Refining the intention

The technical chapter aims to present the honing process of the development of the Thebe Medupe Planetarium. Focusing on the three aspects of the project, this chapter presents the Dome, Water and Light as the three technical topics for the scheme.
Fig. 126. Knowing what to look for. This conceptual diagram considered the external and internal forces affecting the scheme. Attempting to exaggerate the architectural concept as in response to the climatic conditions. May, 2016.
7.1 THE THEBE MEDUPE PLANETARIUM

Technical development
Fig.127. Reorientating. The master plan shows the park in its final iteration stage. From the north the park stretches the width of the site, flanking the park on the north east portion is the restaurant, which acts as the new datum on site. For the visitor, the route enters the landscape where the environment gallery provides a large sheltered and supervised play area for the children. Towards the south, a public staircase descends to meet Mankopane street. This is the visual route. The Planetarium is located on the south west beneath the new terrace. A series of meandering ramps, guided by rainwater filtration channels trace the contours to bridge the 10 meter drop. On the west, the shuttle service and maintenance parking grounds are located behind the last tank. To the east the urban balcony stretches to meet Atlyn Mall on Khoza Street.
7.1.1

THE DOME

The projection room
Fig. 128. The auditorium. The first iteration of the auditorium focused on the interior space. Responding to the technical requirements of the Carl Zeiss Starmaster projector, the line of horizon was determined and the dome dimensions calculated. This section also considered the retaining wall necessary to withstand the force of the earth and ground water. In this iteration, a series of up-stand beams were utilised to stabilise the earth above. This was inverted to minimise the loading capacity necessary to retain 1m of replaced earth. Instead a well-draining growth medium will be considered in order to rehabilitate the roof.
7.1.2
THE SHELL

The Schwedler Dome
Fig.129. The Schwedler dome. Illustrated above, the Schwedler dome makes use of 3 members: the red compression members are laid out longitudinally; and the blue members tie the compression members together by providing tensional support in the latitudes whilst the black diagonal lines provide the necessary triangulation to stiffen the structure. In order to ensure thermal comfort for the 170 visitors, low-lying inlets provide fresh cool air whilst the perforation in the aluminium skin allows the dome to ventilate towards the extraction points provided in the ceiling void. The dome sits within the larger void of the cube, and must be erected within the enclosure. Detail to follow.
7.1.3 MAINTENANCE

Services
In addition to creating an experience for the user, planetariums boast longevity; hence, ease of maintenance and provision for services needs to be considered. The speaker units are mounted externally to avoid obstruction within the dome. A series of down-lighters and up-lighters are used to accentuate the shape of the spherical room such that it provides an opportunity for passers-by to engage with the interior space.

Ventilation is provided through a dehumidifier placed in the service room behind the north wall. This system imports air from the ground via earth tubes to ensure that the necessity for cooling is kept to a minimum. The extracted air is introduced into an insulated air-water heat exchange, before it is recirculated into the system. The service room is highlighted in the section on the following page.
7.1.4
THE PLANETARIUM

October reflection
Fig. 131. Structural Integrity. The idea of a cut-and-fill-back approach poses a number of challenges, predominantly in the form of water and structural stability on the northern retaining wall. With up to 10m of backfill, the retaining wall makes use of tiebacks which are secured to stable rock behind. On the ground, the structure makes use of a raft foundation, carried by pile foundations probing for stable rock beneath. A series of agricultural French drains are utilised to get rid of unwanted accumulation of ground water. A secondary floor (access flooring) provides space for ventilation and conduit support for the projector and ground mounted up-lighters. The ceiling is pitched at a 5° angle and recessed away from the sphere to appear as if disappearing into the void. The services are hidden beyond the ceiling and placed within reach of the catwalk.
7.1.5

THE PLANETARIUM

Cladding note:

Custom 0.58mm thick ‘white’ powder coated perforated aluminium flat sheet cladding panels fixed with Stainless steel self tapping screws to 12mm MDF board bent to shape on site fixed to steel structure with s/s self tapping screws.

