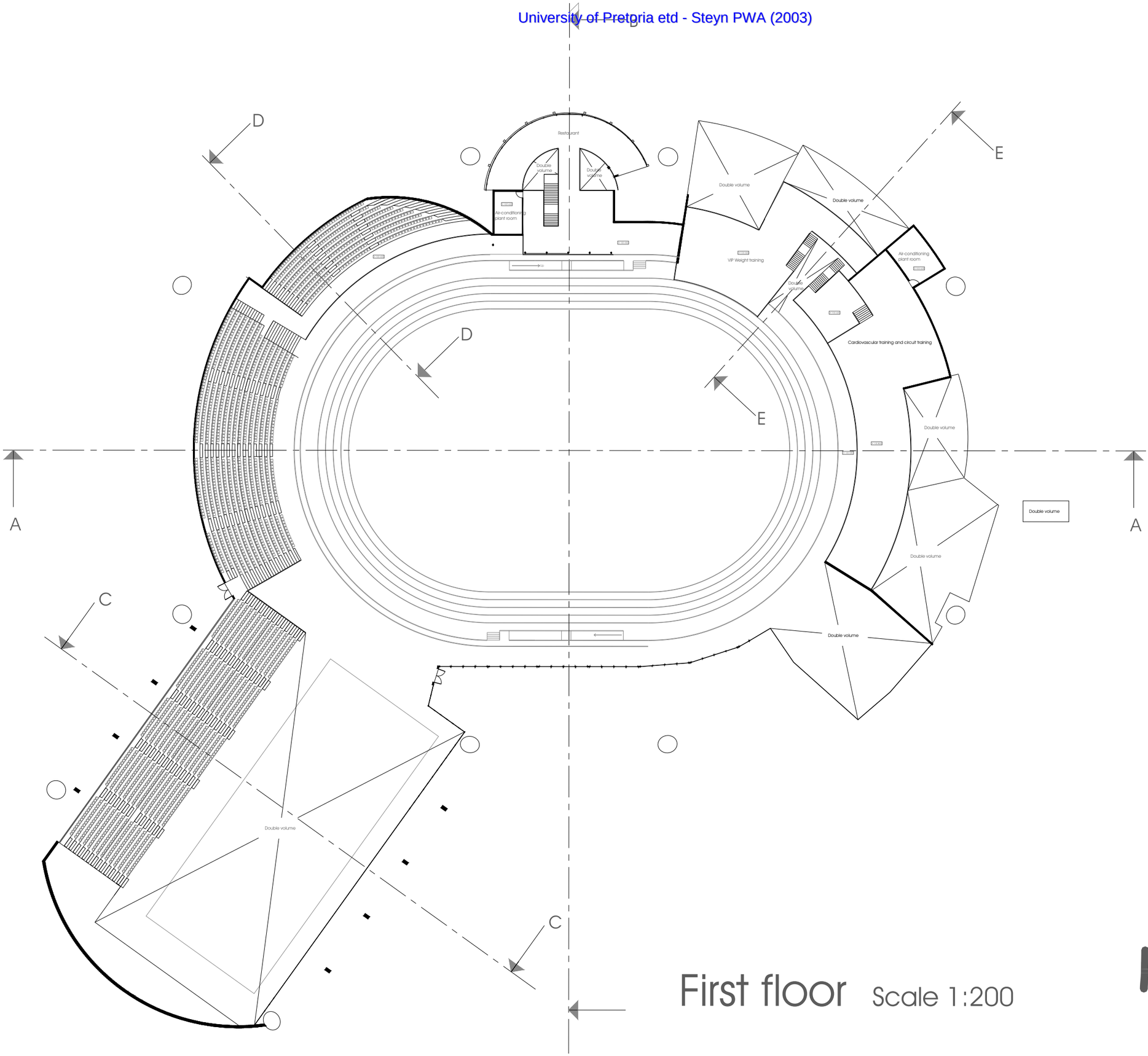
Risk rankings





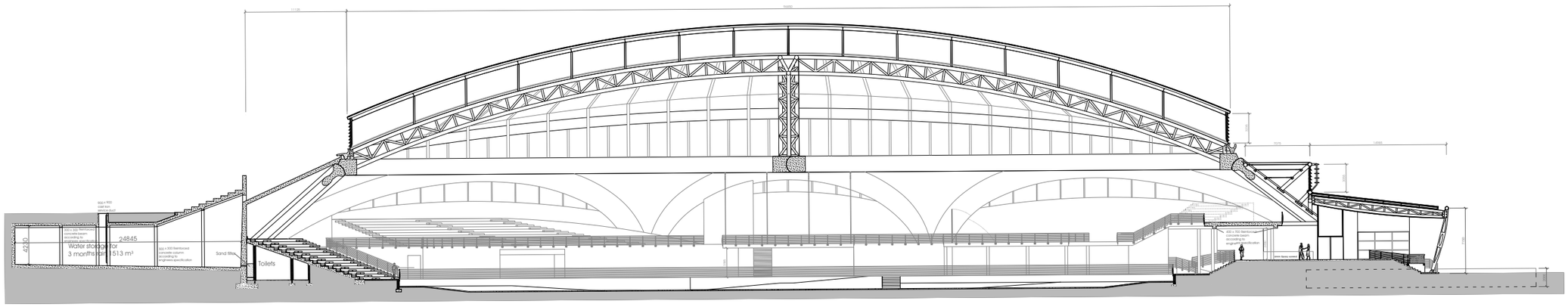
Ground floor Scale 1:200

HPC

