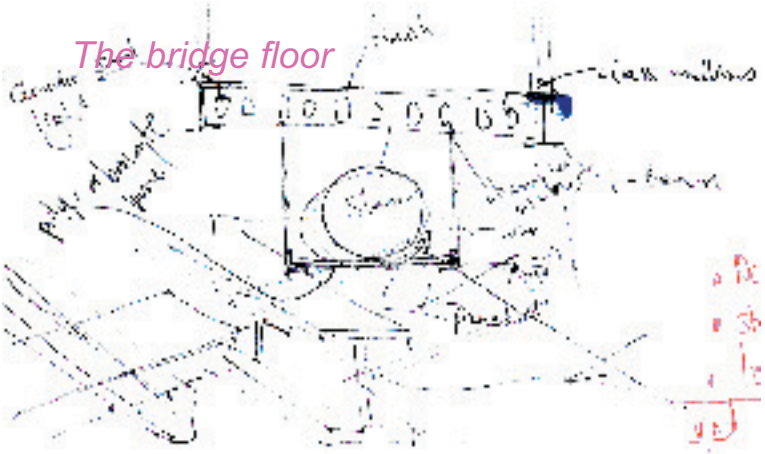
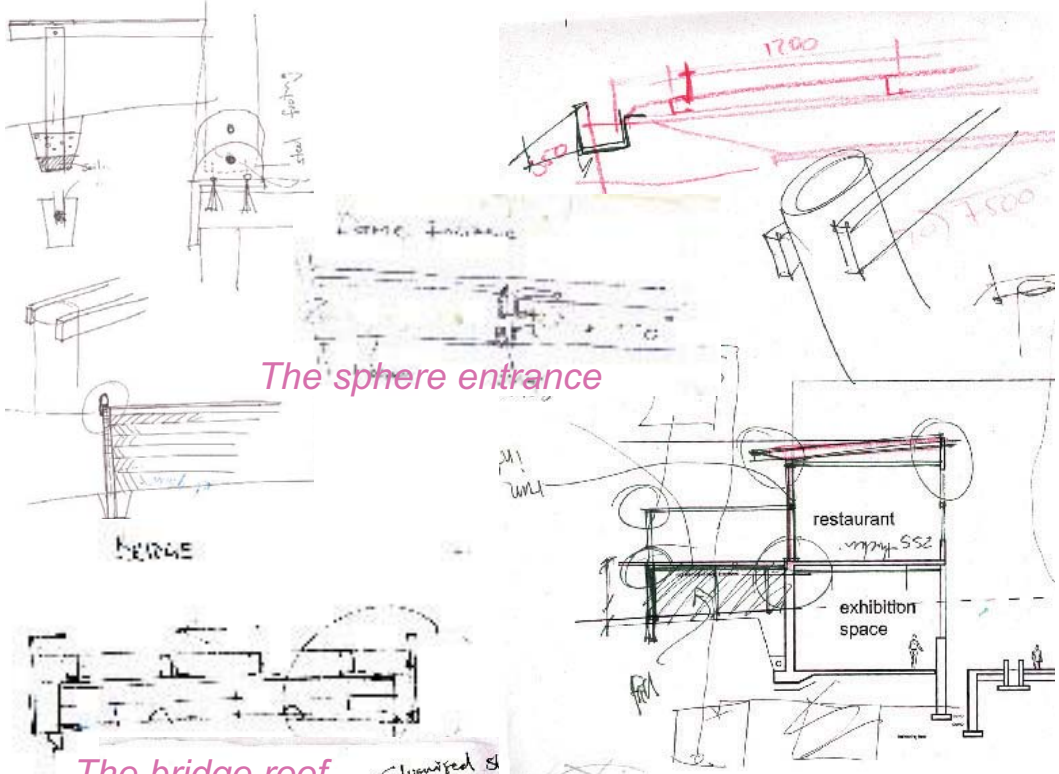
# *Technical Investigation*