Structure Note:

Compression Members: 40x40x3mm Galvanised Mild steel tubular sections with custom fixing plates fixed to 40x40x3mm Galvanized Mild Steel Tension ring beam with 6mm Ø s/s hexagon bolts.

Bottom Tension member: 40x40x3mm Galvanized Mild steel tubular sections fixed to custom bent 230x230x6mm H-columns with Galvanised mild steel end base plates chemically fixed with 6mm Ø stainless steel hexagon bolts to 300mm thick Reinforced concrete ground ring beam as per Engineers detail and specifications.

Acoustic Note:

Noise dampening foam to be propped in place with straining wire. Positioned between the MDF board and cut out where speakers are located. Conduits for sound system to be designed by engineer to fit within the provided cavity between the MDF layers.
Dome assembly

PLANETARIUM DOME DETAIL 1:20
7.1.6

THE PLANETARIUM

Design Section
Unequal length angle continuously welded to top of H-column to act as a base plate for the structure of the dome.

Custom 0.58mm thick 'white' powder coated perforated aluminium flat sheet cladding panels fixed with Stainless steel self tapping screws to 12mm MDF board bent to shape on site fixed to steel structure with s/s self tapping screws.

Dome structure to be manufactured and assembled off site to ensure position of fixings prior to assembly on site.

230x600x6mm custom cut and bent H-column to carry structure of dome to the foundation wall. To rest on 250x250x3mm base plate anchored to foundation wall with cast in place anchor bolts to for adjustment during assembly process.

Concealed light fixture to be fixed onto unequal length angle chemically fixed to foundation wall.

Floor finish to rest on access flooring

Footing detail 1:20
Rain water drainage and filtration

Fig. 132. Approach to water.
At the summit of the hill, there is no opportunity to capture run-off water from adjacent sites. Thus, the design aims to slow down storm water and filter it, before tapping off portions of it for the use within the building. The filtration process occurs within the terraces such that the water is cleared from any debris or dirt before slowly being released back into the water table. This is done through a series of connected sub-surface flow wetlands that align themselves with the ramps. This breaks the rigidity of the ramps and provides an opportunity to highlight the scarcity of water. At a higher level, the columns of the main structure act to transport water down and are detailed across. This is done to disperse water effectively from the green roof above. Maintenance and accessibility are also considered.
7.2.1 WATER TREATMENT

Highlighting the collection of water

Fig.133. Filtration and discharge. Filtration occurs on this level, providing a sediment-free discharge through the use of a French drain system. Positioned at a central incline, water flows towards two opposite discharge points (as detailed on the previous page). Four drains are provided to provide a fail-safe discharge of water accumulating on the roof.

Fig.134. Highlighting water. On the opposite page the discharge points can be seen in elevation as weep holes, topped with a precast concrete lid above the column. The lid retains a portion of the growing medium whilst remaining accessible for service. The weep holes discharge onto an angled concrete panel that allows the water to drain until it meets the splash block, where it is then collected via underground pipes.
52mm thick Stone Veneer coping fixed with mortar to RC Beam.

52mm thick Stone Veneer secured to Cast in-Situ Reinforced Concrete Beam with Galvanised

Intensive Green Roof Structure: Growing medium to match the vegetation on site. Substrate depth to be a minimum of 300mm deep.

200mm Ø Agricultural drain seen in elevation acting as weepholes for stormwater drainage.

300x2500mm Cast in situ Reinforced Concrete Beam as per Engineers details and specifications.

375 Micron DPM to be lapped and sealed underneath 52mm thick stone veneer on 30mm min. screed with 76x70mm fillet at junctions.

Pest control mesh to be fixed between concrete toe and underside of 80mm thick precast

Line of column in elevation.

1200x1200x80mm precast concrete panels used to direct water from intensive green roof.

230mm brick work to conceal the back of the rainwater outlet. Plastered and painted to match the colour of the concrete finish.

