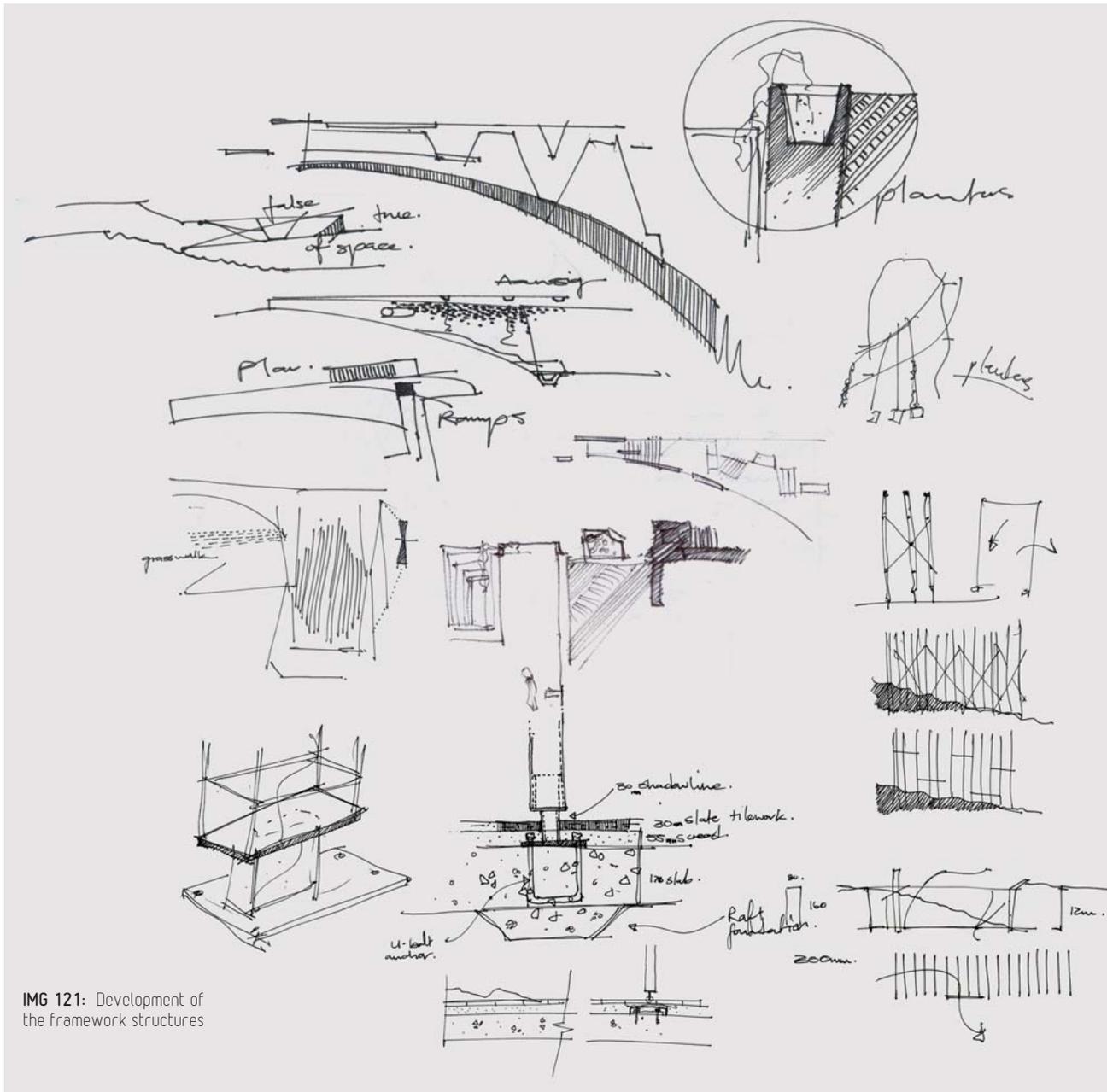




7. TECHNICAL DEVELOPMENT

The technical development is treated as the resonance of the theoretical viewpoints of the dissertation. The investigation should therefore, be seen as the near final synthesis of method or the becoming of a structure and not the rationalised drive to a product.

Basic product selection is made to communicate an understanding of various custom designed solutions that would follow.



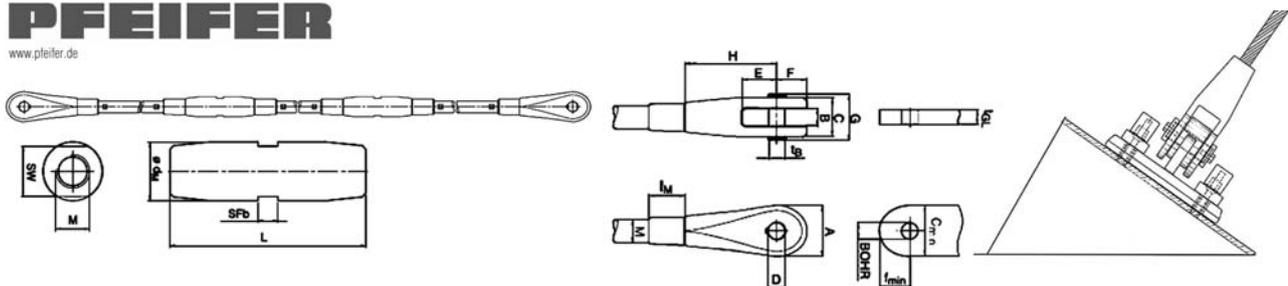
IMG 121: Development of the framework structures