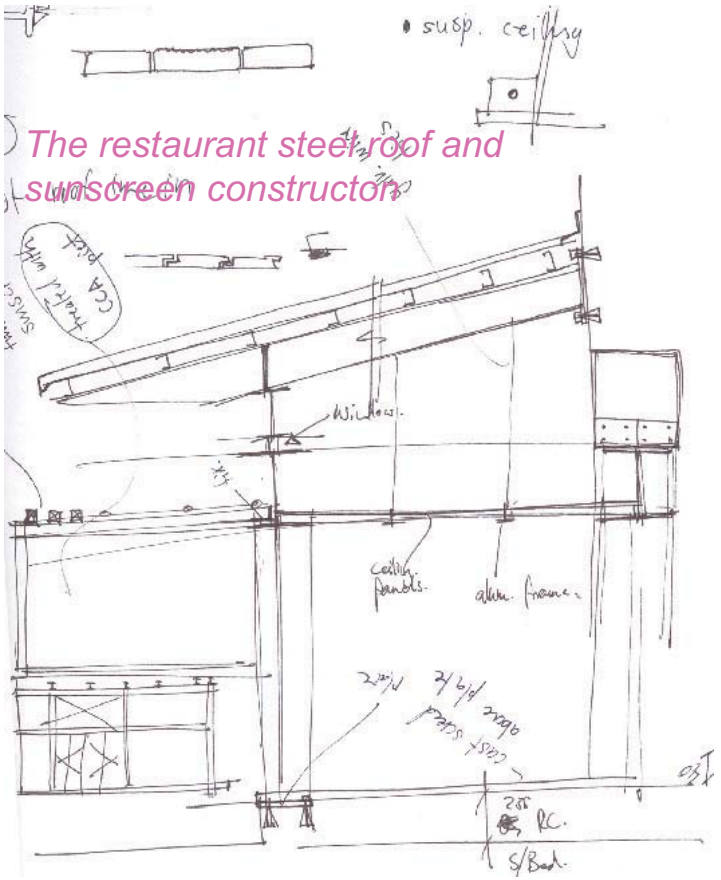
The bridge floor



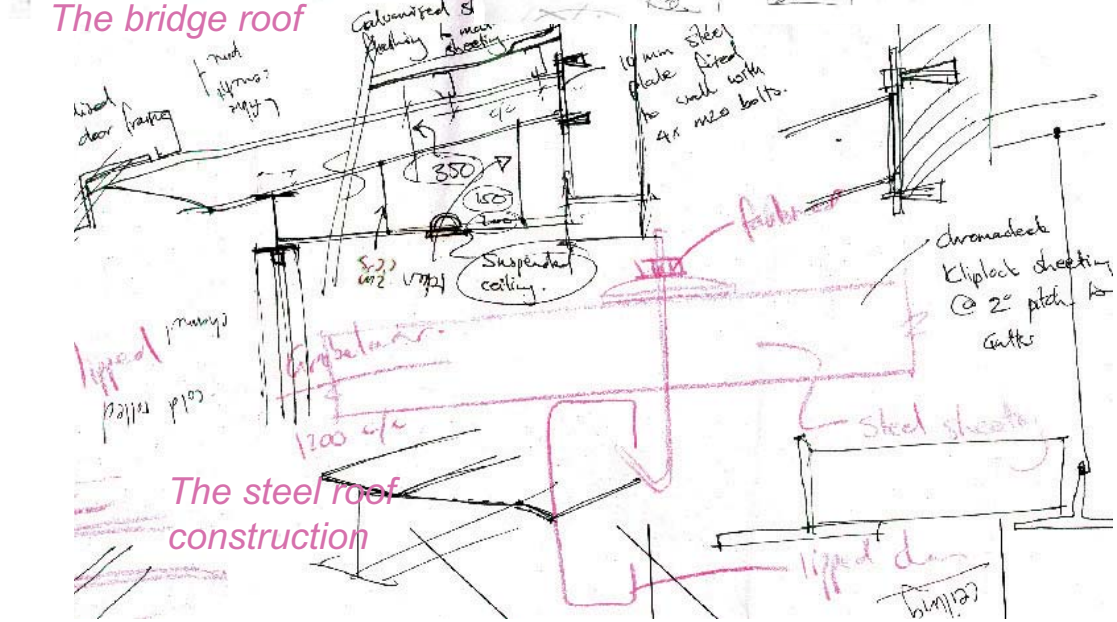
The sphere entrance



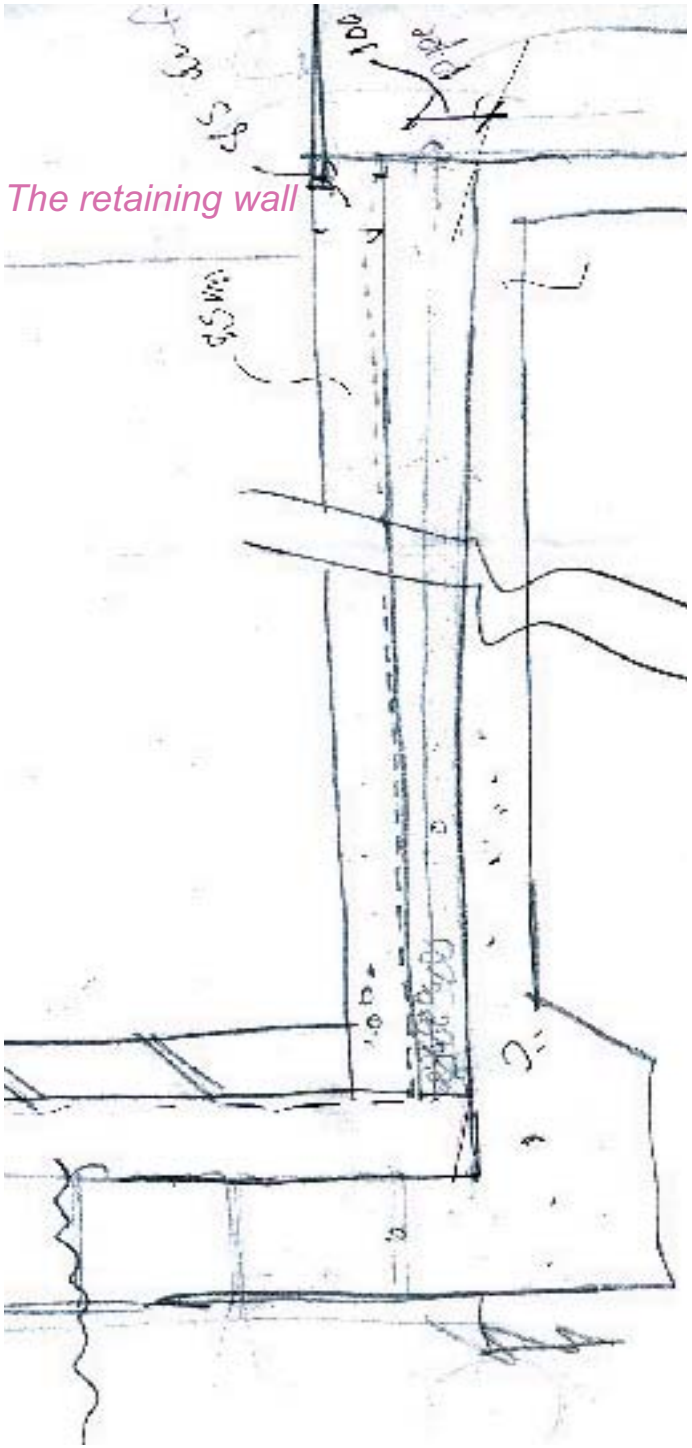

The restaurant steel roof and sunscreen constructon




The bridge roof




The steel roof construction



The retaining wall

# Introduction

The following chapter is supplementary to the set of drawings to motivate the decisions made with regard to the technical resolution of the astronomy centre. It deals with the most important technical issues raised by the design.

## 7.1 Structure

The primary structure of the building is a reinforced concrete structure consisting of a column, beam and slab system. The portion of the building that is situated under the natural ground level is supported by a reinforced concrete cavity wall system. The portion of the building that is located above the ground consists of two structural systems. In the reception and restaurant spaces the building is supported by a stainless steel structure. The administration block is constructed of load bearing masonry walls.