100mm thick precast splashblock positioned at the footing of the columns to direct water away.

Altered Ground Line.

STORMWATER OUTLET 1:20
7.3 LIGHT

Fenestration

FLUSH GLAZING DETAIL 1:10
GLASS NOTE

600mm upstand cast in situ upstand beam and water channel.

Stone chips around drain and enclosed by Geo-Fabric outlet slopes to rain water down pipe.

Waterproofing laid up to 30mm mansard screed sloped to outlets.

Spider fittings fixed to 200x100x8mm Galvanised Mild Steel Tubular Hollow section mullion.

200x100x6mm Galvanised mild steel tubular hollow section fixed between Galvanised Mild Steel mullions to act as louvres.

200x100x6mm Galvanised Mild Steel tubular hollow section columns with thin thick end base plates bolt fixed to cast in place Mild steel anchor bolts at top and bottom of Reinforced Concrete Slabs.

300mm Thick Reinforced Concrete Foundation footing as stormwater channel as per Engineer's detail and specification.

Loose Rock from site as Backfill.

Stone chips around drain and enclosed by Geo-Fabric.

200mm Ø Agricultural drain covered with Geo-textile/filter fabric to slope to rainwater outlets at columns.

750mm wide and 1200mm high Gabion wall anchored in place by 50x50x6.3mm tubular Hollow Section steel members with end baseplates spaced at 750mm C/C fixed to Reinforced Concrete foundation as per Engineer's detail.

500mm internal diameter underground concrete cooking pipe.
7.4 THE ELEVATION

Articulating the facade

Fig. 135. The elevation.
The technical development of the elevation focuses on the cladding system used to achieve the required aesthetic. Initially envisioned as a horizontal band of stone masonry, the southern elevation suspends the rock to appear as if the building was carved out of the landscape. The elevation below illustrates how stone recycled from the earth works could be used. To achieve this, the stone would be cut to shape from larger pieces of rock. This process would require the stone to be bonded to the upstand beam due to the lack of uniformity in the size of stone. Elevation: August, 2016. Sketches: August, 2016.
7.4.1 THE ELEVATION

Articulating the facade

Fig. 136. The elevation. This iteration considers a uniform pattern which allows for the introduction of an anchor, allowing the stone to attach in an orderly fashion to the concrete upstand beam. Although this system would provide for ease of assembly, the process of preparing the rock might require more skilled labour and could be time consuming. Elevation: August, 2016. Details: September, 2016.
7.4.2 APPROACH

Designing the elevation
7.4.3

THE PLINTH

Designing the Southern entrance

Southern Elevation NTS drawn at 1:100
7.4.4 THE PARK

Designing the Northern entrance
7.5
1:20 EXPLORATION

NEW FOUNDATION WALL

OUTSIDE

NEW BARRIER DAM BEEN TO EROSION SOURCES

EXISTING PILE FOUNDATION

INSIDE

85 mm CONCRETE APPEAR

ENVIRONMENT GALLERY WALL SECTION 1:20
7.6
SITE PLAN

Drawn 1:500 illustration NTS
7.6.1 THE RESTAURANT

1:50 Section illustration NTS

[Diagram with annotations]

© University of Pretoria
7.6.2

THE LIGHT ROOM

1:50 Section illustration NTS
GLASS NOTE

- 600mm spun steel in slab extending from roof and water channel.
- Steel shoes around edge and reduced by 150mm diameter concrete.
- Waterproofing extension to 150mm thick screed along the walls.
- Slab thickness decreased from 200mm to 100mm over the steel section.
- 100mm Betonit Silicate high performance, low-heat, low-water concrete mix.