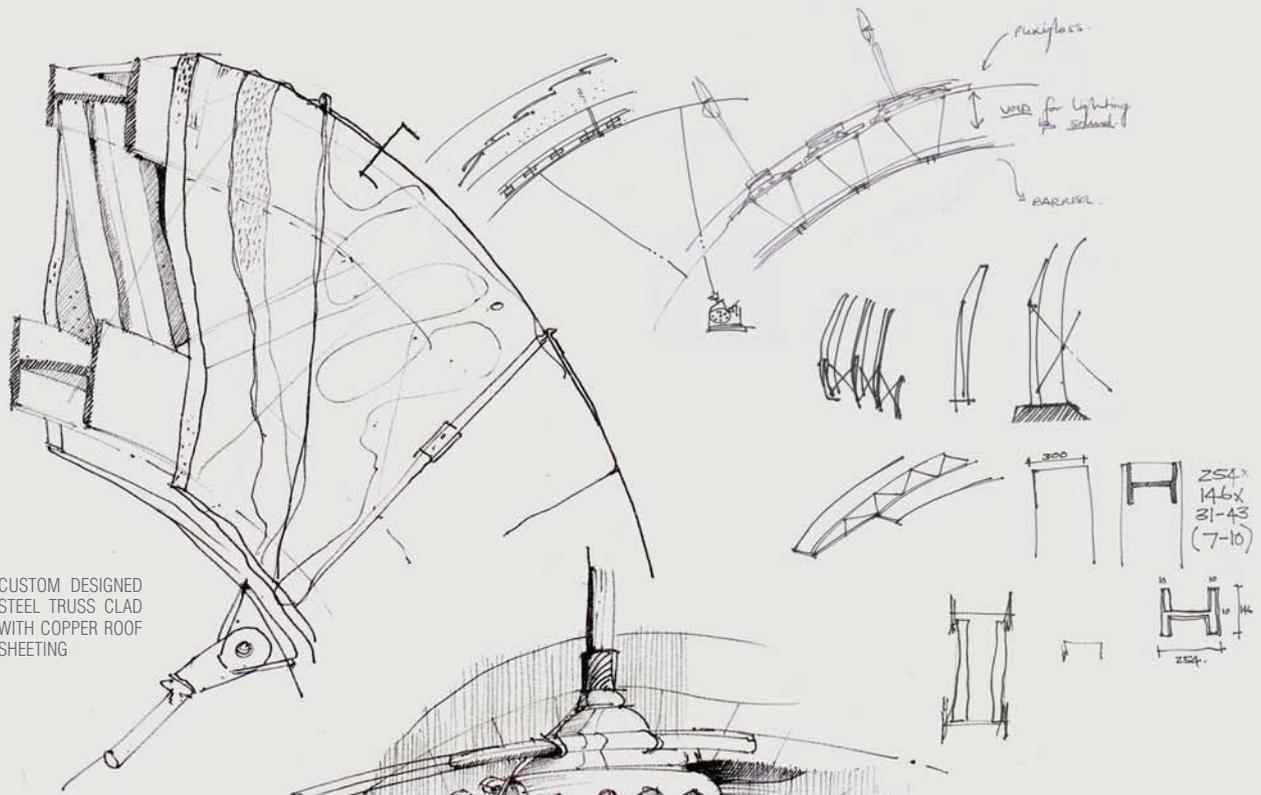
ROD SYSTEM

Pfeifer specialises in and developed a comprehensive range of products that offers an aesthetic and economic solution for any type of application and load range. Pfeifer's Rod Systems and connector types serve as an example of various application or custom design possibilities.

PFEIFER

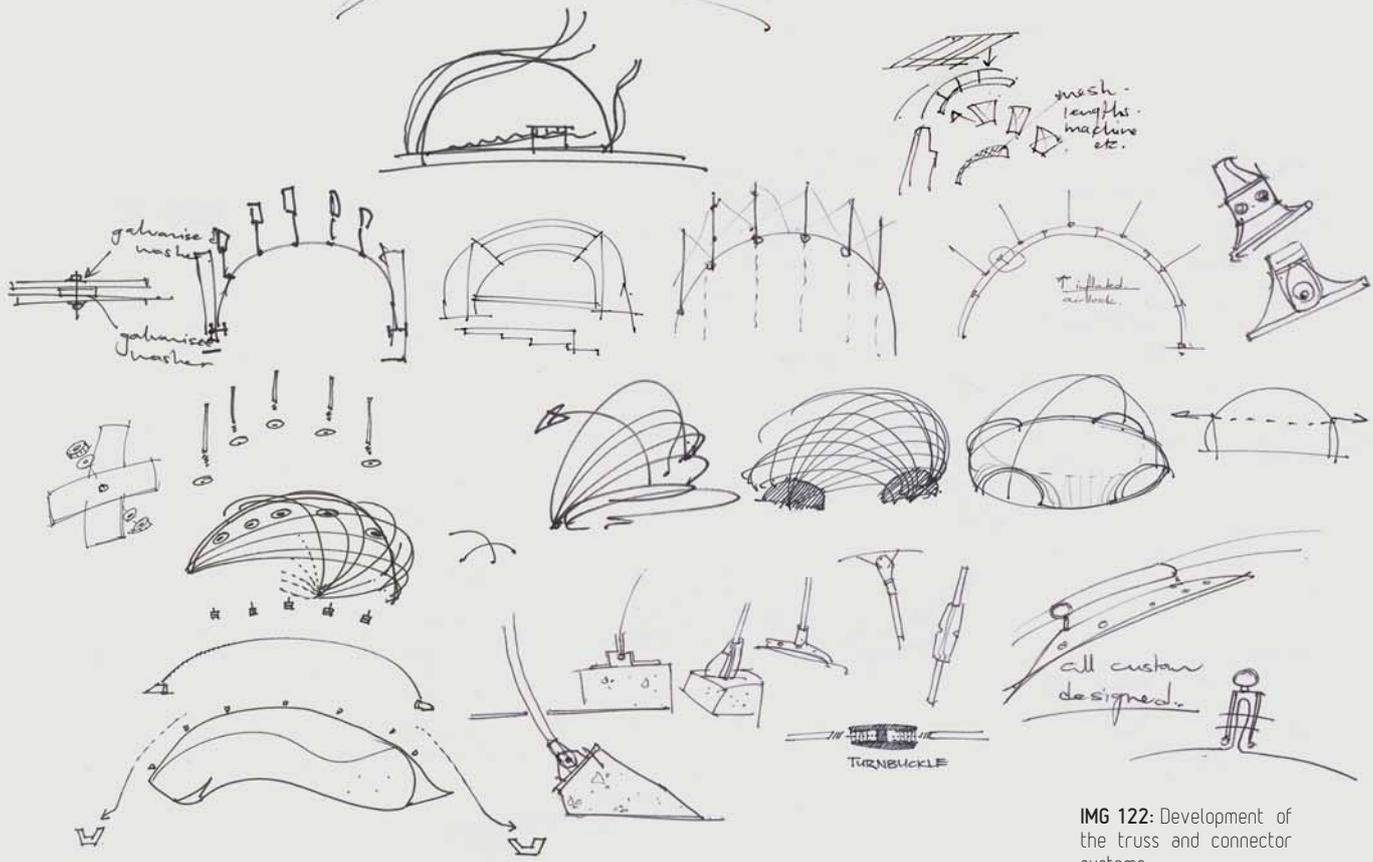
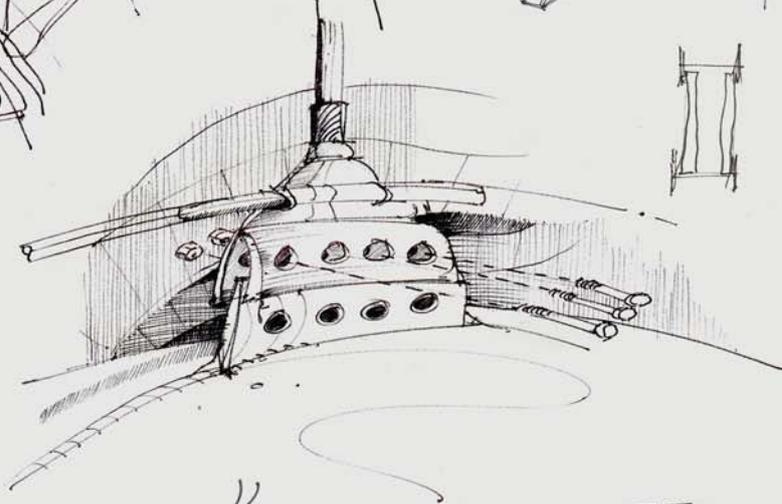
www.pfeifer.de





CUSTOM DESIGNED
STEEL TRUSS CLAD
WITH COPPER ROOF
SHEETING

EXPLORATION OF A
CLAMP SYSTEM



IMG 122: Development of
the truss and connector
systems

RETAINING WALL

The site has sedimentary clay soil with little water movement. According to SW Jacobsz (2011) the type of sedimentary clay found on the site is not very active as it is discarded onto the grounds by the Apies River. Jacobsz (2011) proposed a Gunitte (Spray Concrete) retaining wall system as excavation on the back of the walls will not be necessary. This system will include ground nails on a 1,5m to anchor the retaining wall. The use of Micro piles could be necessary to stabilise the ground during excavations. Excavation typically takes place on 2m intervals and when the excavation surpasses 6m into the ground a 1.5 metre interval is used from thereon. The concrete layer is applied to a typical thickness of 300mm and is reinforced with a double galvanised mesh layer. A Structural concrete footing is dug out with the last excavation phase. Any moisture build-up against the retaining wall will be drained via a grid of wick drain socks that leads the water through weep holes (approximately 120mmx

30mm) into the open gutter system on the interior of the structure that flows into a water collection tank. A 300 cubic metre tank with a height of 7,5m will be provided and sensors will automatically switch the pumps on to pump water to the ground level. This will ensure that the tank will be able to accommodate heavy rains or unforeseen circumstances. The tank will exert 75kpa of pressure on the floor slab, and Jacobsz is certain that the slab will be cast on solid ground conditions at the depth of the machine room level.