# Phases of the construction of the sphere

## Phase One

*Construction of the four reinforced concrete columns*

*Figure 7.7.1*

*Figure 7.7.2*

## Phase Two

*Casting of the first reinforced concrete floor slab*

## Phase Three

*Construction of the reinforced concrete compression ringbeam*

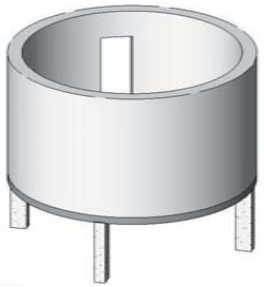


*Figure 7.7.3*

## Phase Four

*Construction of the reinforced concrete diagonal fins and casting of the second reinforced concrete floor slab*

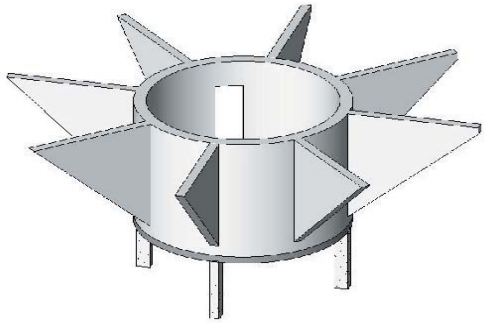


*Figure 7.7.4*

## Phase Five

*Attaching the circular steel trusses to the reinforced concrete compression ring(below) and to a steel tension ring(above)*

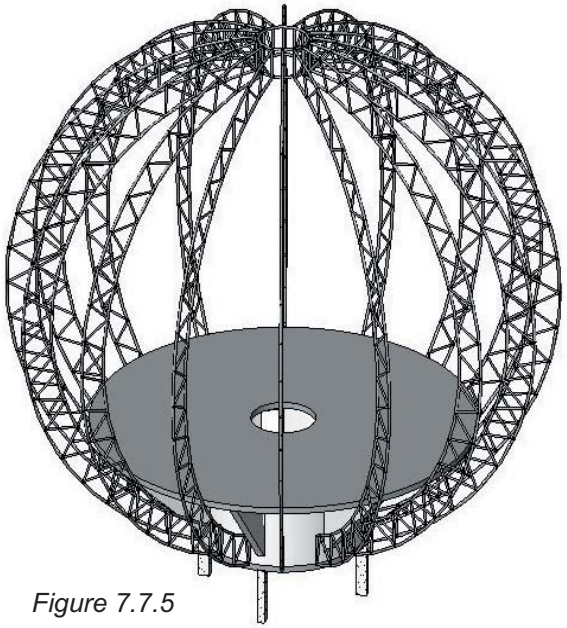


*Figure 7.7.5*

## *Phase Six*

*Attaching the circular lipped channel steel purlins to the outside of the trusses*

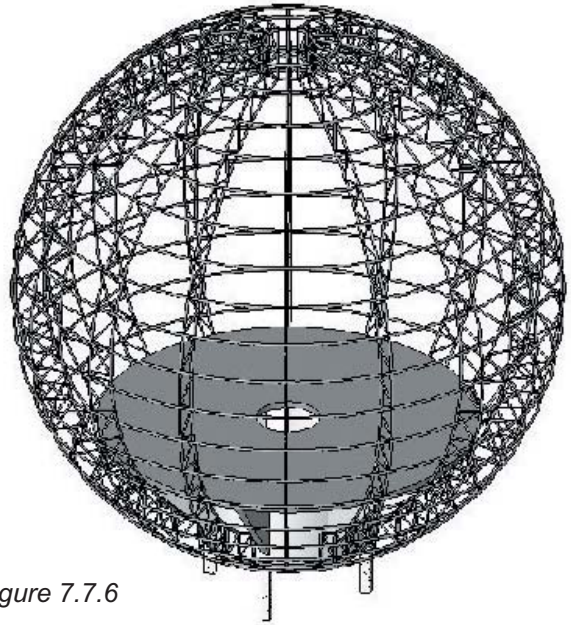


*Figure 7.7.6*

## *Phase Seven*

*Attaching the circular lipped channel steel purlins to the inside of the trusses*

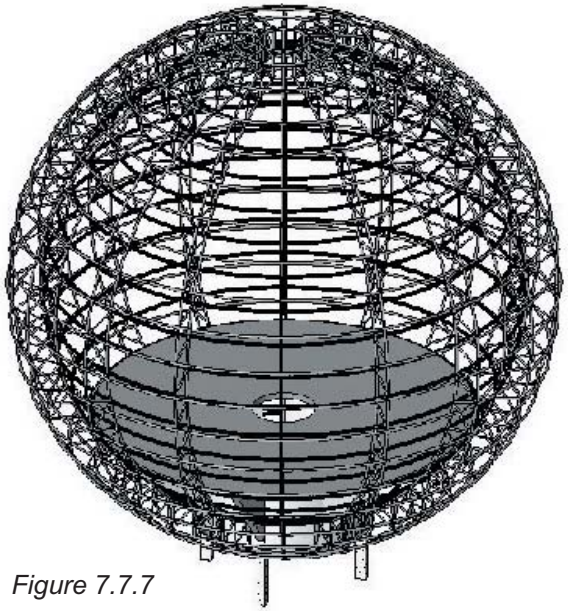


*Figure 7.7.7*

## *Phase Eight*

*Attaching 3 x 3mm plywood to the purlins, covered with filt and cladded with copper sheeting. Inserting the perforated alminium display screen with sound absorbant panels to the interior purlins*

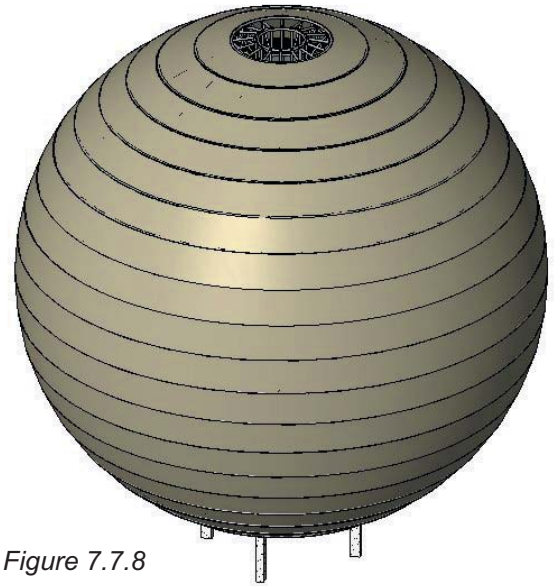


*Figure 7.7.8*

# 7.2 Skin

The skin of the building consists of a number of materials. The reception and restaurant areas are glazed, the services block on the western façade is constructed of off shutter concrete and the ticket box is enclosed by a light transmitting fibre-optic concrete wall. The dome is cladded with copper sheeting. All glazing to be installed according to Part N of the SABS(0400).