LIGHT ROOM

EXCAVATED PIT

Roof foundations per engineer's details and specifications.
7.6.3 PLANETARIUM

1:50 Section illustration NTS
7.6.4
ENVIRONMENT GALLERY

1:50 Section illustration NTS
7.6.5 PLANS

The room and the garden
7.6.6
LOWER LEVELS

Planetarium and lobby plans

Mankopane street
**LIST OF FIGURES**

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fig.137</td>
<td>Mankinds relationship with the sky and sands</td>
<td>iv</td>
</tr>
<tr>
<td>Figure 1</td>
<td>In search of a new typology.</td>
<td>01</td>
</tr>
<tr>
<td>Figure 2</td>
<td>View eastward on Thindisa Street towards Pretoria CBD. The suburban condition.</td>
<td>02</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Block Study Nel &amp; Sadiq 2016. Densification and disappearance of open space adapted from Stals (1998;80.)</td>
<td>03</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Sketch of a Saulsville neighbourhood park, view SE towards Atteridgeville.</td>
<td>04</td>
</tr>
<tr>
<td>Figure 5</td>
<td>An inspiring institute for the contemporary citizen</td>
<td>05</td>
</tr>
<tr>
<td>Figure 6</td>
<td>International examples of inspiring public buildings.</td>
<td>06</td>
</tr>
<tr>
<td>Figure 7</td>
<td>View towards Pretoria CBD, eastwards on Mabothe Street.</td>
<td>07</td>
</tr>
<tr>
<td>Figure 8</td>
<td>Oudstad no. 21: The site of the Atteridgeville Water Reservoir is identified as a Green Island</td>
<td>09</td>
</tr>
<tr>
<td>Figure 9</td>
<td>Discovery. First engagement with the water reservoirs. Author, site visit 2016.</td>
<td>10</td>
</tr>
<tr>
<td>Figure 10</td>
<td>Levels. Attempting to understand the three dimensional in-between space. Author, 2016.</td>
<td>11</td>
</tr>
<tr>
<td>Figure 11</td>
<td>The tight knit fabric of Atteridgeville.</td>
<td>15</td>
</tr>
<tr>
<td>Figure 12</td>
<td>Urban settlements orbiting around Pretoria's Church Square.</td>
<td>16</td>
</tr>
<tr>
<td>Figure 13</td>
<td>Crude Urban Zoning, the Apartheid City way (Turok,1993:4)</td>
<td>17</td>
</tr>
<tr>
<td>Figure 14</td>
<td>Approach to Natural Features. Urban Balcony. May,2016.</td>
<td>17</td>
</tr>
<tr>
<td>Figure 15</td>
<td>Current condition: Monotonous residential environments spread across the landscape (Nel &amp; Sadiq, 20016).</td>
<td>18</td>
</tr>
<tr>
<td>Figure 16</td>
<td>Proposed condition: Diversify the urban fabric and create social anchors to contain lost energy (Nel &amp; Sadiq, 2016).</td>
<td>18</td>
</tr>
<tr>
<td>Figure 17</td>
<td>Conceptual Methodology: Activity to define boundary. Psychological city walls (Nel &amp; Sadiq, 2016).</td>
<td>19</td>
</tr>
<tr>
<td>Figure 18</td>
<td>Section through Maunde Street. Illustrating the peaks of the Quagga Mountains.</td>
<td>20</td>
</tr>
<tr>
<td>Figure 19</td>
<td>Abstraction of the island effect.</td>
<td>20</td>
</tr>
<tr>
<td>Figure 20</td>
<td>Sketch of approach to site, highlighting the domination of municipal infrastructure on the surrounding landscape.</td>
<td>21</td>
</tr>
<tr>
<td>Figure 21</td>
<td>Oudstad no. 21 in relation to its context NTS.</td>
<td>21</td>
</tr>
<tr>
<td>Figure 22</td>
<td>Site Plan, including the space left over after planning, creating a tail-piece stretching east.</td>
<td>23</td>
</tr>
<tr>
<td>Figure 23</td>
<td>Isolated. October, 2016.</td>
<td>24</td>
</tr>
<tr>
<td>Figure 24</td>
<td>Inverted. October, 2016.</td>
<td>24</td>
</tr>
<tr>
<td>Figure 25</td>