The option remains to use the Gunitte Concrete layer as permanent shuttering and to cast a thin layer of concrete on it for an off shutter finish. All the excavated soil can be used to sculpt mounds for animal display areas. Jacobsz emphasised the fact that a full Geotechnical report will be needed to finalise the design of the retaining wall system.

AIR CONDITIONING SYSTEM

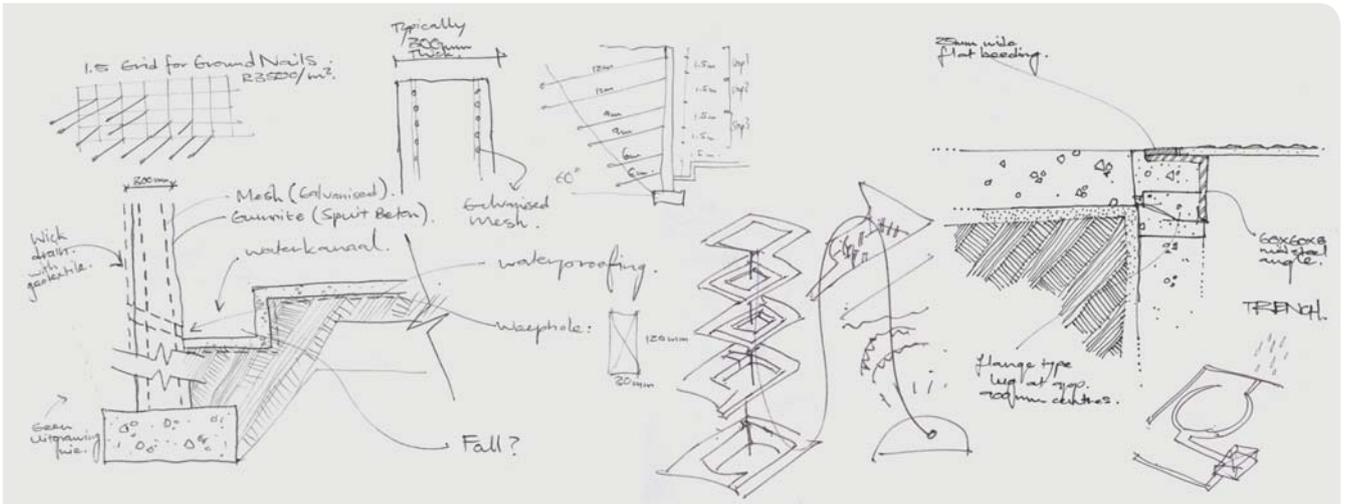
The Climate in this type of environment must preferably be controlled by means of an energy efficient Air-conditioning system to ensure the occupants comfort levels for this type of application. According to Arie Hoogenboezem (2011) typical design parameters for this type of membrane structure are 22-23°C. Due to the high volume the stratification effect will cause hot air to rise. The conditioned air will be supplied via outlets under the seating to ensure the climate the occupants experience is comfortable. The micro climate of the environment at high level is not really important as this space will never be occupied.

To ensure the dome is fully inflated Hoogenboezem (2011) suggested that a over pressure design is included in the HVAC system which monitors the indoor pressure as opposed to adjacent environments. To enable this, static pressure sensors will be utilised to control a fresh air supply fan system. This air is introduced from



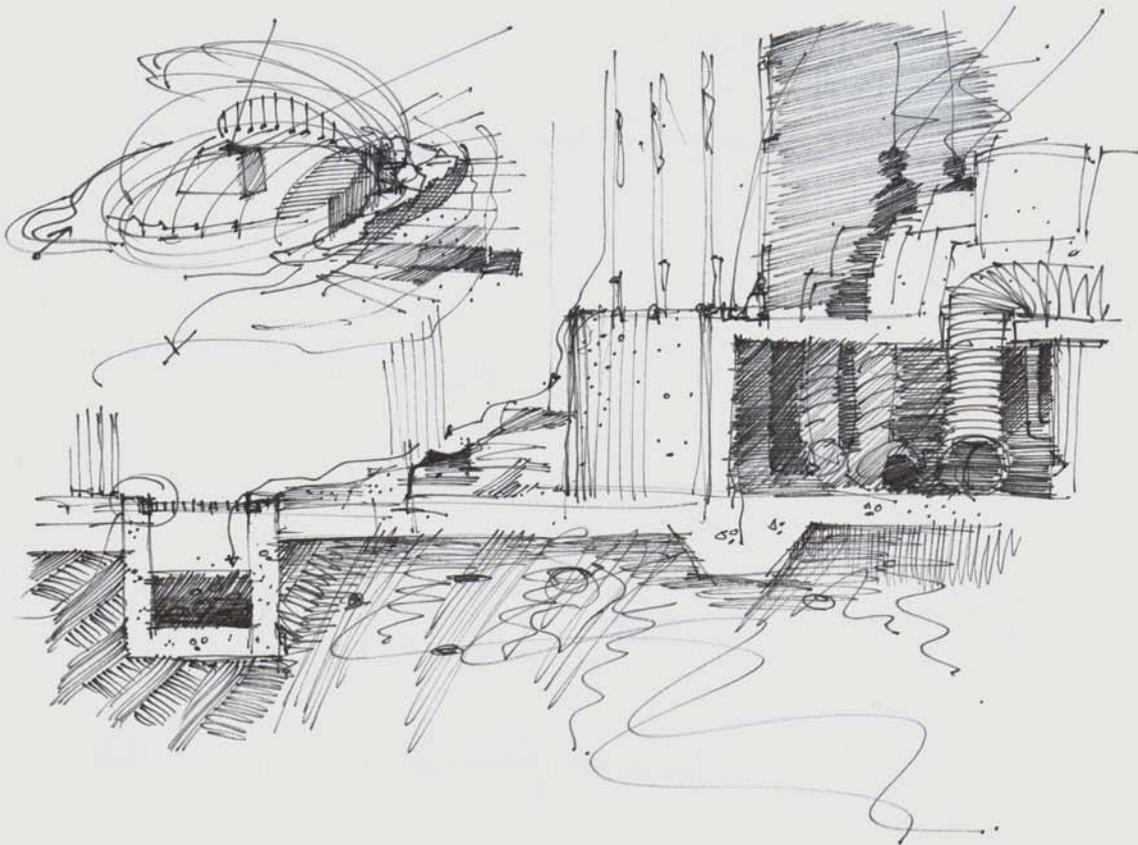
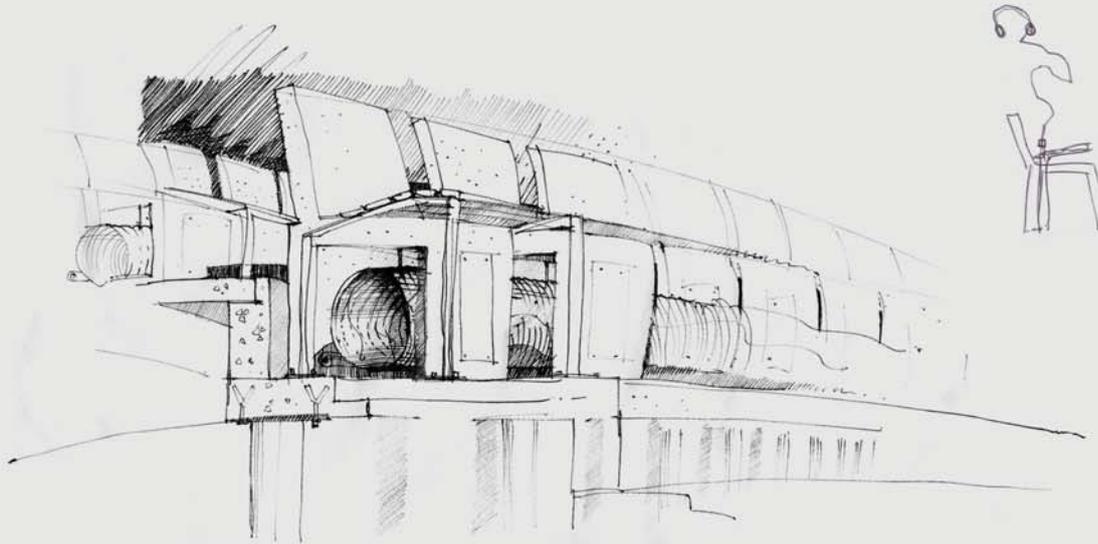
IMG 123: The proposed retaining wall system used at the Gautrain development. 2011 (Images Courtesy of S.W. Jacobsz)

