Chapter 2

Baseline and technical documentation

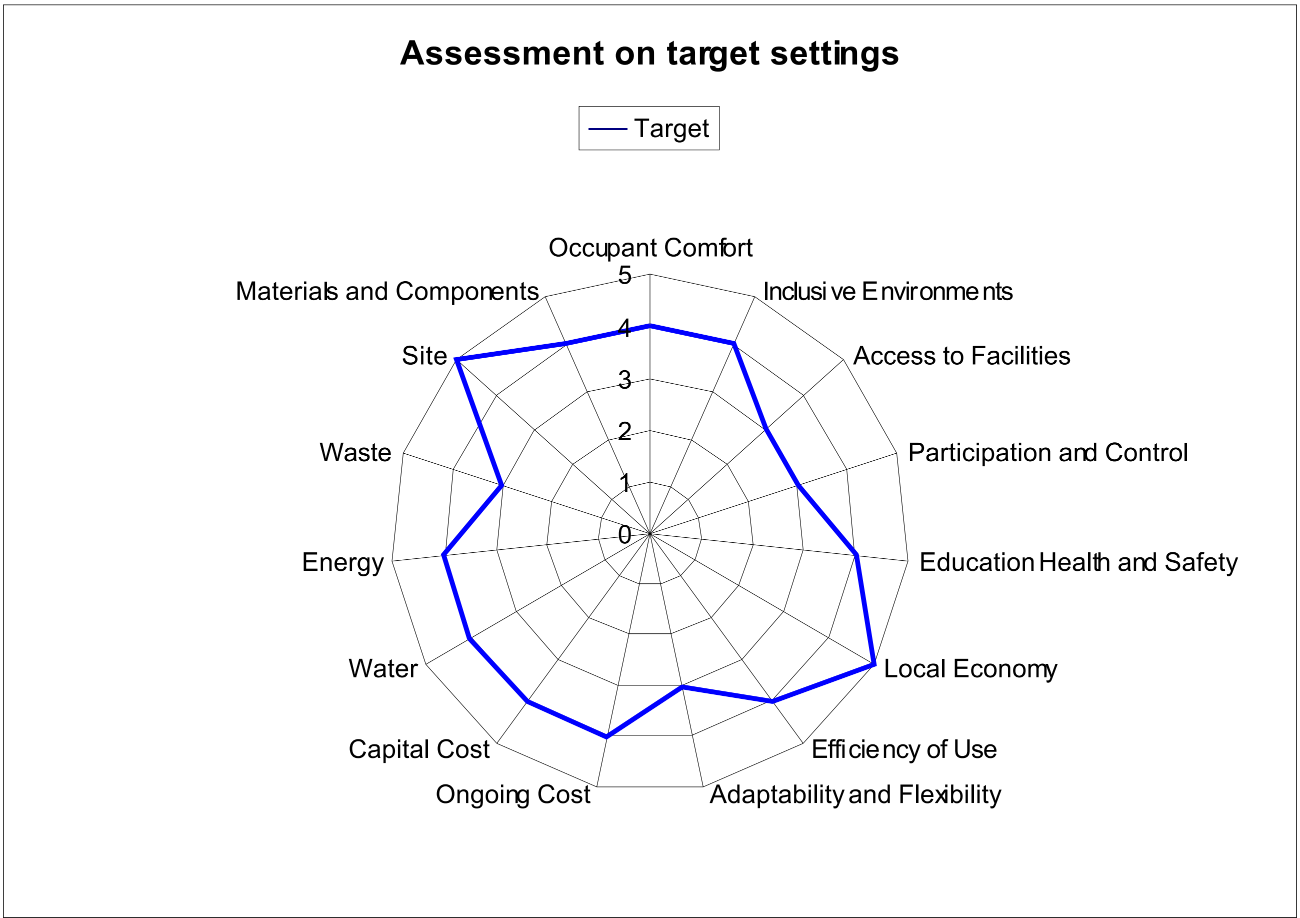
The Sustainable Building Assessment Tool

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)

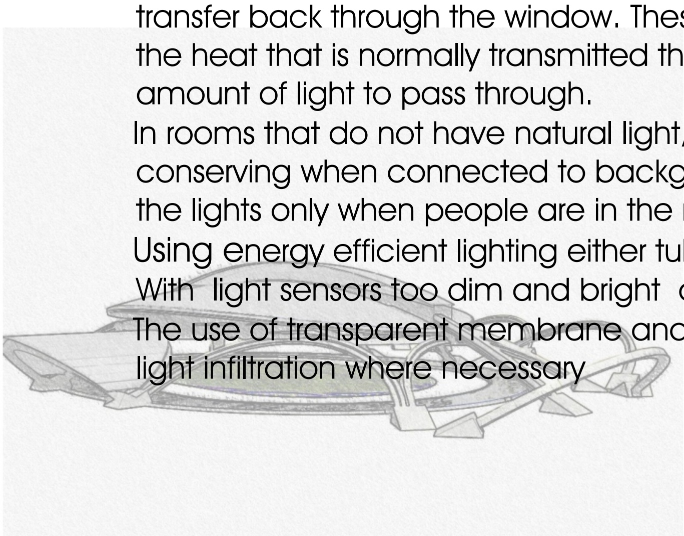
According to the accommodation schedule different light is required for different purposes. The more detailed and exacting the work that is to be carried out in a working environment such as the offices, kitchens and medical centre, the higher the level of illumination on the working plane needs to be.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