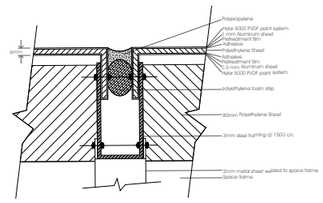


First floor Scale 1:200

HPC



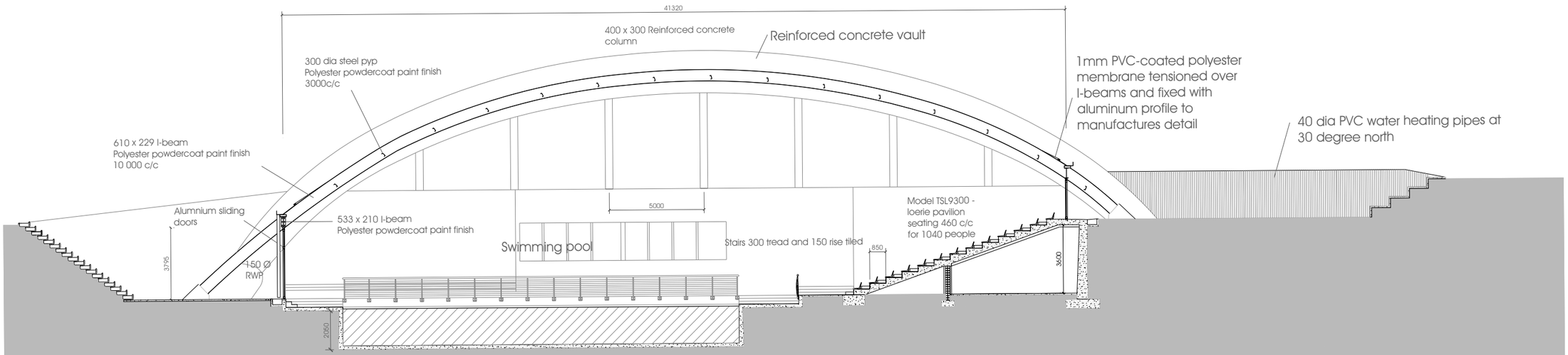
Section A-A Scale 1:100