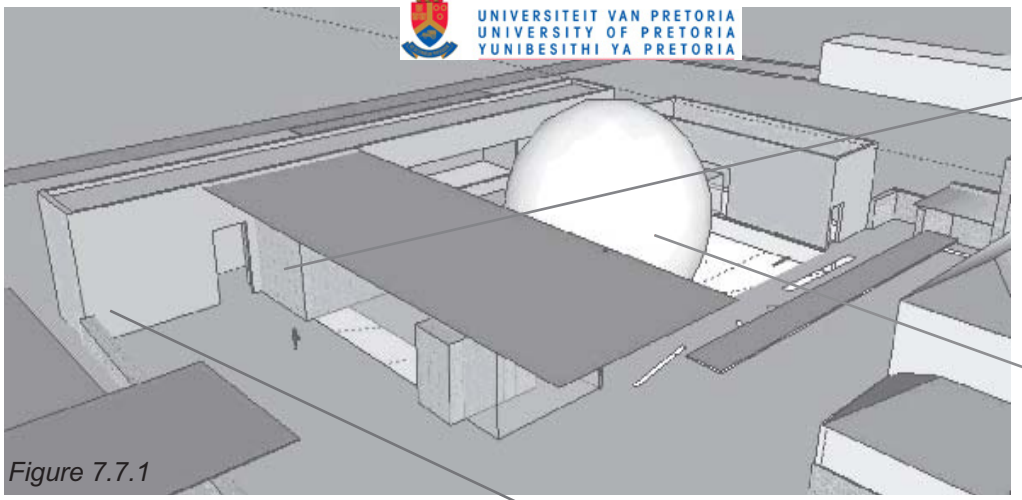


Figure 7.7.1

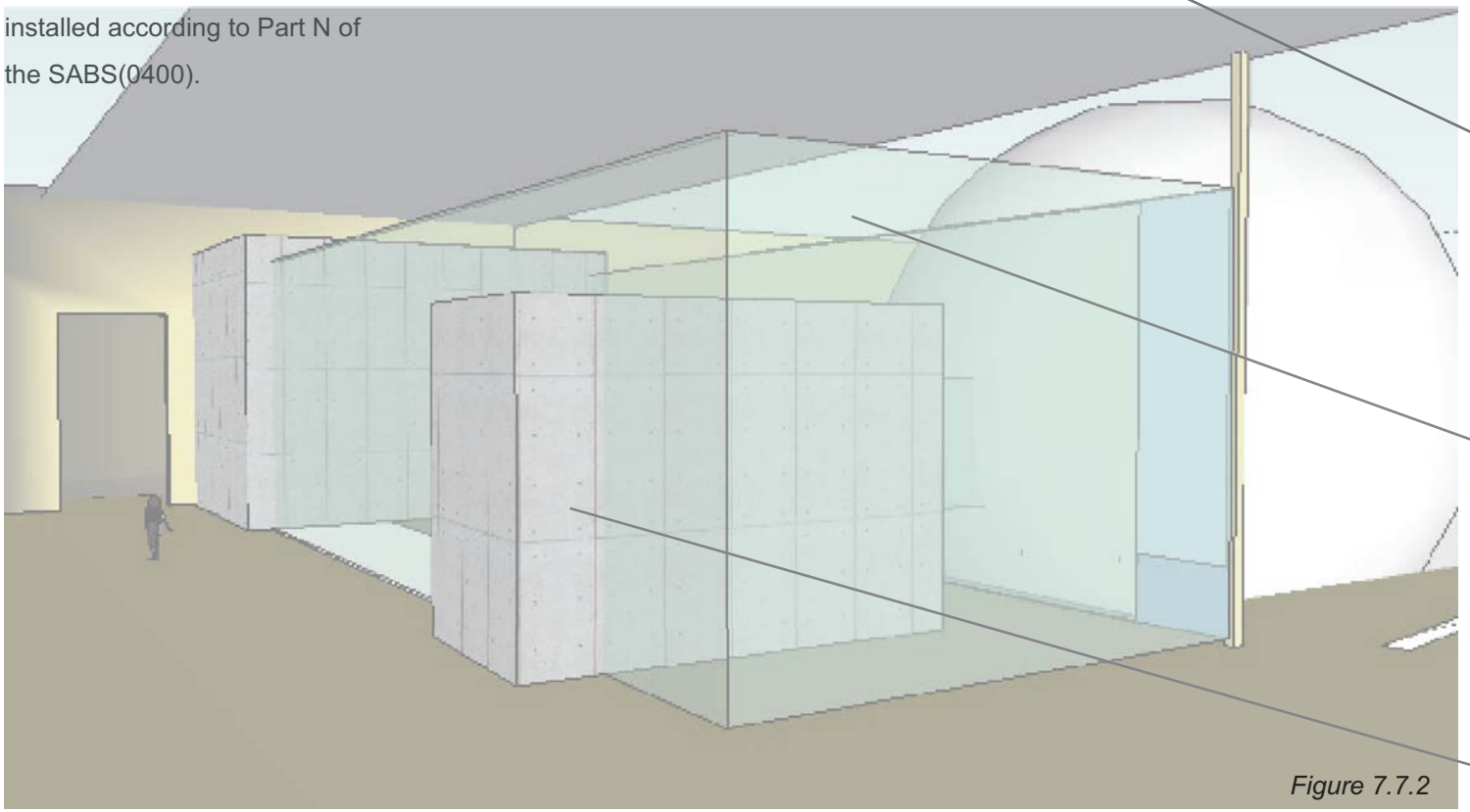


Figure 7.7.2

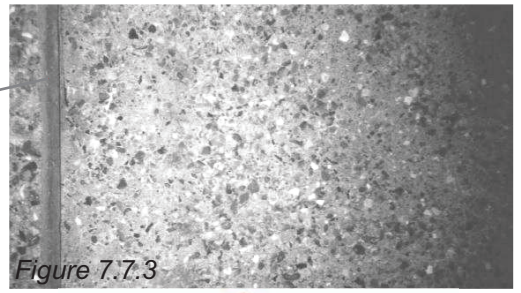


Figure 7.7.3

Figure 7.7.4

Figure 7.7.5

Figure 7.7.6

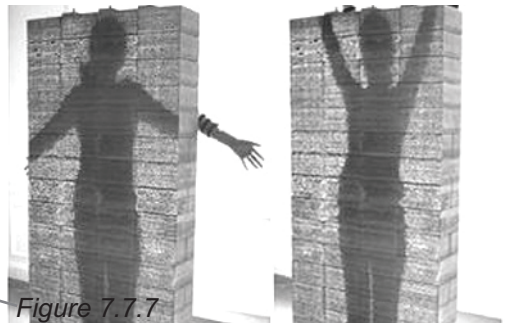


Figure 7.7.7

## 7.3 Fire

The following guidelines as dictated by the National Building Regulation (part T of SABS 0040) have been considered :

- Life safety and provision for escape
- Minimize the spread of fire both within the structure and from building to building
- Detection and prevention of the spread of smoke and heat
- Provision for detection devices.