<td>Energy axis. July, 2016.</td>
<td>25</td>
</tr>
<tr>
<td>Figure 26</td>
<td>Movement axis. July, 2016.</td>
<td>25</td>
</tr>
<tr>
<td>Figure 27</td>
<td>Photograph looking NE from the roof of the submerged reservoir. March, (Author) 2016.</td>
<td>26</td>
</tr>
<tr>
<td>Figure 28</td>
<td>Proposed avenue to connect the site with Maunde Street via Atteridgeville Cemetery.</td>
<td>28</td>
</tr>
<tr>
<td>Figure 29</td>
<td>Approach from Atteridgeville Cemetery, south of the site. The 20Ml tank dominates the surrounding scale.</td>
<td>29</td>
</tr>
<tr>
<td>Figure 30</td>
<td>Establishing connections to the surrounding context. Inviting ‘the everyday’. April, 2016.</td>
<td>30</td>
</tr>
<tr>
<td>Figure 31</td>
<td>Activating the site. Exploration. April, 2016</td>
<td>31</td>
</tr>
<tr>
<td>Figure 32</td>
<td>Approach from Tlale Street. With the exception of the domed concrete roof, the tanks are hidden behind the topography.</td>
<td>32</td>
</tr>
<tr>
<td>Figure 33</td>
<td>On site sketch, highlighting the tranquility of the hill and the serenity of the surrounding neighbourhood.</td>
<td>33</td>
</tr>
<tr>
<td>Figure 34</td>
<td>Conceptually activating the vertical plane on site. Connection with sky. March, 2016.</td>
<td>34</td>
</tr>
<tr>
<td>Figure 35</td>
<td>Noli map of site in the larger context highlighting Maunde Street, Atteridgeville Cemetery and Atlyn Mall. August, 2016.</td>
<td>37</td>
</tr>
</tbody>
</table>
Figure 37  Sky and earth. Conceptual sketch exploring relationship to the sky. April, 2016.
Figure 38  Zoning diagram illustrating areas of common spatial qualities. May, 2016.
Figure 39  The 8Ml tank up-close. May, 2016.
Figure 40  Imaginative diagram of the development of site in context
Figure 41  The contour map. The gentle slope on the north can be compared to the embankment on the south.
Figure 42  Understanding the conditions of the site. July, 2016. NTS
Figure 43  From the Plateau. View south, only the rooftops of the surrounding homes are visible. May, 2016.
Figure 44  Passers-by on Mankopane Street. The site is completely hidden from its immediate context. February, 2016.
Figure 45  The hills beyond. View south over-looking the quality control tank. April, 2016.
Figure 46  The 20 Mega litre tank
Figure 47  Panorama looking north towards Lotus Gardens.
Figure 48  View towards disused burried tank.
Figure 49  View of the green island.
Figure 50  Looking North the disused tank provides another plateau which acts as a lookout point. April, 2016.
Figure 51  Formidable. The three platonic circles stand side-by-side fortifying the site. April, 2016.
Figure 52  From the top of the water tank. With as little as a 4 meter elevation the rest of Atteridgeville is revealed. April, 2016.
Figure 53  BFG. The gigantic tanks are softened by their round shapes. April, 2016.
Figure 54  UNISA seen from Freedom Park. Author, 2016.
Figure 55  The Freedom Park. Southern Elevation, Architecture is noticeable in the Reed lights at dusk. Graham A. Young, 2012.
Figure 56  Pretoria CBD from Freedom Park. The relationship of Natural features with urban cores. Author, 2016.
Figure 57  Provision of safe environment for children. Image courtesy of Colectivo720
Figure 58  Maintaining functionality of the site while proposing new functions for the disused tanks. Image courtesy of Colectivo720