Detail 1 Scale 1:10

Section B-B Scale 1:100

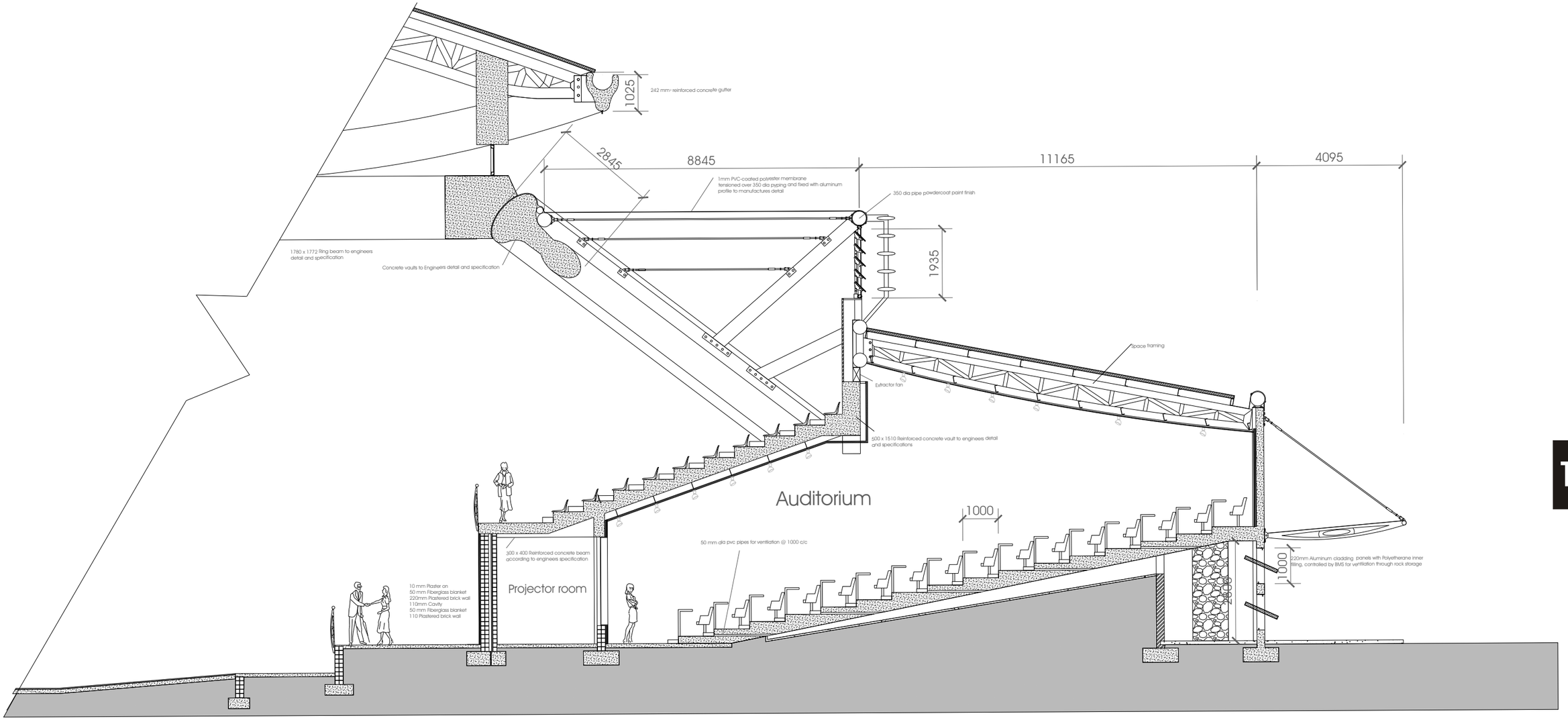
HPC



Section C-C Scale 1:100