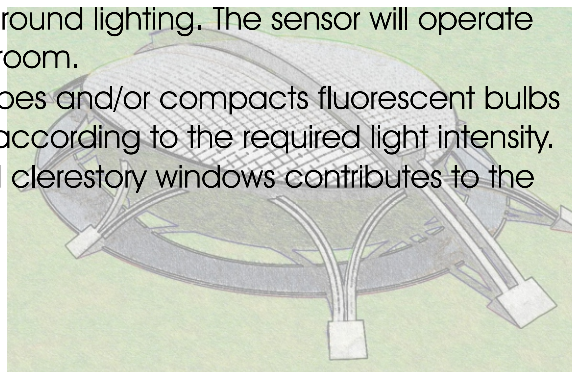
Assessment (5)

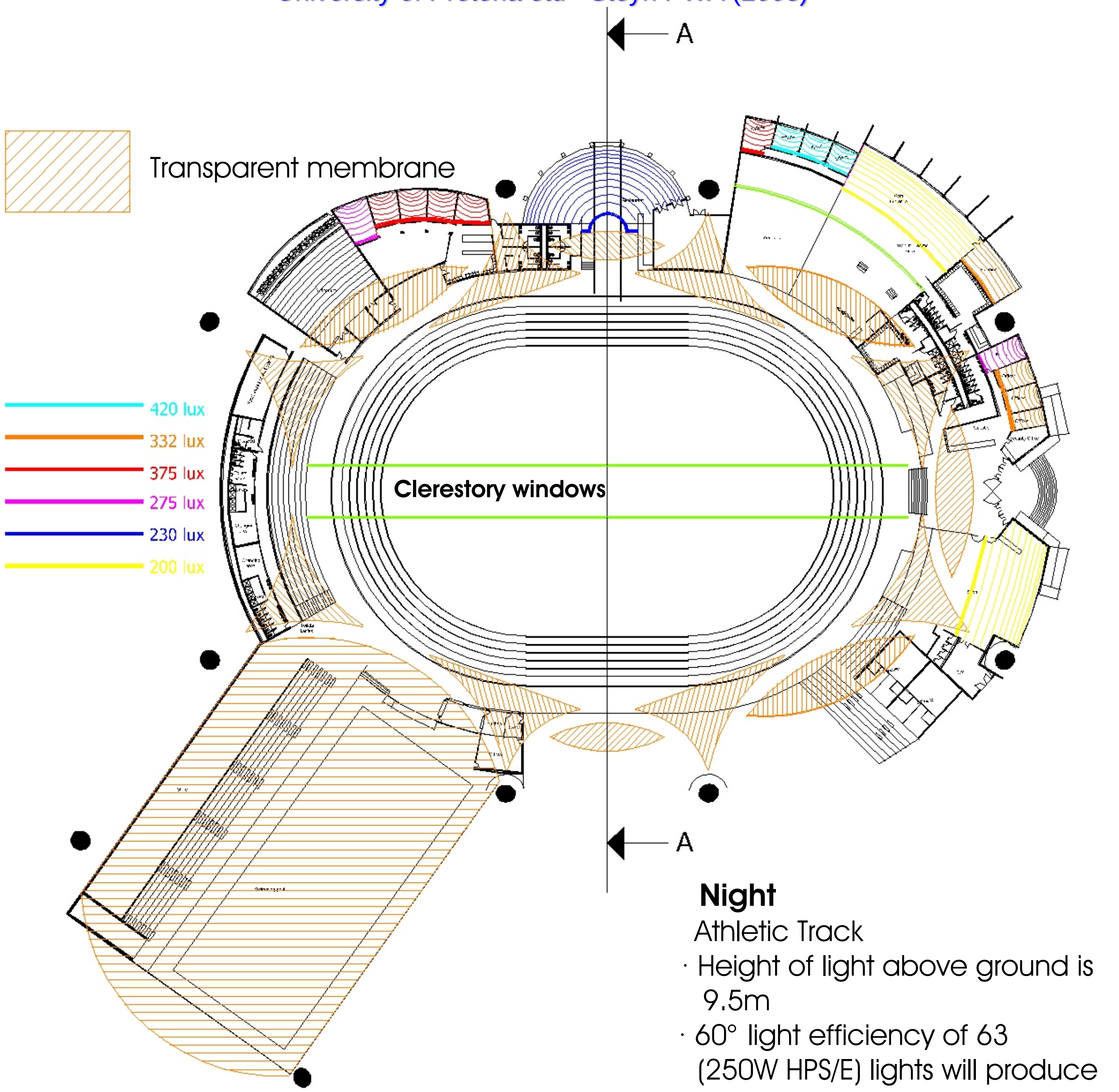
Windows on the northern side receive up to two to three times the amount of light compared to southern facing windows, even when ignoring direct radiation.