Escape routes do not exceed 45m and fire extinguishers are provided at 30m intervals. Fire equipment will form part of the 'building management system' and a sprinkler system and smoke detectors will be installed in the applicable areas. The building is smoke free in all internal areas.

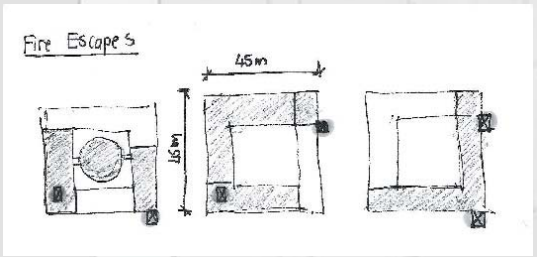



*Figure 7.3.1 Diagram of fire escapes*

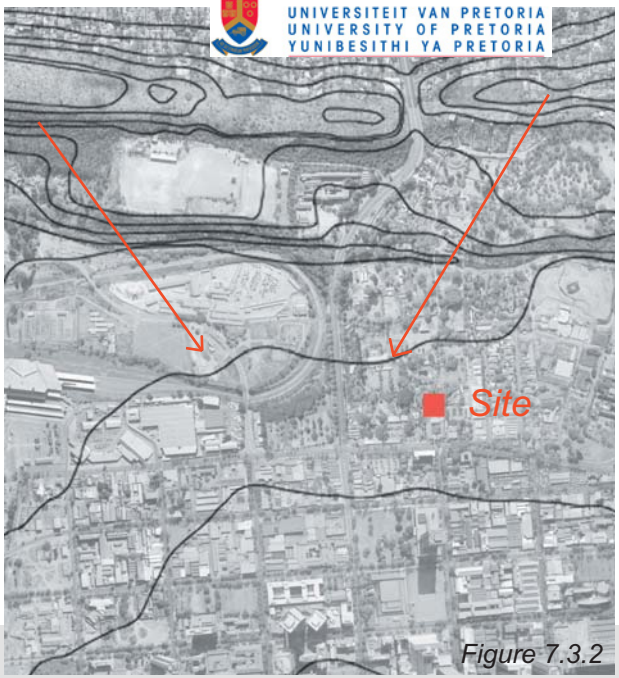



*Figure 7.3.2*

**Problems** caused by temperatures in this area : high temperatures, high diurnal temperature ranges, intensity of precipitation at times and inefficient dispersal of air pollution. The area is characterised by generally high temperatures and relatively high humidity.

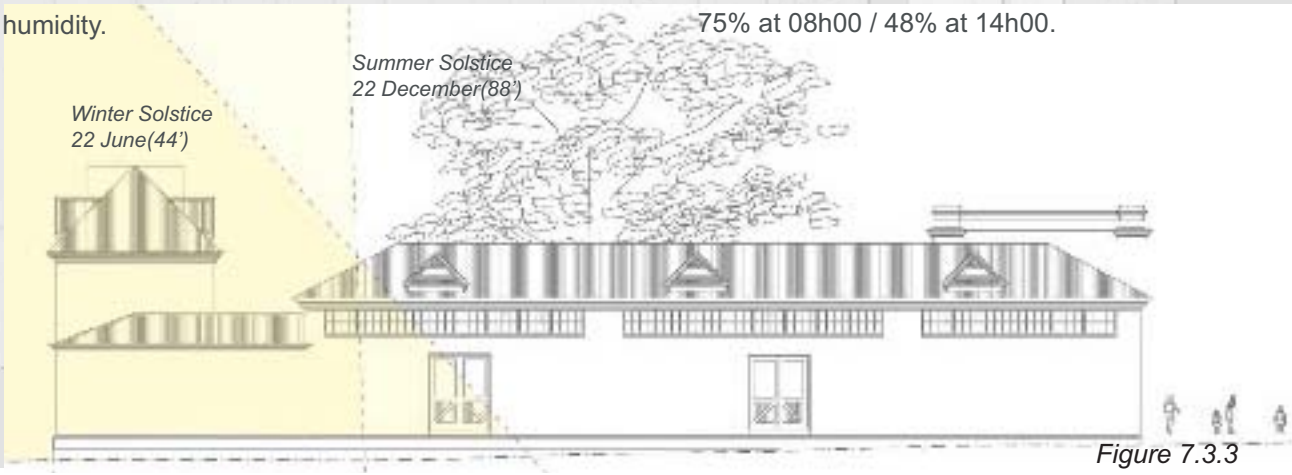



*Figure 7.3.3*

## 7.4 Natural determinants

**Wind Direction**: North east in the morning, back north west in the afternoon. Strength 3,9m/s. Daspoort ridge slows down the morning winds, afternoon winds stronger as they are funnelled through the poort ridge. Thunderstorms are accompanied by turbulent wind patterns.

**Geology** shale and quartzite.

**Rainfall** is Seasonal(in summer), average 741mm per year. Thunderstorms can cause up to 90 – 100mm/hr.

**Hailstorms** are fairly common.

Average annual **cloud cover** : 33%, varying between 13% in July and 54% in December.

**Humidity** : monthly average : min of 57% at 08h00 / 29% at 14h00 in September to a max of 75% at 08h00 / 48% at 14h00.

# 7.5 Orientation and solar control

The entrance of the facility faces west creating direct access and a visual link from the zoo forecourt. The restaurant opens up to the north unto a deck facing the zoo. To minimise direct sunlight from above the deck is equipped with a timber sunscreen. The entrance and gift shop buildings have glazed skins with vertical louvre systems that control direct solar radiation on their western façades.