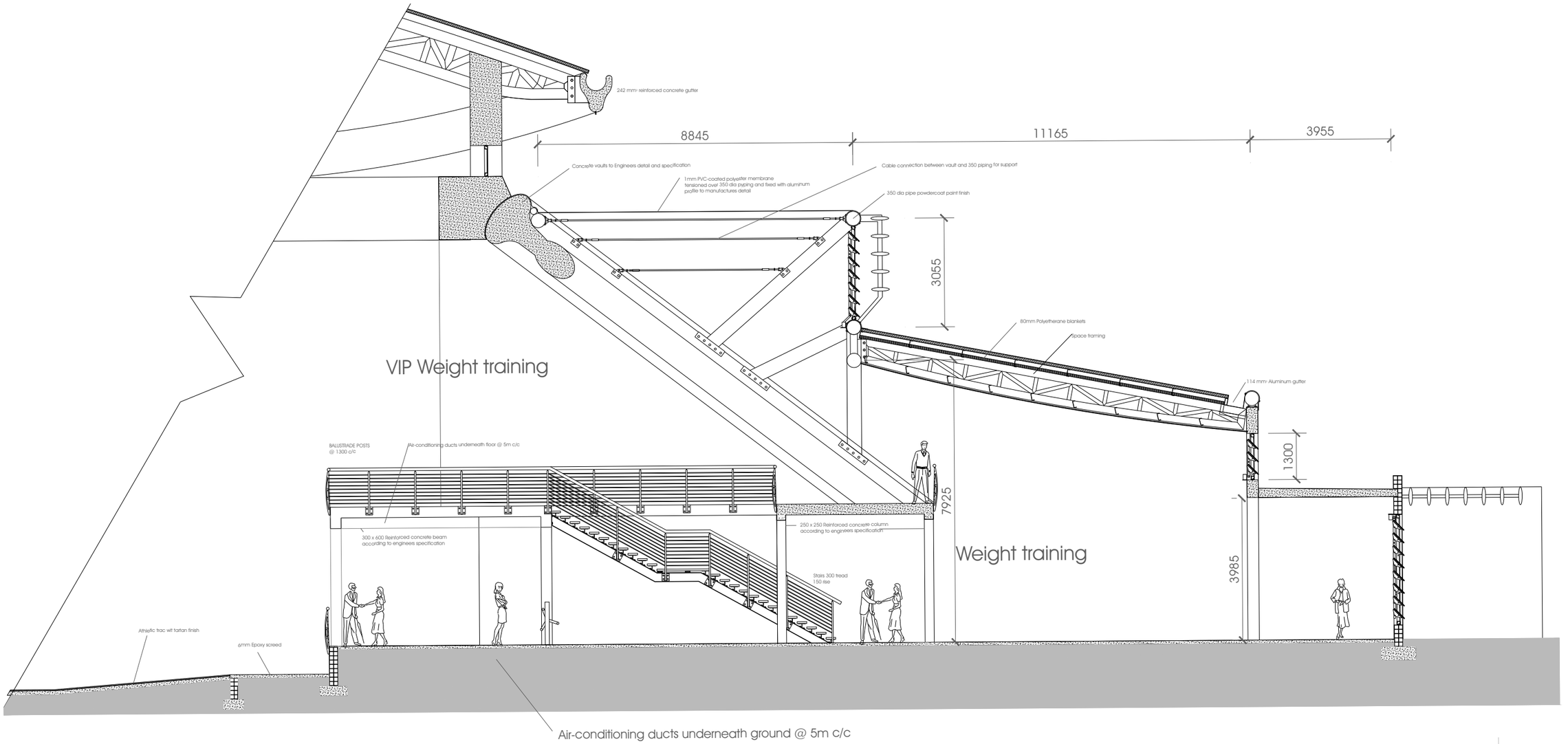
HPC

p 119



Section D-D Scale 1:50

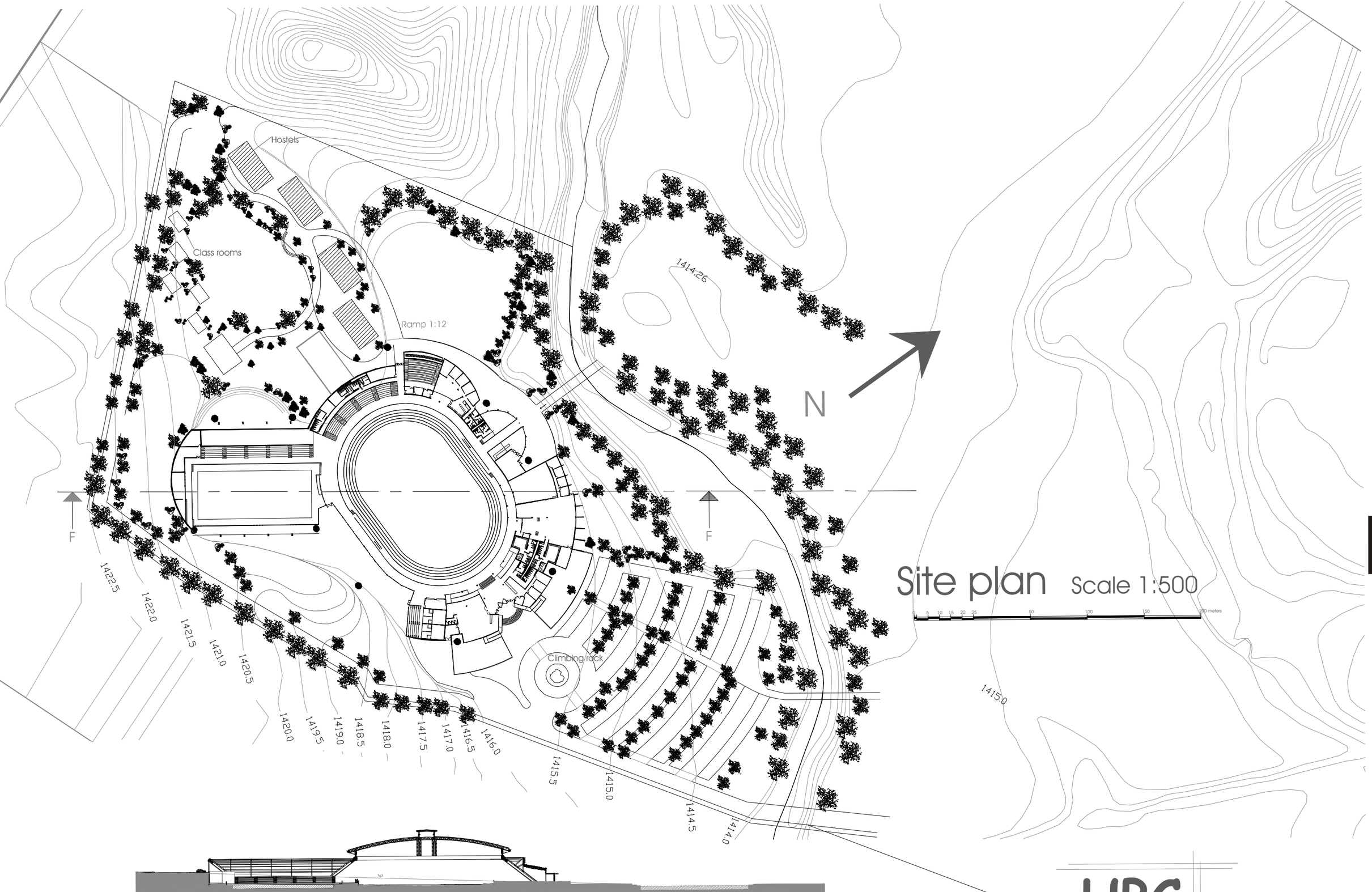
HPC



Section E-E Scale 1:50

HPC

p 121



Site plan Scale 1:500

Section F-F Scale 1:500

HPC

p 122

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