IMG 124: opposite: Study of material use and the handling of water that invites play at Maropeng



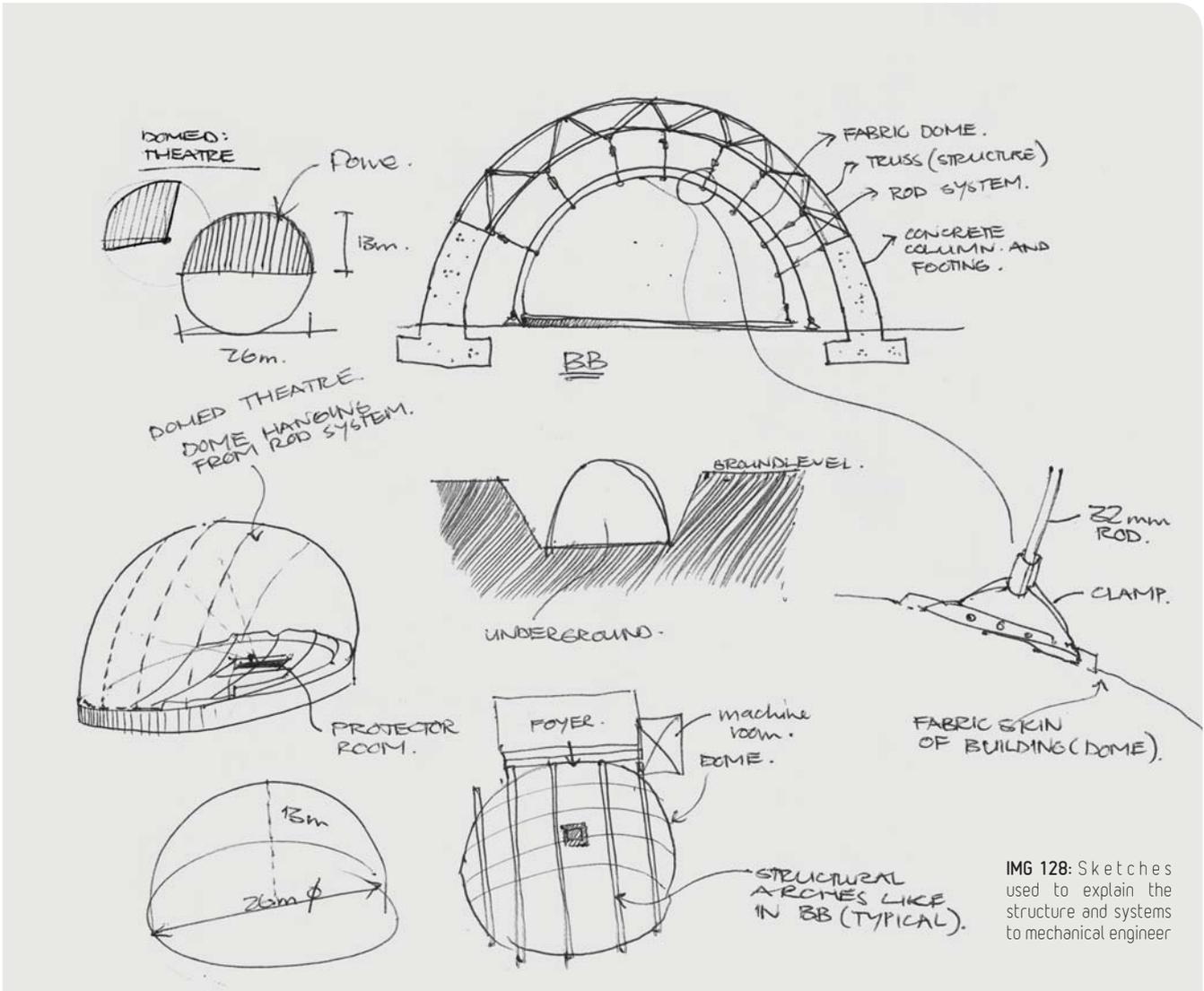
IMG 125: Sketches of factors regarding the retaining wall system





IMG 126: Technical development sketches

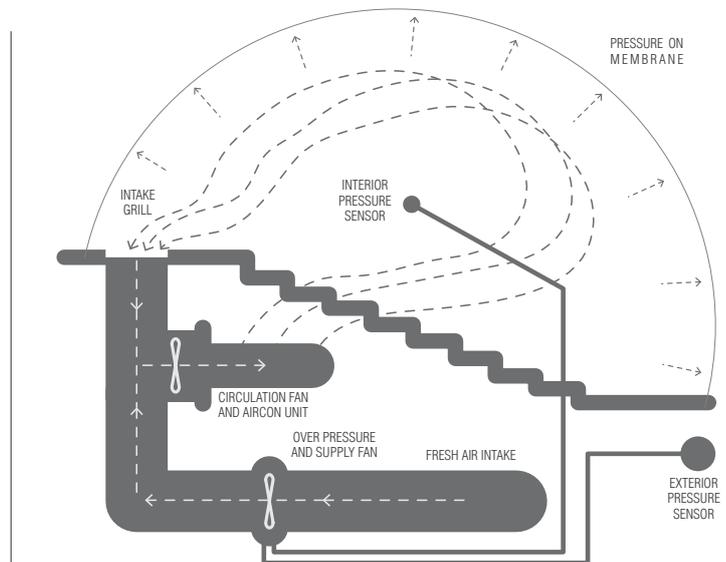
IMG 127: opposite: Elementary diagram explaining the basics of the airflow and over pressure system used to fill the dome out



IMG 128: Sketches used to explain the structure and systems to mechanical engineer

a clean source (outdoors) to maintain the required over pressure. Airlock type entrance doors must be utilised as well as properly sealed construction methods to prevent air from escaping too easily from the interior of the building.

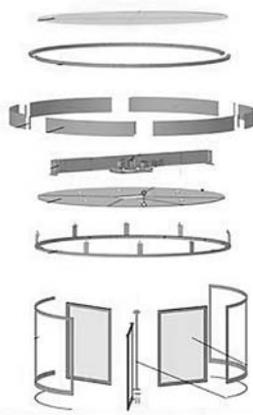
The estimated size of the machine room during the initial spatial planning proves sufficient for this application as a room of approximately 5 x 5 x 2,5high would be required (Hoogenboezem, 2011). Along with this an outdoors area to place heat rejection equipment of approximately same area would be advisable. This can be some distance away out of the eye; approximately 40m can be accommodated or even more if required. The size of a fresh air duct to introduce the required fresh air and over pressure would be approximately 700 x 700 mm big and will reticulate from the plant underneath the seating to a clean source outdoors. The ducting distributing the air underneath the seats will be in the form of a network starting big from the source (1m x 1m) and become smaller as this is branched off. Approximately all the air supplied underneath the seats must be returned again to the plant room for recirculation thus a return air plenum with grilles somewhere in the back floor of size 5m² (in any shape or multiples of sizes) will work well. An important note to make is that in this application noise outbreak from HVAC equipment is very undesirable thus proper sound attenuating measures needs to be implemented (Hoogenboezem, 2011).