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







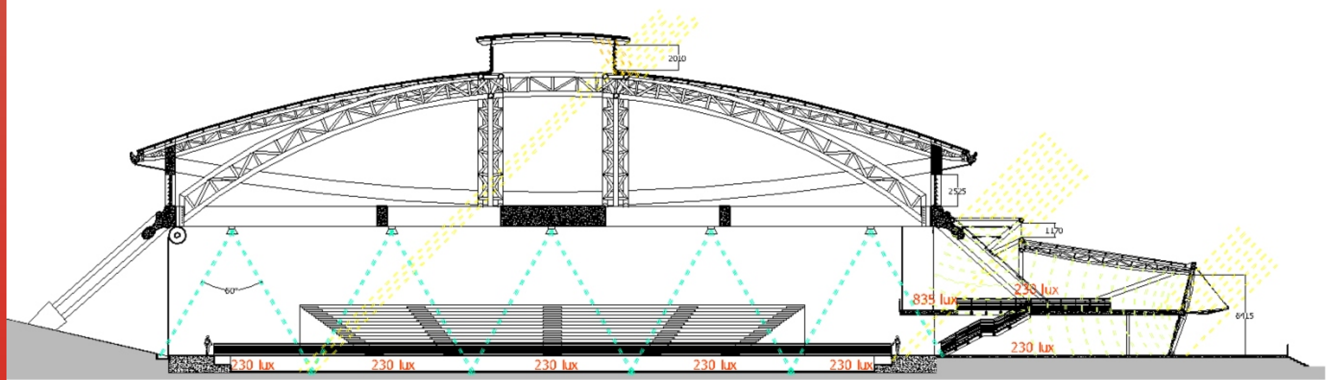
Daylight factor contours Fig.63

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

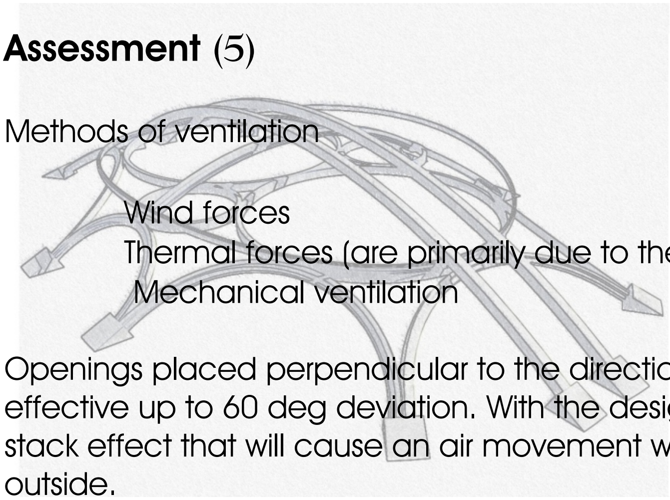
Required ventilation is provided naturally and by mechanical ventilation where natural ventilation is insufficient.

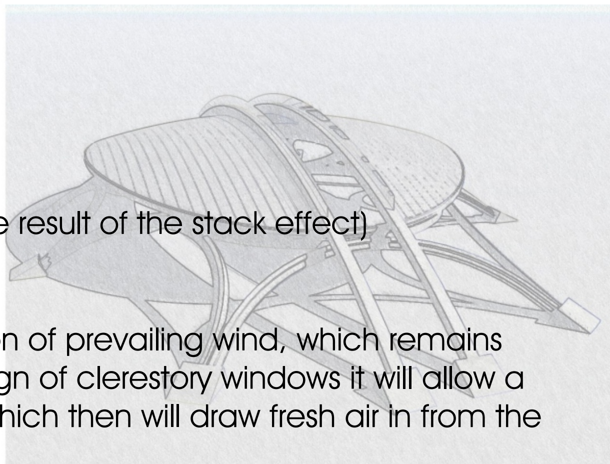
Target (5)

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)

