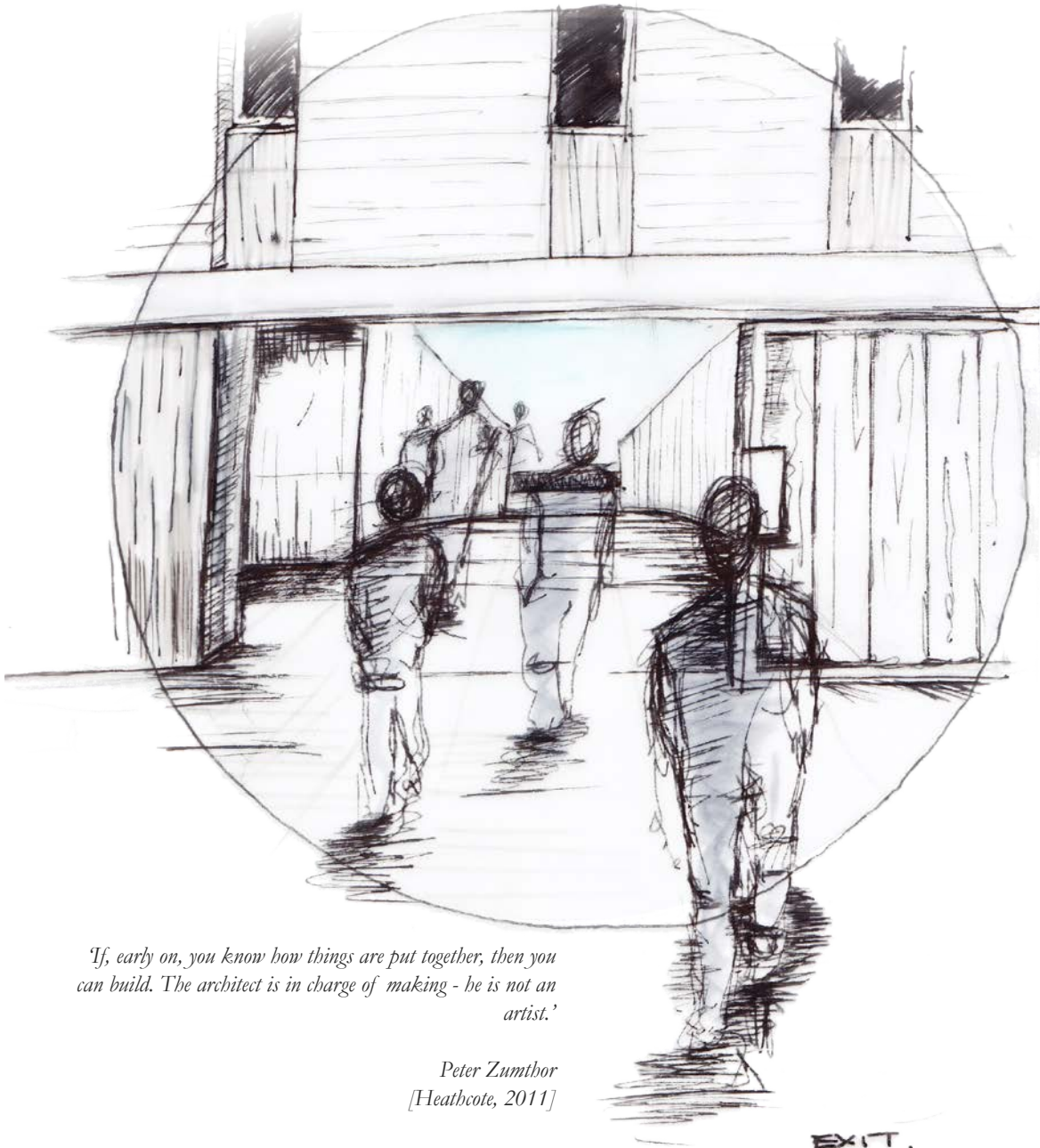


Figure 100 - Exit from the chamber into the courtyard



'If, early on, you know how things are put together, then you can build. The architect is in charge of making - he is not an artist.'