AIR LOCK PRODUCTS



A



B



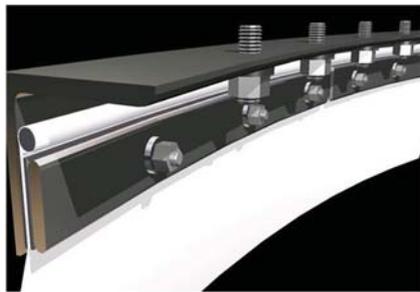
C

A: Rotating door system

B: Rotating door system

C: RUND™ cylindrical air curtain system

D: Clamping systems by Birdair to serve as precedent for the design of the custom clamping systems for the proposed visitor centre



D

RADOMES

Typical radome pressurization systems contain either 2, 3 or 4 blowers, an air intake plenum, motor starters and an automatic radome control panel - all mounted on an integral skid. Multiple blowers provide redundancy that guards against failures from the loss of a single unit. Centrifugal, non-overloading, backward-inclined blade blowers provide constant pressure over a wide range of airflow conditions without the need for complicated controls. Radomes also use a PTFE membrane (Teflon®) coating is thermally fused to high-strength woven fiberglass under temperatures exceeding 600°F). There are no adhesives used in either the manufacture of the membrane or

the assembly of the envelope itself. The result is a chemically inert structure having inherently stable characteristics (including hydrophobicity) with a maintenance-free envelope which never requires painting, re-coating or caulking over the 20 year design life. Accidental damage to the radome envelope may be repaired in place by heat-welding a piece of the same material over the damaged area. The dome shaped radome envelopes are constructed from gore shaped panels, each heat sealed with the next to form an air and watertight lap seam.



Lowering membrane into place



Clamping membrane to the base



Pressurisation system

MEMBRANE

Birdair's new Tensotherm™ product, is made with Saint-Gobain's SHEERFILL® II Architectural Membrane and a special grade of FABRASORB® Acoustical Membrane. SHEERFILL can help lower air conditioning requirements in buildings, reducing peak cooling demand by 10 to 15 percent.

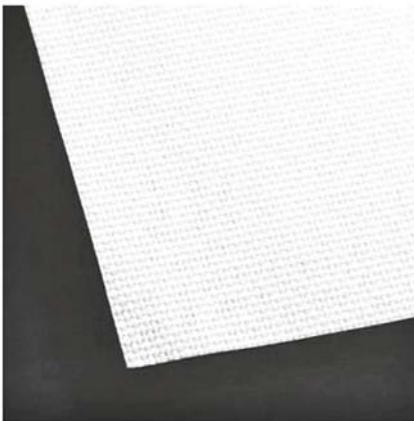
A: PTFE Fiberglass Outer Layer: PTFE, or polytetrafluoroethylene, is a Teflon®-coated woven fiberglass membrane that is extremely durable and weather resistant. Lightweight and translucent, PTFE fiberglass is completely immune to UV radiation.

B: Lumira™ aerogel, created by Cabot Corporation, is the world's most effective thermal insulation. It is also the world's lightest solid material. Lumira™ aerogel is unlike any

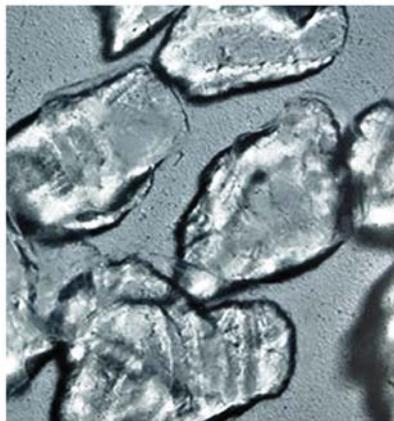
other thermal insulating material because its insulating capability never deteriorates. In fact, under compression, where most insulations lose insulating abilities, its insulating value actually increases. Lumira™ aerogel is also responsible for providing Tensotherm with its excellent acoustic attenuation capability. And, being a hydrophobic material, Lumira™ aerogel cannot hold or be affected by moisture. The net result is an insulation which has similar efficacy as the PTFE fiberglass membranes that sandwich it.

C: Inner Layer: Tensotherm's PTFE fiberglass interior liner can provide a continuous vapor barrier or effective acoustical barrier depending on climate conditions and mechanical requirements.

D: On the inner layer the last layer, film screen is applied. A significant problem in dome theatres is cross reflection and consequent loss of contrast. Low gain screens (less reflective) and a overall matt interior surface treatment ensure best results.



A



B



C

COPPER CLADDING

The standard roofing copper roles are fabricated in 300 or 600mm widths. The seam is typically made up of a 100mm strip of material; seams can either be shiplap or standing. The underside of the custom truss will be shiplap for a smooth finish but on the sides - to emphasize the radial structure - standing seams will be used to interplay with the reflection of light and shadow lines. The seam stands 25 or 38mm high depending on the number of times the material is folded over and serves as small gutter systems which guides water around skylights or other window openings.

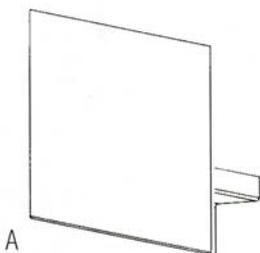
Copper mesh can also be used on the underside of the truss to allow water to seep through and the structure to breathe. A flashing can be used to grip the seam of the mesh. The plates will be cut to the exact sizes on the drawings and then folded onto the structure. The seams can be folded flat or remain standing on the edges of the structure.

Pine shutter board 18-20mm thick is fixed to the steel sub structure, Monier slip sheets are laid onto the shutter boards and thereafter a spacer membrane layer follows. The Delta Trela spacer membrane serves as insulation and creates an 8mm void between the copper cladding layer and the structure. For vertical applications the spacer membrane is not required. Copper or stainless steel brackets can be used to fix the copper cladding.

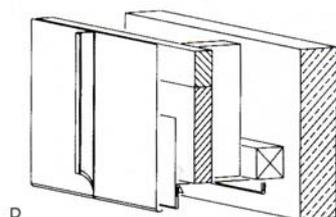
According to Frans du Toit (2011) from Cupric Tectonics the copper cladding sheets used for the Freedom Park project was up to 40m in length. Measurements taken on site indicated that the sheets would expand by 12mm – du Toit indicated that it would be possible to clad the whole top surface of the truss system with a single rolled sheet.