Figure 59  Reintegration of unused site into urban fabric. Image courtesy of Colectivo720
Figure 60  Brasilia National Museum, from a distance. Oscar Niemeyer.
Figure 61  Brasilia National Museum, close up. Oscar Niemeyer.
Figure 62  Drawings of authors memories of space making as a child.
Figure 63  Spatial zoning. April, 2016.
Figure 64  Third Place 03 Play. (Nel & Sadiq, 2016)
Figure 65  Crude telescope. A sketch of the telescope which ignited Thebe Medupe’s curiosity. October, 2016.
Figure 66  Urban Receptors. The children of Tshwane envisioned playing and engaging in the outdoor rooms. July, 2016.
Figure 67  The Thebe Medupe Planetarium. Dedicated to the South African astrophysicist : Thebe Medupe.
Figure 68  Configuring the planetarium. August exploration.
Figure 69  The Zeiss Planetarium. Located on the roof of the Zeiss factory. Carl Zeiss Archive, 2010.
Figure 70  The Adler Planetarium. Opening day, 12 May 1930. (Unknown, 1930)
Figure 71  The Johannesburg Planetarium. East Elevation captured from parking on Yale street. Author, 2016.
Figure 72  Panorama, Johannesburg Planetarium. North elevation, photographed on a public holiday. June, 2016.
Figure 73  The Johannesburg Planetarium plan. The 400 seater is situated within the borders of the University.
Figure 74  Bernard Tschumi. An urban park for the twenty first century? (1982).
Figure 75  Exploration of a programme without a plan. Combining the qualities of the site with the necessities of programme.
Figure 76  The Rain-Animal. Based on the description of the Rain-Animal given below.
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>77</td>
<td>The Environment Gallery. August, 2016.</td>
<td>79</td>
</tr>
<tr>
<td>78</td>
<td>Conceptual Sketch. The fascination with the sky and landscape. March, 2016.</td>
<td>80</td>
</tr>
<tr>
<td>79</td>
<td>The Architectural translation of Concept. August, 2016.</td>
<td>81</td>
</tr>
<tr>
<td>80</td>
<td>Definition of the outdoor room, emphasising the visual route. August, 2016.</td>
<td>82</td>
</tr>
<tr>
<td>81</td>
<td>Responding to the landscape. July, 2016.</td>
<td>83</td>
</tr>
<tr>
<td>82</td>
<td>Disconnect. Removing the user from the surroundings in order to purposefully reveal them. April, 2016.</td>
<td>83</td>
</tr>
<tr>
<td>83</td>
<td>Unlocking the front door. Inviting residents of Tshwane to uncover the spirit of Atteridgeville.</td>
<td>84</td>
</tr>
<tr>
<td>84</td>
<td>Decentralised follies. NTS. April, 2016.</td>
<td>85</td>
</tr>
<tr>
<td>85</td>
<td>Spatial containers. NTS. April, 2016.</td>
<td>85</td>
</tr>
<tr>
<td>86</td>
<td>Collection space. NTS. April, 2016.</td>
<td>85</td>
</tr>
<tr>
<td>87</td>
<td>Plan without programme. NTS. April, 2016.</td>
<td>85</td>
</tr>
<tr>
<td>88</td>
<td>Gravitas. Accentuating the scale of the tanks through landscape manipulation.</td>
<td>86</td>
</tr>
<tr>
<td>89</td>
<td>Delayed gratification. Inspiring the beyond.</td>
<td>87</td>
</tr>
<tr>
<td>90</td>
<td>The movement route. July, 2016.</td>
<td>90</td>
</tr>
<tr>
<td>91</td>
<td>The visual route. July, 2016.</td>
<td>91</td>
</tr>
<tr>
<td>92</td>
<td>June design.</td>
<td>93</td>
</tr>
<tr>
<td>93</td>
<td>A room and a garden.</td>
<td>97</td>
</tr>
<tr>
<td>94</td>
<td>Ruin the site. March, 2016.</td>
<td>98</td>
</tr>
<tr>
<td>95</td>
<td>Above ground, April, 2016.</td>
<td>99</td>
</tr>
<tr>
<td>96</td>
<td>The tunnel. May, 2016.</td>
<td>100</td>
</tr>