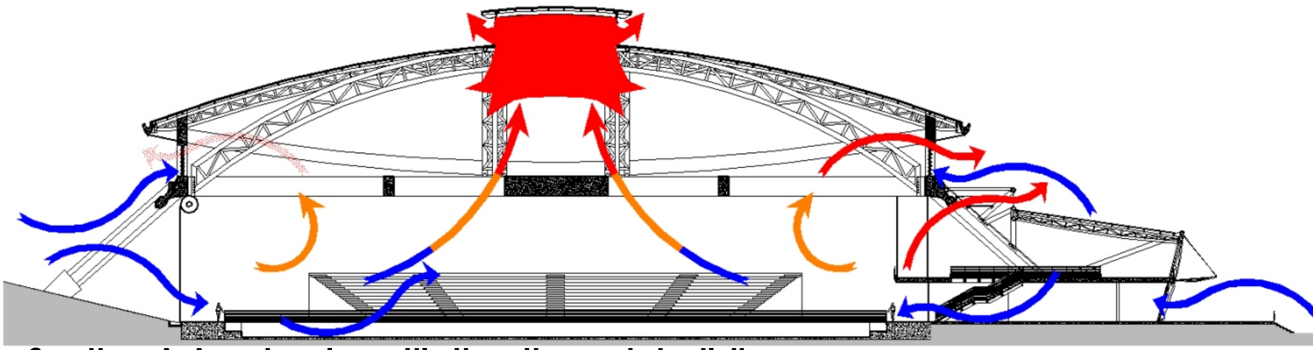




Methods of ventilation

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 275m^2 and ventilation tempos of 9,09m^3/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 7,3m^2
The window opening in the indoor open space area is 1128m^2

Gymnasium

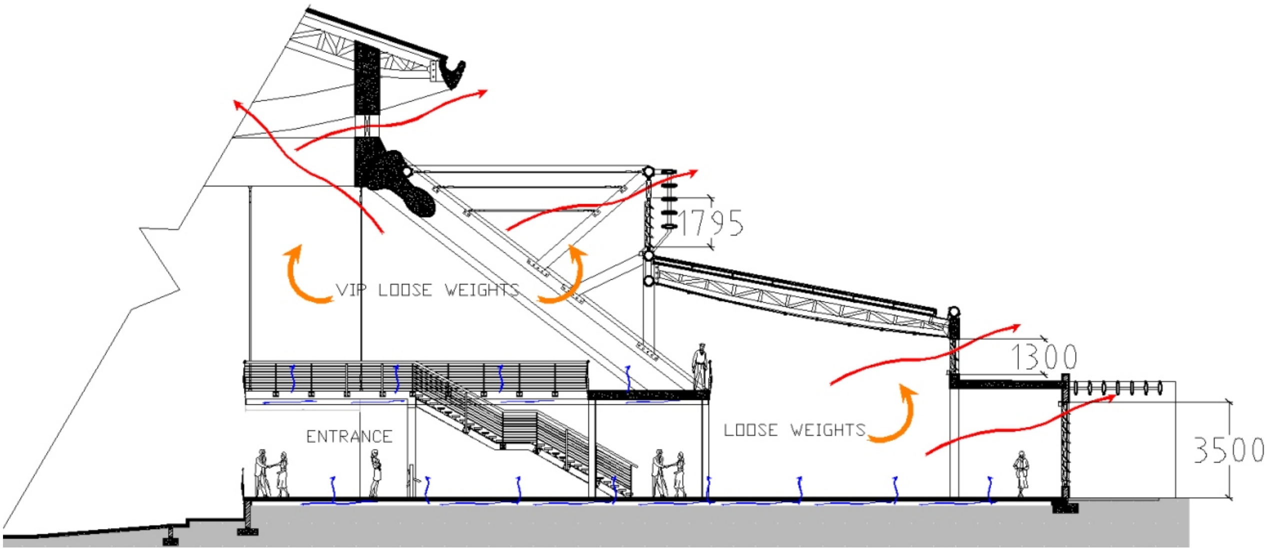
The 150 occupants produce 66kW of heat that contributes to the thermal force.
To achieve an air change rate of 7.8 air changes per hour a window opening of 30.1m^2 is required that will produce an airflow of 0.2m/s that is comfortable.
The window opening in the gym is 46m^2

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 7.3m^2 is required that will produce an airflow of 0.2m/s that is comfortable.
The window opening in the spinning area is 18m^2

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 m^2 is required that will produce an airflow of 0.2m/s that is comfortable.
The window opening in the aerobics area is 17.8m^2