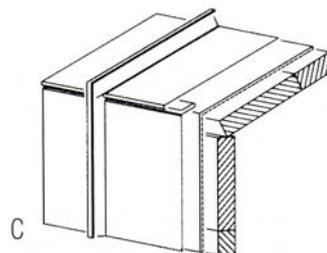
- A: Base starter strip for use in wall cladding
- B: Ventilated base of curtain wall
- C: Visually continuous seam on roof edge
- D: Mono-pitch roof ridge with flashing and ventilation



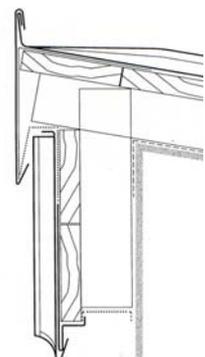
A



B



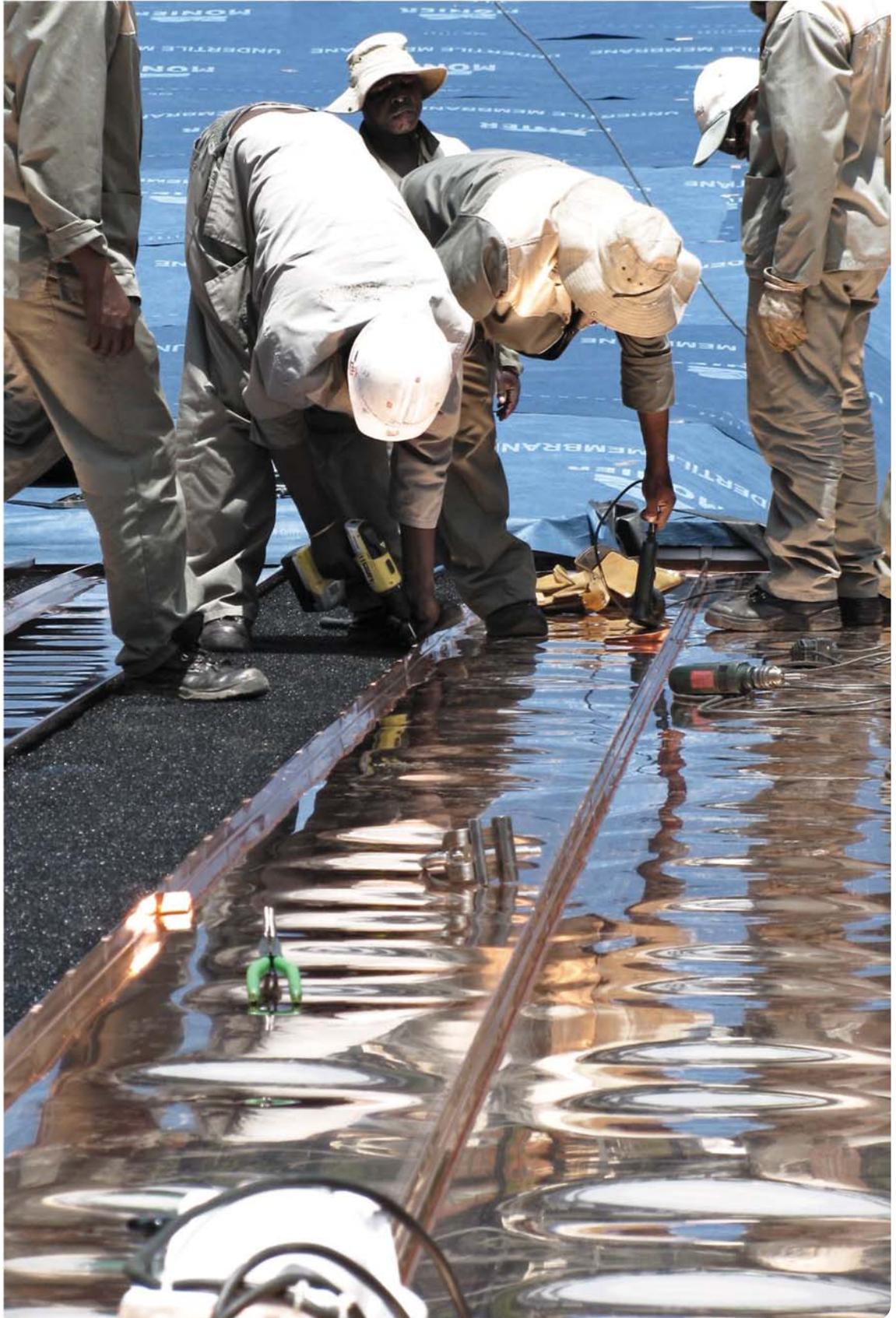
C





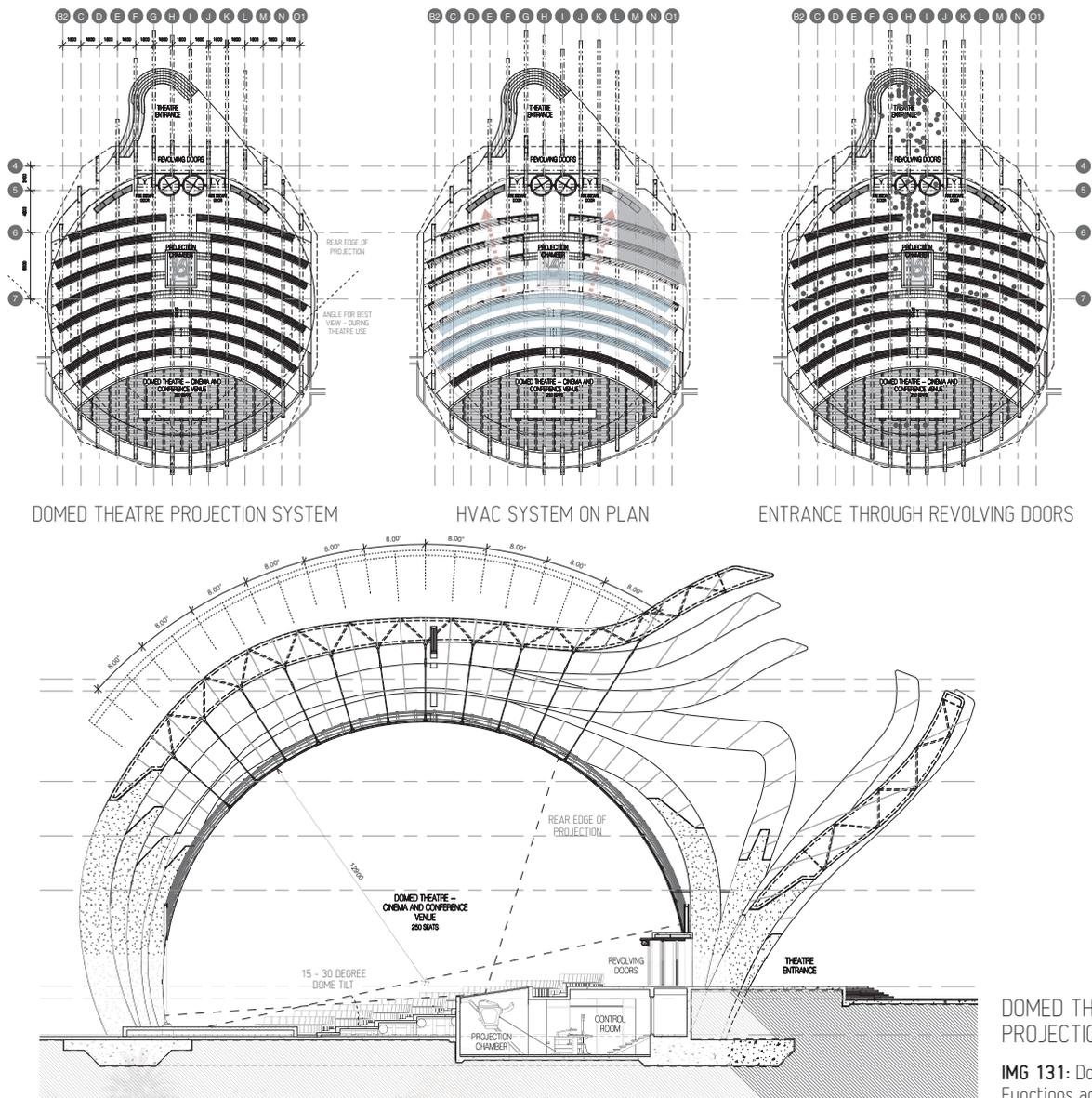
ZOO
115





IMG 129: opposite:
Photo journal of building phases at Freedom Park focussing on the copper cladding work (Photos courtesy of Frans du Toit, Cupric Technics)

IMG 130: Cladding the roof surface at freedom park (Photos courtesy of Frans du Toit, Cupric Technics)



DOMED THEATRE PROJECTION SYSTEM
IMG 131: Domed Theatre Functions and access

DOMED THEATRE PROJECTION SYSTEM

The OMNIMAX Theatre System which presents motion pictures on a dome screen (typically using about 80% of a hemisphere) was developed to provide a “Space Theatre” which is characterized by a tilted dome in the range of 25-30° uses a fish-eye lens with a beam angle slightly in excess of 180°. The image occupies a lateral field of view averaging 180°, and a vertical field of view averaging 125°.