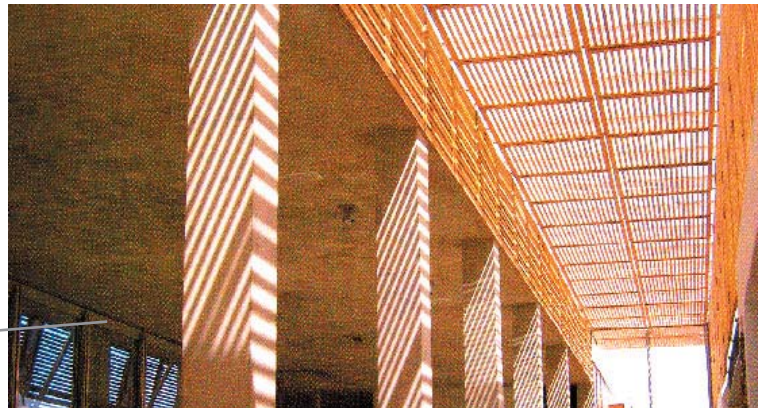


Figure 7.5.4

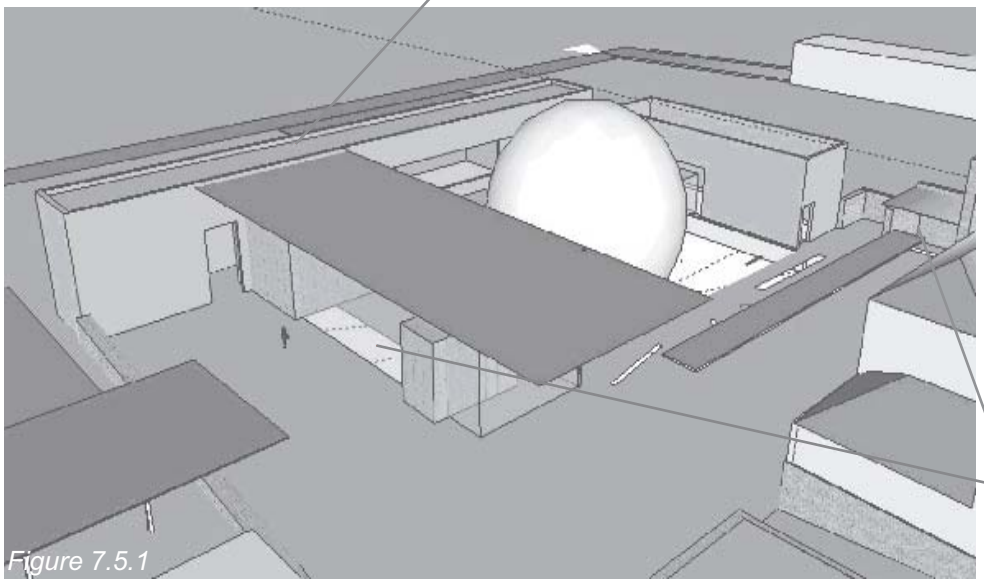


Figure 7.5.1

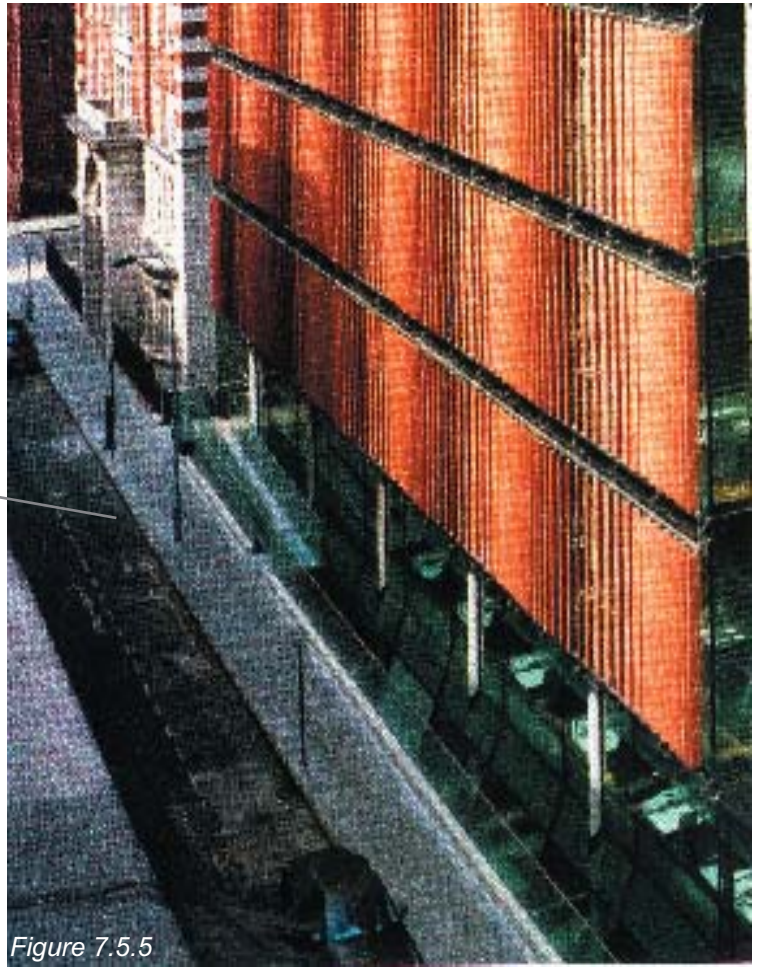


Figure 7.5.5

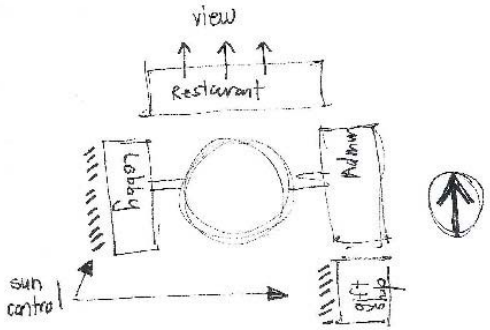



Figure 7.5.2 Orientation

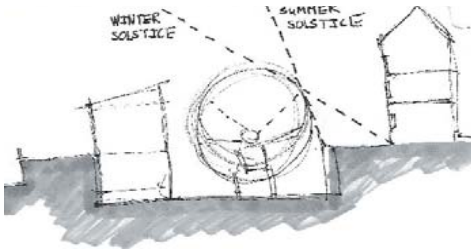
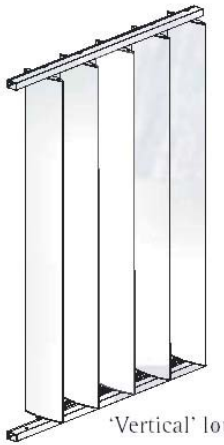
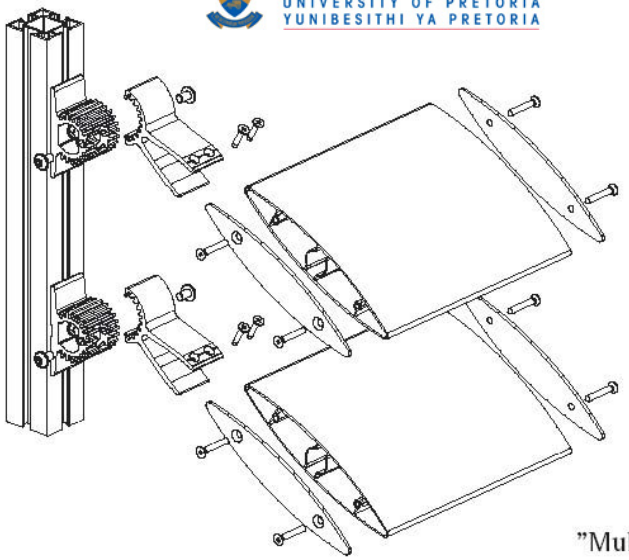