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

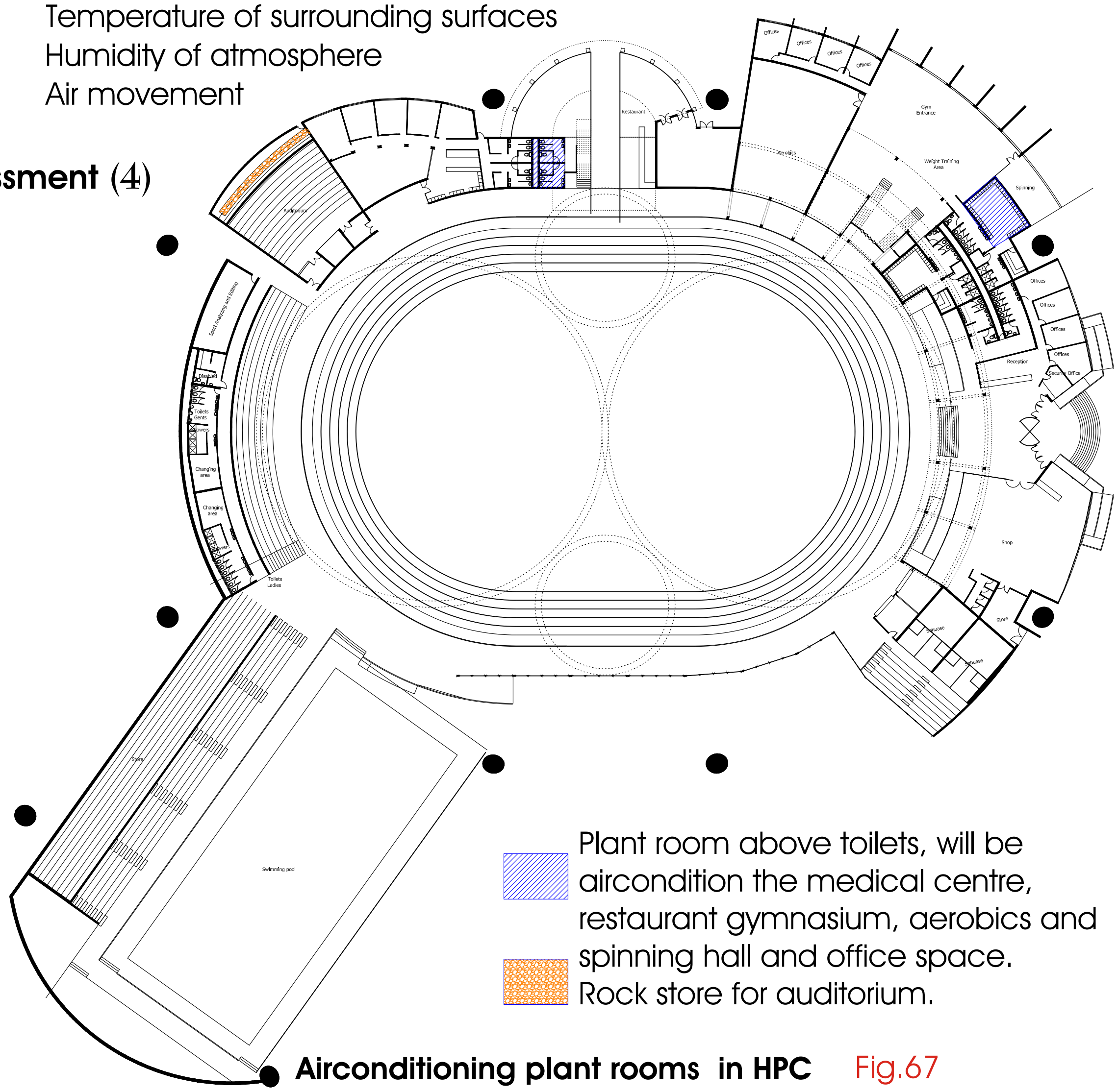
- Thermal comfort

Target (4)

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

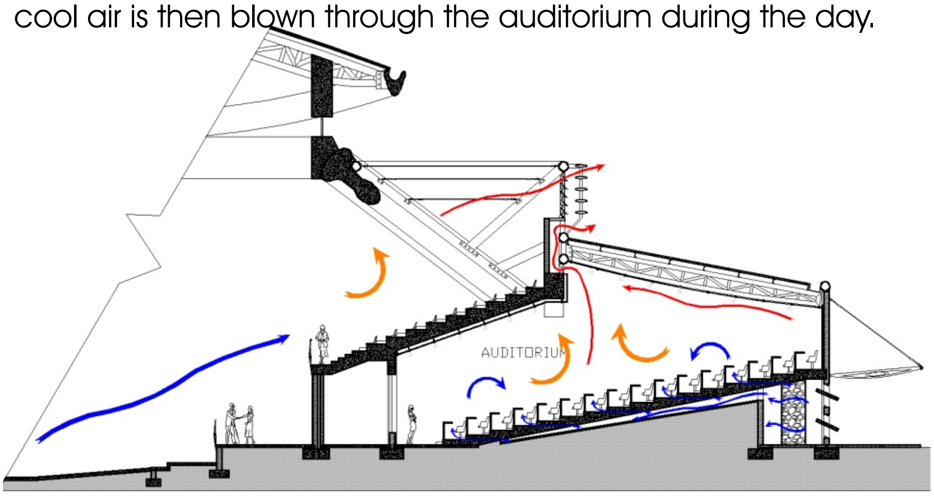
Air temperature
Temperature of surrounding surfaces
Humidity of atmosphere
Air movement

Assessment (4)



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.