The system's ideal is to involve and immerse the viewer within the motion picture. The edges of the picture is beyond the recognition field of view. The sense of reality is achieved by reducing or eliminating the various “clues” which remind the audience that they are watching a picture.

OMNIMAX Theatres range from 94 to 380 seated theatres. The front seats

require that the audience lean back at rather steep angles in reclining seats, the angle thus varies from the front to the back of the theatre.

Another significant problem in dome theatres is cross reflection and consequent loss of contrast. Low gain screens (less reflective) and a overall matt interior surface treatment ensure best results.

For a booth with an operator the temperature should run no more than 22°C-25°C. The Control or Projector room houses various electronic units that is a collection of heat sources. A typical projection booth with an operator will be painted flat black to minimize the amount of reflected light that might spill out into the audience seating area through the booth windows.



IMG 132: Projection on the dome: immersion

POLYURETHANE FLOOR

Stockmeier Urethanes Manufactures AlsatanR SW, a non porous athletic track sandwich design. The covering has a high resistance against scratches. The cover consists of a flexible elastomeric base layer of black rubber granules and polyurethane binder and is then sealed with a two-component polyurethane system and a final coating with a two-component polyurethane and coloured granules broadcasted on top. This system was formulated for athletic tracks and multi use game areas and offers specially adjusted formulations and thicknesses for a variety of uses. The product is highly wear resistant, secure and elastic, and thus will also provide an ideal surface for the theatre. The covering has a soft feel underfoot and provides the same non reflective surface as carpeting would.



ROUGH CUT SLATE

Slate tiles will be used for most of the exterior surfaces in the NZG Visitor Centre. The natural look and texture of the product reflects the material of the excavation level and is also rooted in the history of Pretoria. According to Anton Jansen the 'watervoortjies' (aqueducts) of Pretoria was layed with slate. There is an opportunity to use this material in a more topographical nature creating a more dynamic surface as one would expect naturally. The example above indicates the possibility to communicate the intervention of man though interplaying textures.



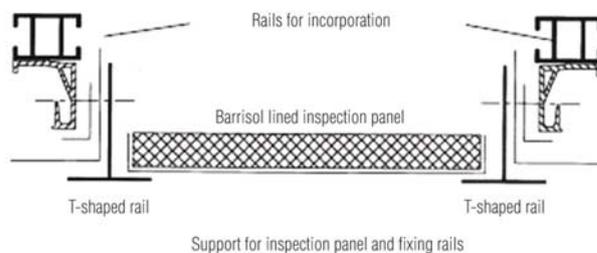
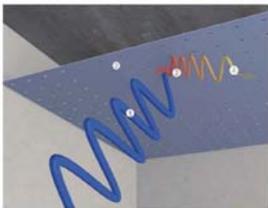
IMG 133: Slate surface texture options

POSSIBLE CONCRETE ADD MIX

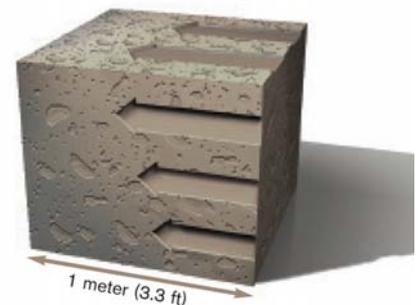
Penetron cementitious capillary waterproofing products are formulations consisting of common cement, quartz sand (of special grade) and multiple activating chemicals that provide the most effective permanent concrete waterproofing.

BARRISOL

MICROACOUSTIC®



PENETRON®



STRETCH CEILING

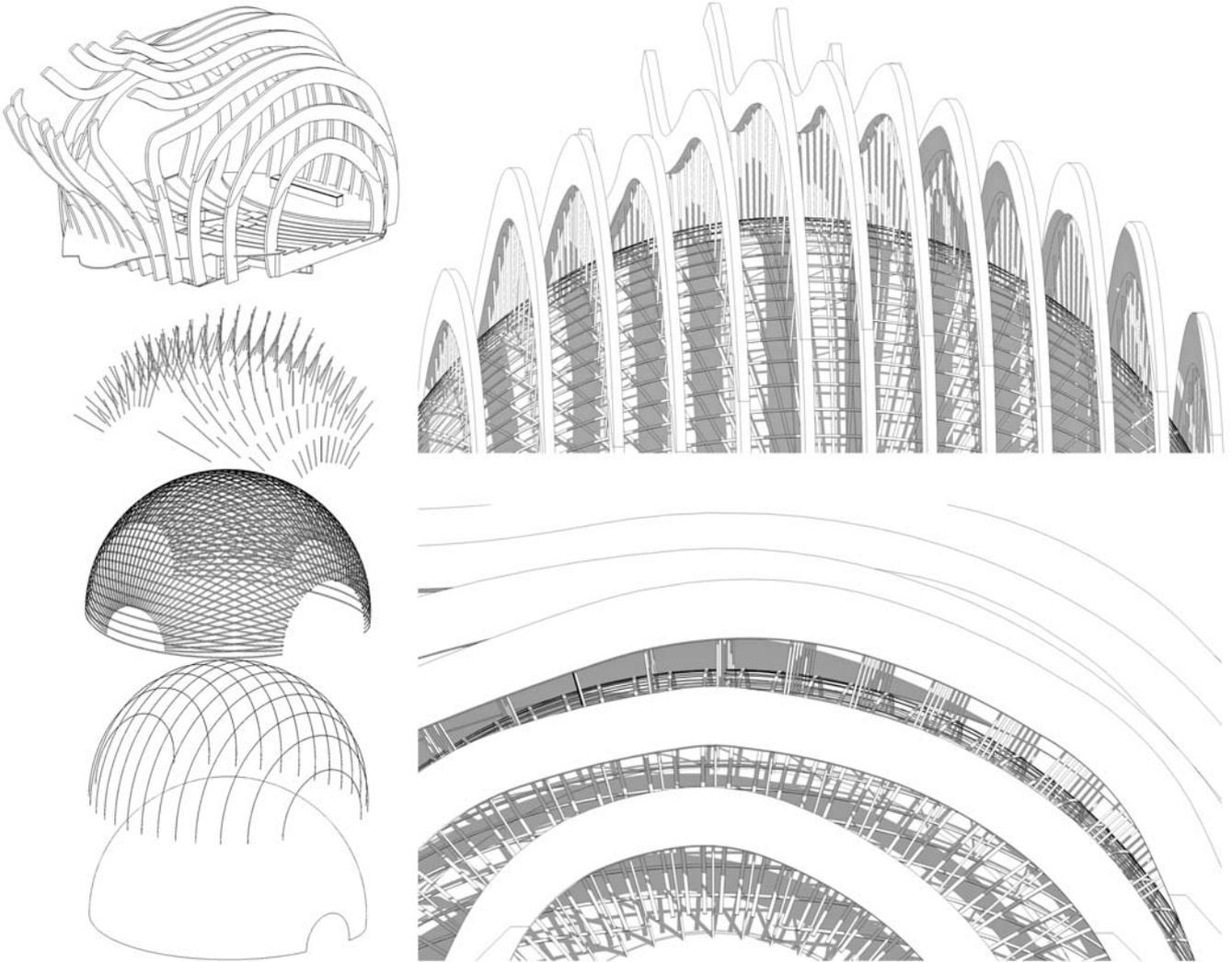
Barrisol's is a stretch ceiling product which is non-toxic and meets current international standards on fire classifications. Safety devices and Sprinklers can easily be incorporated into the system. Barrisol is waterproof and does not develop moulds or fungi, it is thus insensitive to damp.