<tr>
<td>97</td>
<td>Urban reception. June, 2016.</td>
<td>101</td>
</tr>
<tr>
<td>98</td>
<td>Makukhu. This iteration was set aside as it perpetuates the notion of romanticised poverty. June, 2016.</td>
<td>103</td>
</tr>
<tr>
<td>99</td>
<td>The table cloth. Adapted from a plan of the acropolis. July, 2016.</td>
<td>104</td>
</tr>
<tr>
<td>100</td>
<td>The outdoor room. A sequence of thresholds that balances the garden and room. July, 2016.</td>
<td>104</td>
</tr>
<tr>
<td>101</td>
<td>The terrace. July, 2016.</td>
<td>105</td>
</tr>
<tr>
<td>102</td>
<td>The Podium. July, 2016.</td>
<td>106</td>
</tr>
<tr>
<td>103</td>
<td>Ascension. The provision of a public staircase emphasises prospect and draws the user between the tanks. August, 2016.</td>
<td>107</td>
</tr>
<tr>
<td>104</td>
<td>The Moroccan fountain.</td>
<td>107</td>
</tr>
<tr>
<td>105</td>
<td>The Master Plan. August, 2016.</td>
<td>108</td>
</tr>
<tr>
<td>106</td>
<td>The roof plan. September, 2016.</td>
<td>111</td>
</tr>
<tr>
<td>107</td>
<td>Restaurant 1. July, 2016.</td>
<td>112</td>
</tr>
<tr>
<td>108</td>
<td>Restaurant 3. July, 2016.</td>
<td>113</td>
</tr>
<tr>
<td>109</td>
<td>Restaurant 2. July, 2016.</td>
<td>113</td>
</tr>
<tr>
<td>110</td>
<td>The Environment Gallery; a mystical play room.</td>
<td>114</td>
</tr>
<tr>
<td>111</td>
<td>Concentrating the view; the Rain Animal will continue to have a place in the South African landscape. July, 2016.</td>
<td>115</td>
</tr>
<tr>
<td>112</td>
<td>Early plan of the Environment Gallery. August, 2016.</td>
<td>115</td>
</tr>
<tr>
<td>113</td>
<td>Observing the Rain Animal. April, 2016.</td>
<td>115</td>
</tr>
</tbody>
</table>
Figure 114  Framing the view. Cross-section of the environment gallery. July, 2016. 116
Figure 115  Perspective of the outdoor room from the restaurant. July, 2016. 116
Figure 116  A glance into history. Musee Gallo-Roman, Lyon, France. Bernard Zehrfuss, 1975. (Author, 2016) 117
Figure 117  The disused tank. On section, the columns can be seen populating the interior of the tank. July, 2016. 117
Figure 118  Roof plan of Environment Gallery. Reflecting the position of the columns beneath. August, 2016. 117
Figure 119  Experience. August, 2016. 118
Figure 120  The story of water. The planetarium’s lobby becomes another story telling room. August, 2016. 119
Figure 121  Visual participation. Sticks and Stones pavilion, 2014. David Chipperfield. Berlin, Germany. (Author, 2016) 119
Figure 122  A place for meeting. Adapted from Parque de la Ereta, the walkways become an elongated viewing platform. June, 2016. 120
Figure 123  A new skin. March, 2016. 121
Figure 124  A stepped section through the environment gallery and planetarium. August, 2016. 123
Figure 125  Carved out of the landscape the Architecture becomes the plinth for the existing superstructures. 123
Figure 126  Knowing what to look for. May, 2016. 131
Figure 127  Reorientating. 133
Figure 128  The auditorium. 135
Figure 129  The Schwedler dome. 137
Figure 130  The catwalk. 139
Figure 131  Structural Integrity. 141
Figure 132  Approach to water. 146
Figure 133  Filtration and discharge. 148
Figure 134  The elevation. Elevation: August, 2016. Sketches: August, 2016. 152
Figure 135  The elevation. Elevation: August, 2016. Details: September, 2016. 154
LIST OF REFERENCES

Books


Papers


Theses


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