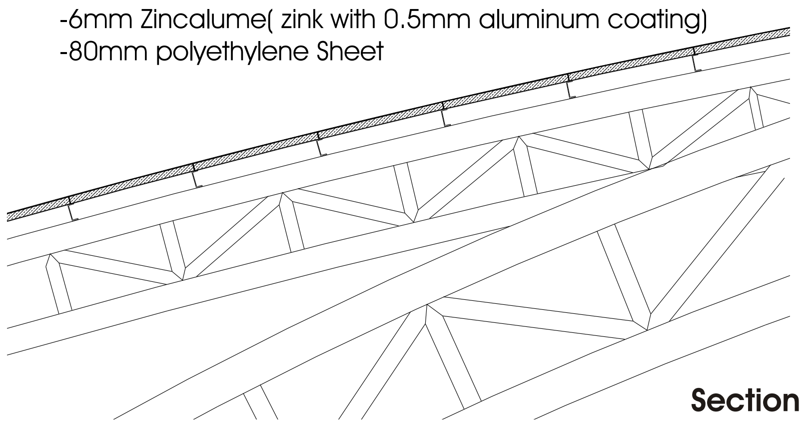
Rock storage underneath the auditorium Fig.68

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

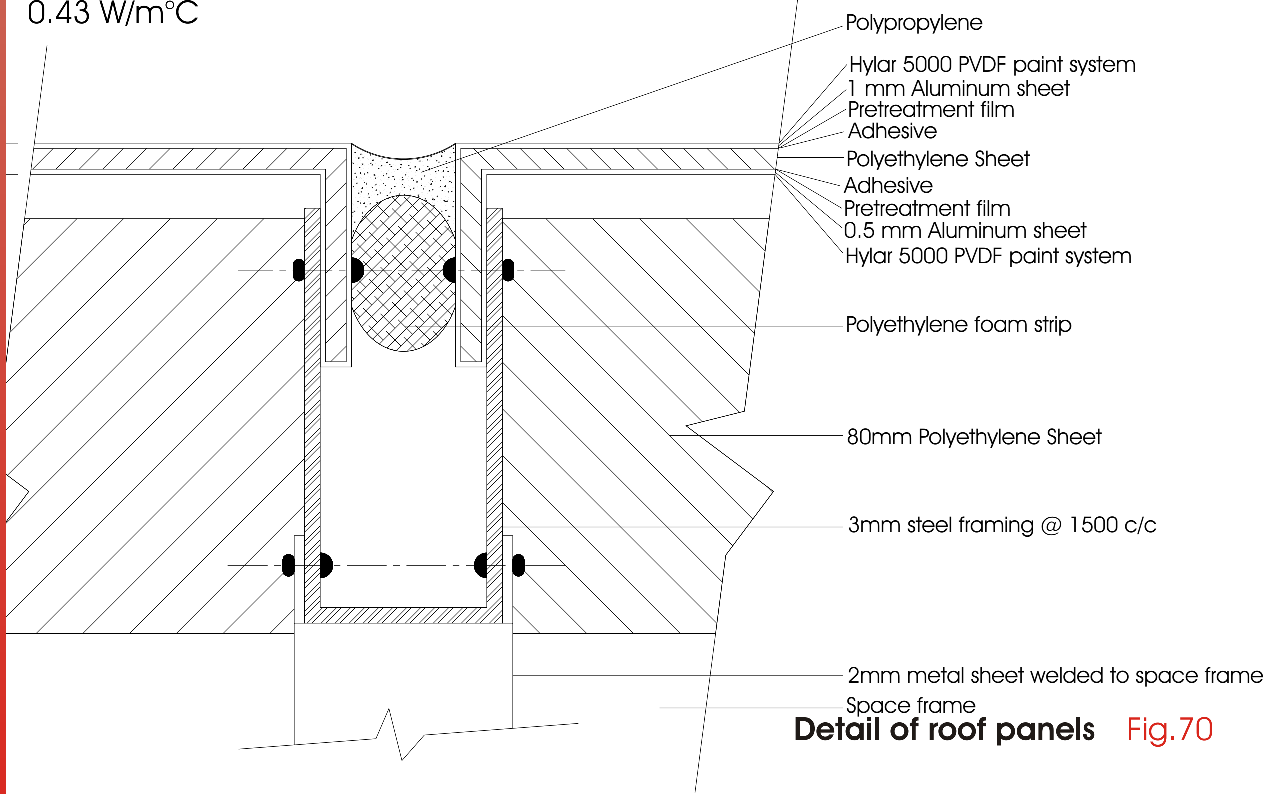
To keep the heat of the building inside in the winter and outside in the summer the thermal mass of building envelope plays an important role.