The air lock, similar to double glazing, forms an insulating buffer and prevents condensation formation on the fabric. Soundproofing and acoustic qualities of the product create a softer atmosphere due to the air lock in the plenum. The fabric is composed of retentive molecules and is able to return to the initial shape and tension after distortion. The width of the sheet without weld can vary from 150 cm to 256 cm.

LIFTS

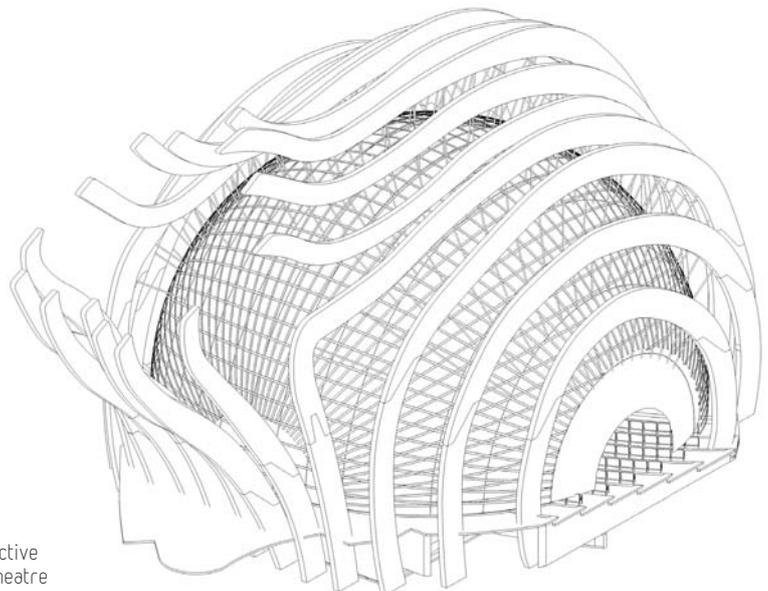
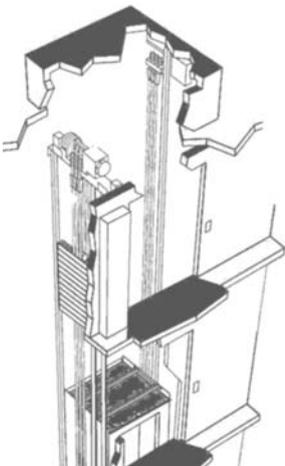
Machine roomless elevator systems employ a smaller sheave than conventional geared and gearless elevators. The reduced sheave size, together with a redesigned motor, allows the machine to be mounted within the hoistway itself—eliminating the need for a bulky machine room on the roof. The GeN2 Comfort system enables architects greater freedom of design and builders benefit from a more controlled installation process with minimum building interface.

PERSPECTIVE VIEWS OF THE STRUCTURE

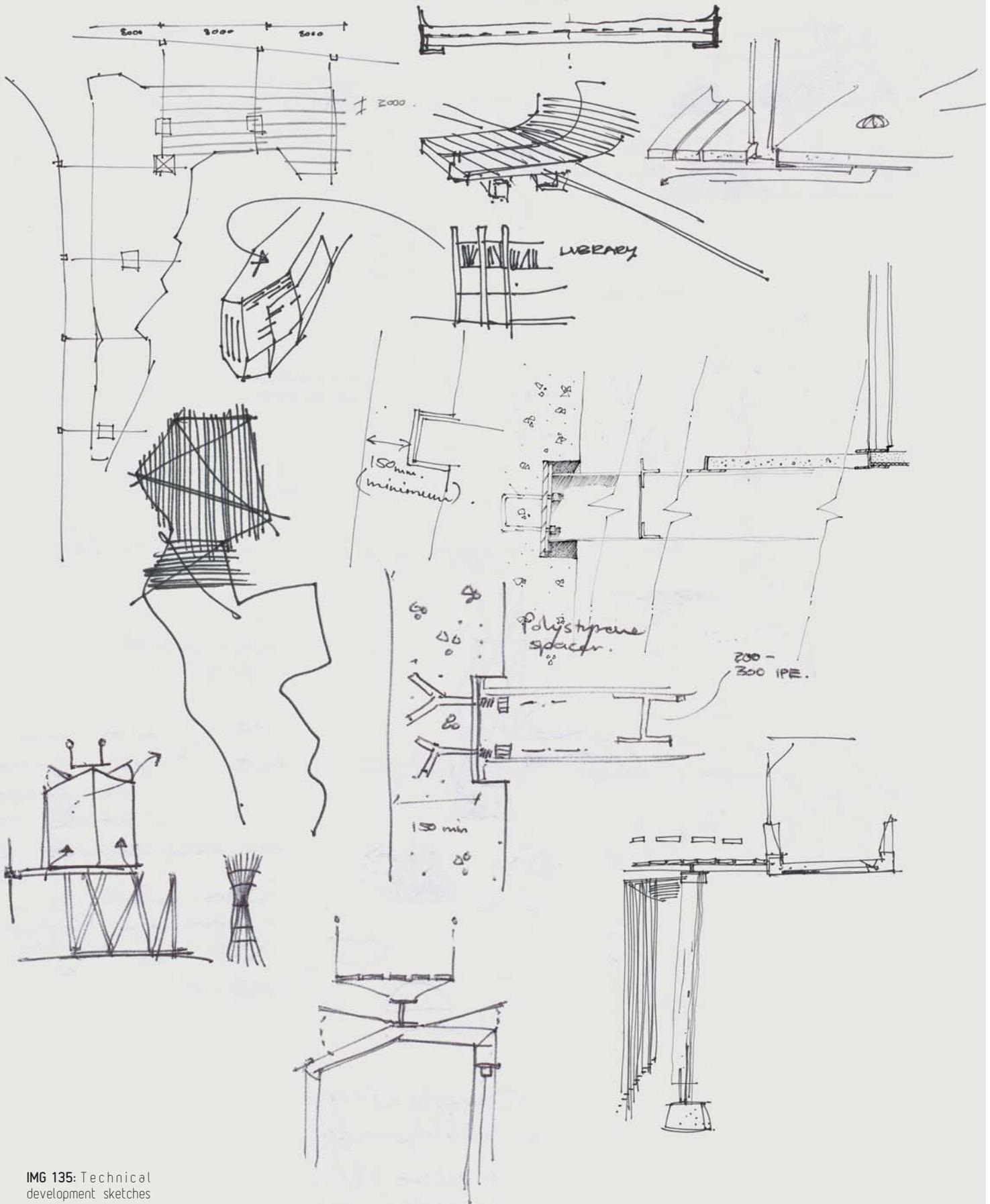


OTIS
www.otis.com

Gen2™ Comfort



IMG 134: Perspective view of domed theatre



IMG 135: Technical development sketches on the zoo keeper's level



IMG 136: left: Aerial view of the Freedom Park development (courtesy of Frans du Toit, Cupric Techtonics)

IMG 137: below: Copper cladding details on Freedom Park building