*Figure 7.5.3 The astronomy centre does not block natural sunlight to the museum.*

Louvre blade fitting



'Vertical' louvre blade fitting

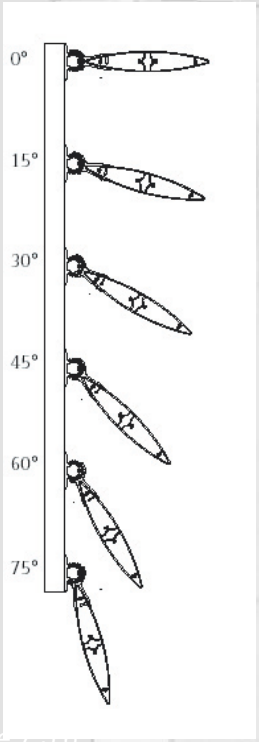


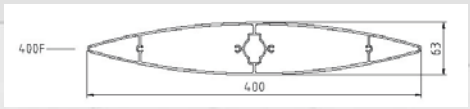
"Multifit" system

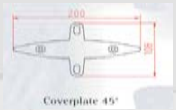
*Figures 7.5.7 - 7.5.12: Vertical louvre details*

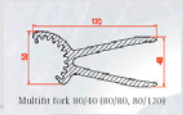
*The Star Stops*

The star stops are allocated areas on the floor in the temporary exhibition space from where the visitor can view certain star contellations on specific dates. These allocated spots had to be calculated with regard to the roof height and angle of view in relation to the constellation coordinates in the sky.



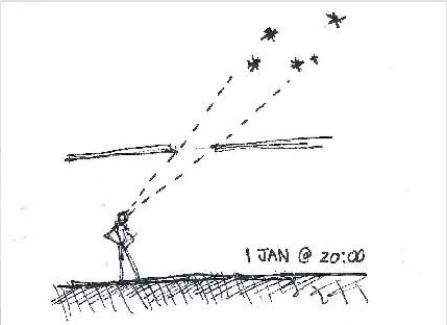




*Figure 7.5.13*


*Figure 7.5.14 Calculation of star stops*

## 7.6 Access

The entire facility is accessible to the user by wheelchair. All the spaces on different levels are connected by ramps with the exception of the *planet room* that is equipped with a stair lift for wheelchairs. None of the ramps exceed the ratio of 1m: 12m.

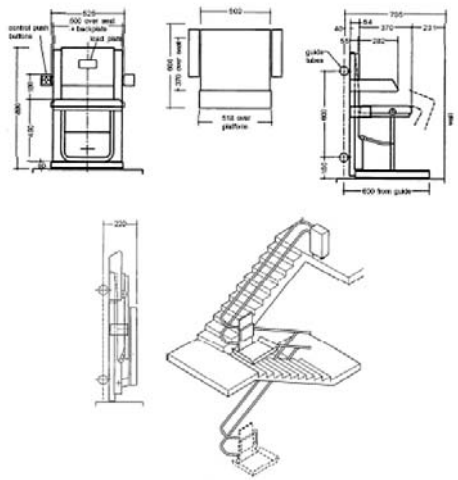


*Figure 7.6.1: Detail of stair lift for wheelchairs*

## 7.7 Services

All kitchen and exhibition deliveries are accommodated on the eastern edge of the building, thus clearly distinguishing public and private activities. Services and staff enter the premises by making use of the service road of the zoo east of the astronomy centre.

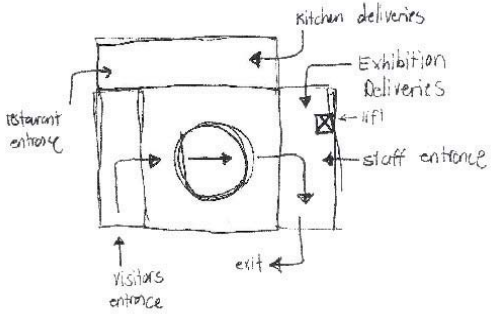



*Figure 7.7.1: Facility working diagram*

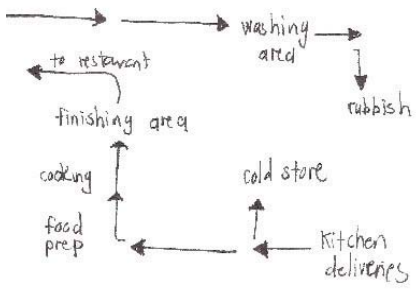



*Figure 7.7.2: Working diagram of kitchen*

*Figure 7.7.3*

# 7.8 The planetarium

## *Sound and display*

Curved surfaces as that of the ceiling in the interior of the planetarium can cause a focal point to develop for sound concentration. Absorbing surfaces avoid sound concentrations and allow the reverberation time to be matched to the required value (Neufert et al 2002:124). The sound system will be installed into the bulkhead in the planetarium by a specialist. Sound insulation ceiling boards will be attached to a lightweight bi-curving display screen of custom perforated aliminium. The display screen will be finished with white enamel paint to reflect the lights that will be projected onto it.

## *Seating arrangement and size determination*

*Concentric seating*

There are various arrangements for seating in planetariums. Concentric seating is the classical arrangement of seating in a planetarium. This arrangement maximises the number of seats in a given dome diameter. In arranging the rows of seats rising from the centre toward the edge of the dome improves viewing conditions for all seats and is most favourable for astronomical presentations (www.zeis.de 04/0707).