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	



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

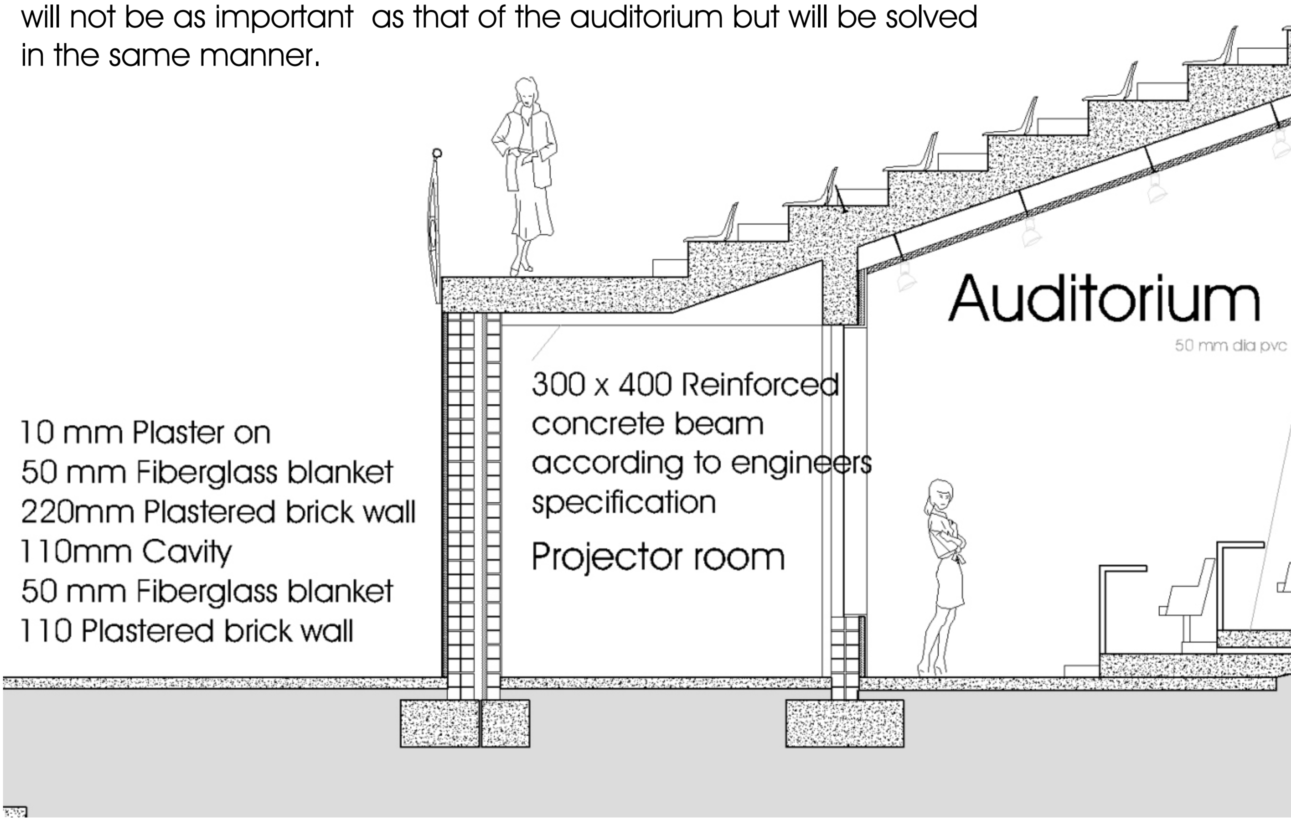
Noise levels are limited in work and living environments to acceptable levels.

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.