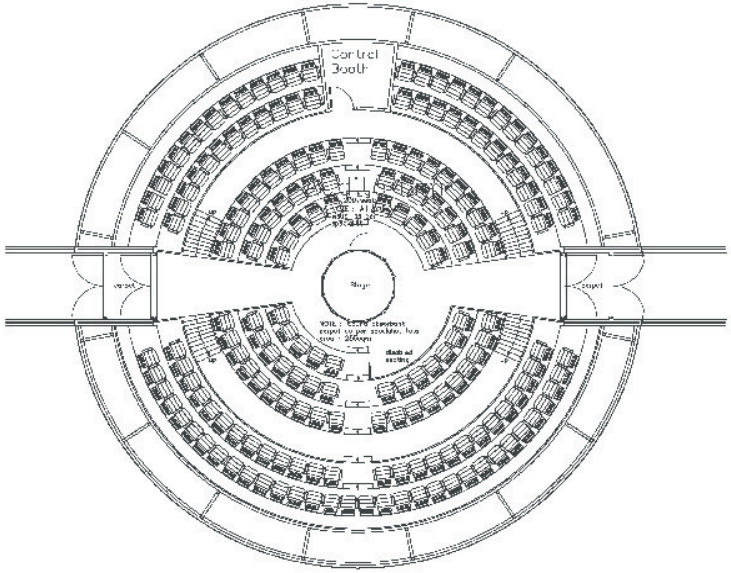



*Figure 7.8.1: Seating arrangement in auditorium*

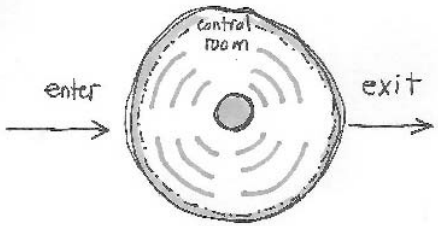



*Figure 7.8.2: Working diagram for auditorium*

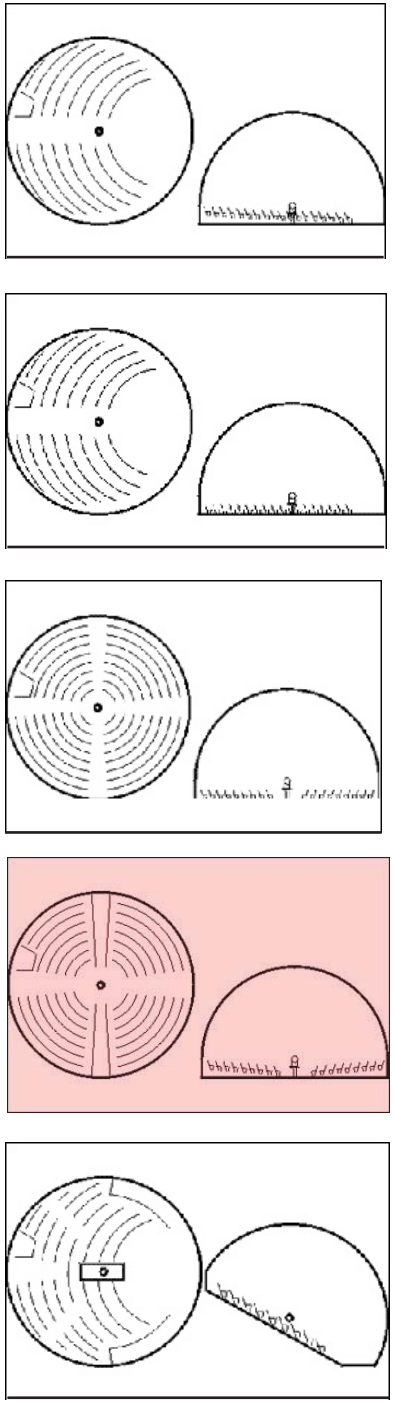


*Figure 7.8.3: Variations of seating arrangements in planetariums*

*Distinction based on size*

| | Diameter between | Seating Capacities |
|---|---|---|
| Small Planetariums | 5 m and 12 m | approx. 30 – 100 |
| Medium-size Planetariums | 12 m and 18 m | approx. 100 – 200 |
| Large Planetariums | greater than 18 m | approx. 200 – 400 |

## *Technical equipment*

Content of shows will primarily be astronomical but will also consist of other visual material. A combination of a star projector, a battery of slide projectors and a state of the art immersive video will be used. Show material will be developed, bought or hired through collaboration and exchange with other science centres and planetariums internationally.

*Control system*

The three projection systems, the sound system as well as the cove and theatre lighting system will be integrated and computer controlled. A flexible degree of automation will be possible ranging from a manually controlled star show with a live presenter in attendance to a fully automated, pre-packaged computer controlled presentation.

*Figure 7.8.4: The Universarium*

*Slide projectors*

A full dome projection system consisting of two banks of six slide projectors, lensed and linked to illuminate the entire interior surface of the dome will be used. Dramatic low cost visual can be created in such a way.

*Immersive video projectors*

A 360 ° video projector will be used to create panorama views that provide exceptional visual impact. Computer controlled edge blend technology is used to seamlessly combine the images from the projectors in real time.

*Star field projector*

A fully automated Universarium starfield projector capable of controlling latitude, daily (sidereal) motion, precession, heading (azimuth) and annual motion will be installed. The projector will create a realistic view of the night sky with crisp, accurate, pinpoint stellar images in varying magnitudes, as well as star clusters, nebulae, galaxies and the milky way. The projector will be mounted on as elevator system to lower the instrument into a storage well, to enhance the versatility of the theatre.

| | |
|---|---|
| Dome diameter | |
| UNIVERSARIUM M IX / M IX TD | 18 m to 30 m (59 ft to 98 ft) |
| Dome inclination | |
| UNIVERSARIUM M IX | 0° |
| UNIVERSARIUM M IX TD | up to 30° |
| Number of seats | |
| UNIVERSARIUM M IX | approx. 200 to 500 |
| UNIVERSARIUM M IX TD | approx. 180 to 450 |
| Starball | |
| Horizon height, horizontal dome | |
| preferable | 2200 mm |
| available | 3000 mm |
| Horizon height, tilted dome | |
| preferable | 1800 mm |
| Or | project-dependent |
| Installation area (project-dependent) | |
| East-West | approx. 2500 mm |
| North-South | approx. 2400 mm |
| Weight | approx. 1500 kg |
| Projectors for Sun, Moon and Planets | |
| Number | 8 |
| Installation area | |
| East-West | 1950 mm |
| North-South | 2320 mm |
| Inclination range | 0° to 30° |
| Weight | approx. 830 kg |
| Control cabinet | |
| Desk | on request |
| Control panel | 450 mm (B) x 250 mm (T) x 50 mm (H) |
| Control computer | industrial model |
| Operating program | MS Windows NT |
| Auditorium | |
| Temperature | +15°C to 30°C |
| Temperature constancy | ±1°/h |
| Relative humidity | < 70% |
| Electrical Connection | |
| Operating voltage | 3x 230/400 VAC ±10% |
| Fuses and ratings | 3x 35 A |
| Mains supply frequency | 50/60 Hz |
| Power consumption | approx. 16 kVA |
| Permissible supply failure time | < 10 ms |

(www.zeiss.de 04/07/07)