- Views

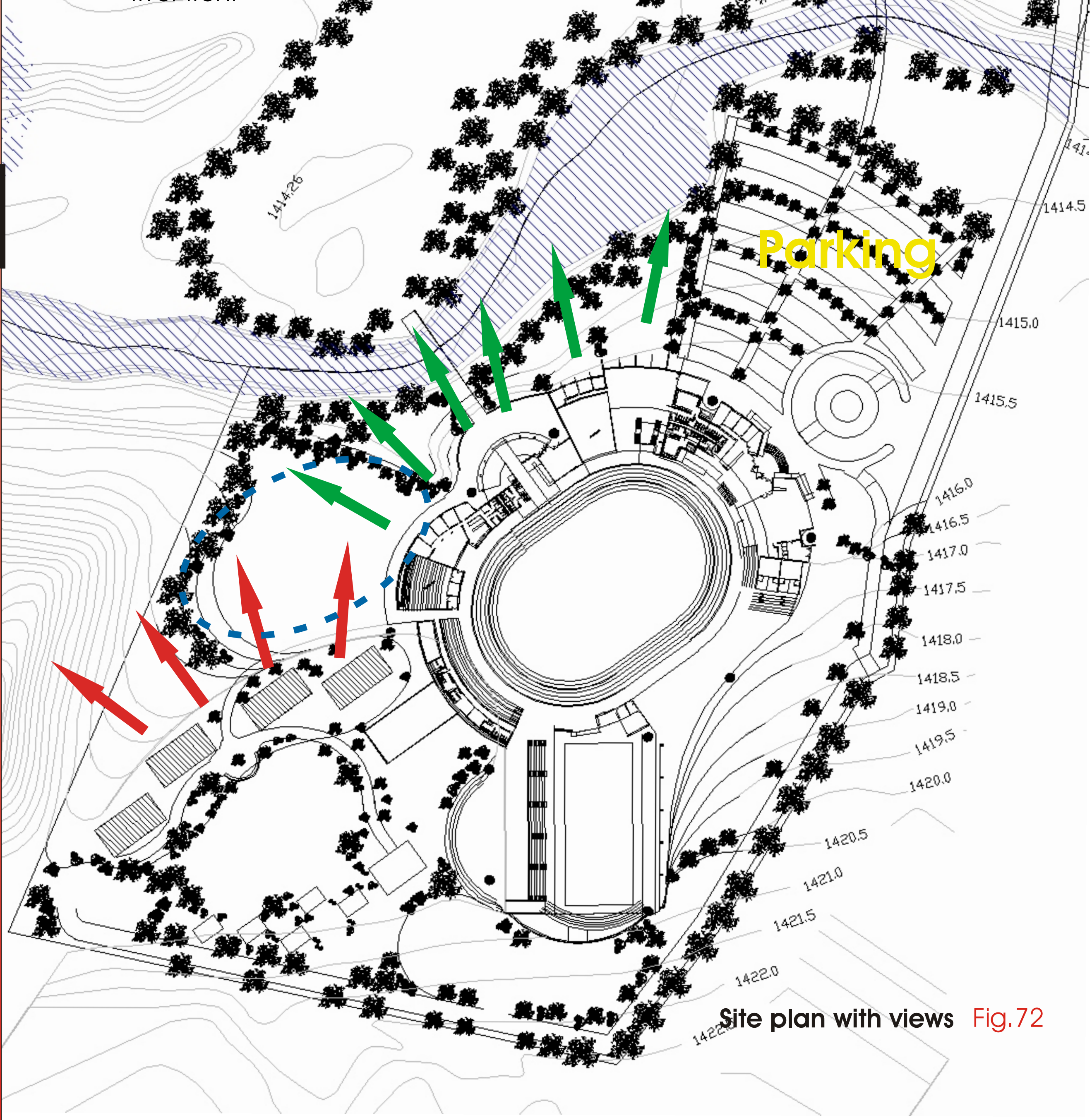
All living and work areas have access to a view. Humans all have an internal clock that is synchronized to the cycle of day and night. From a psychological standpoint, windows and skylights are essential means of keeping the body clock working properly.

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)

- Green arrow: Medical centre, restaurant, and gymnasium view on to river front
- Red arrow: View of hostels onto river front
- Blue dashed outline: Outside space lives out onto the river front



Site plan with views Fig.72

Fig.73

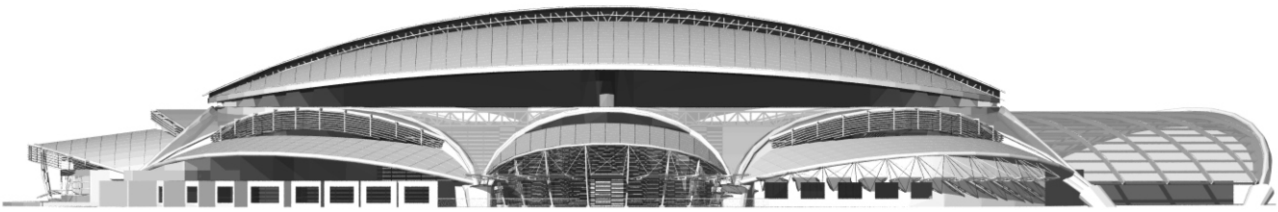
Fig.74

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