Peter Zumthor
[Heathcote, 2011]

Chapter 9:
PROGRESS
Technology and Systems

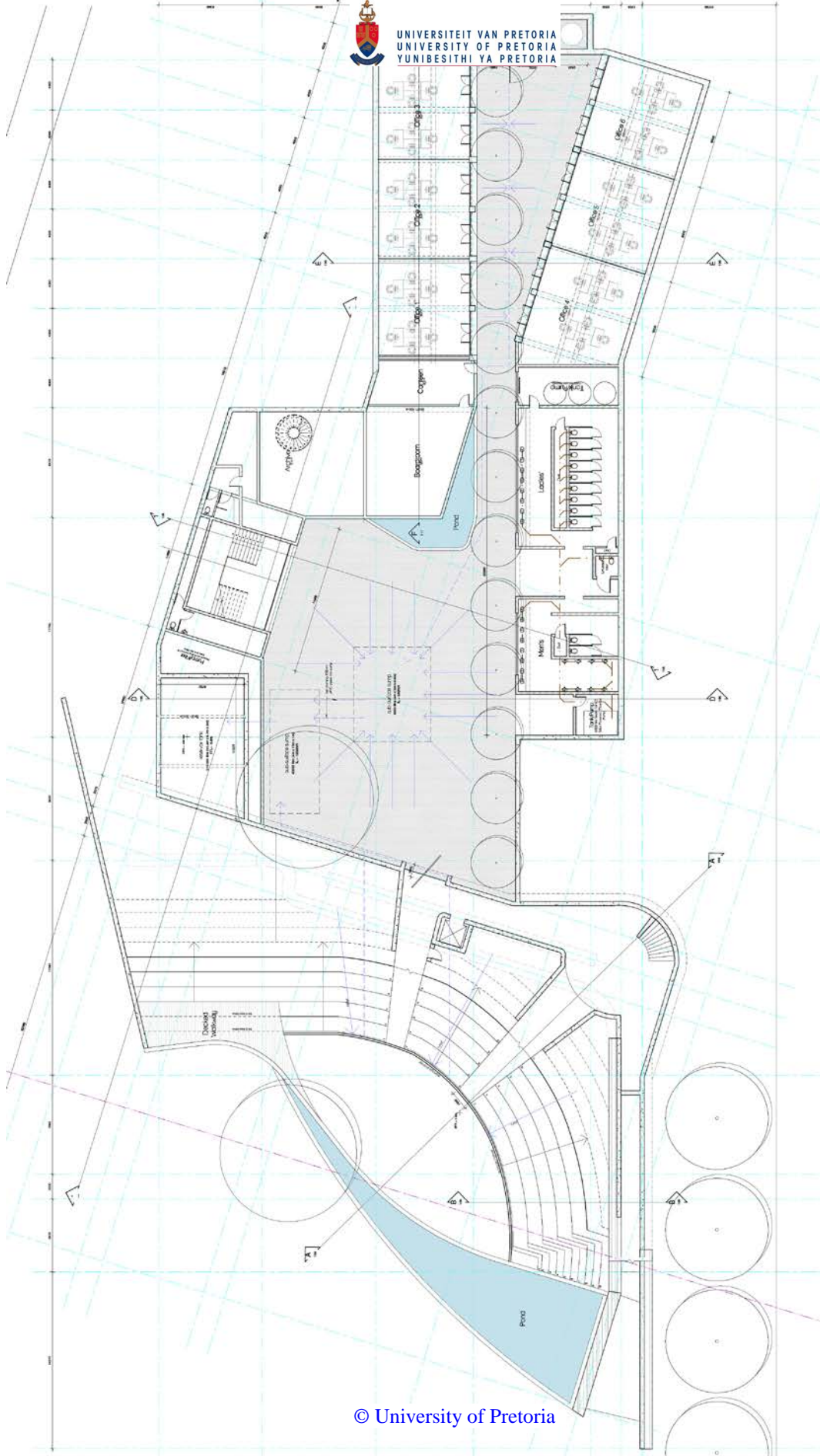


Figure 101 - Development of the Ground Floor Plan (NTS), 22
September 2016

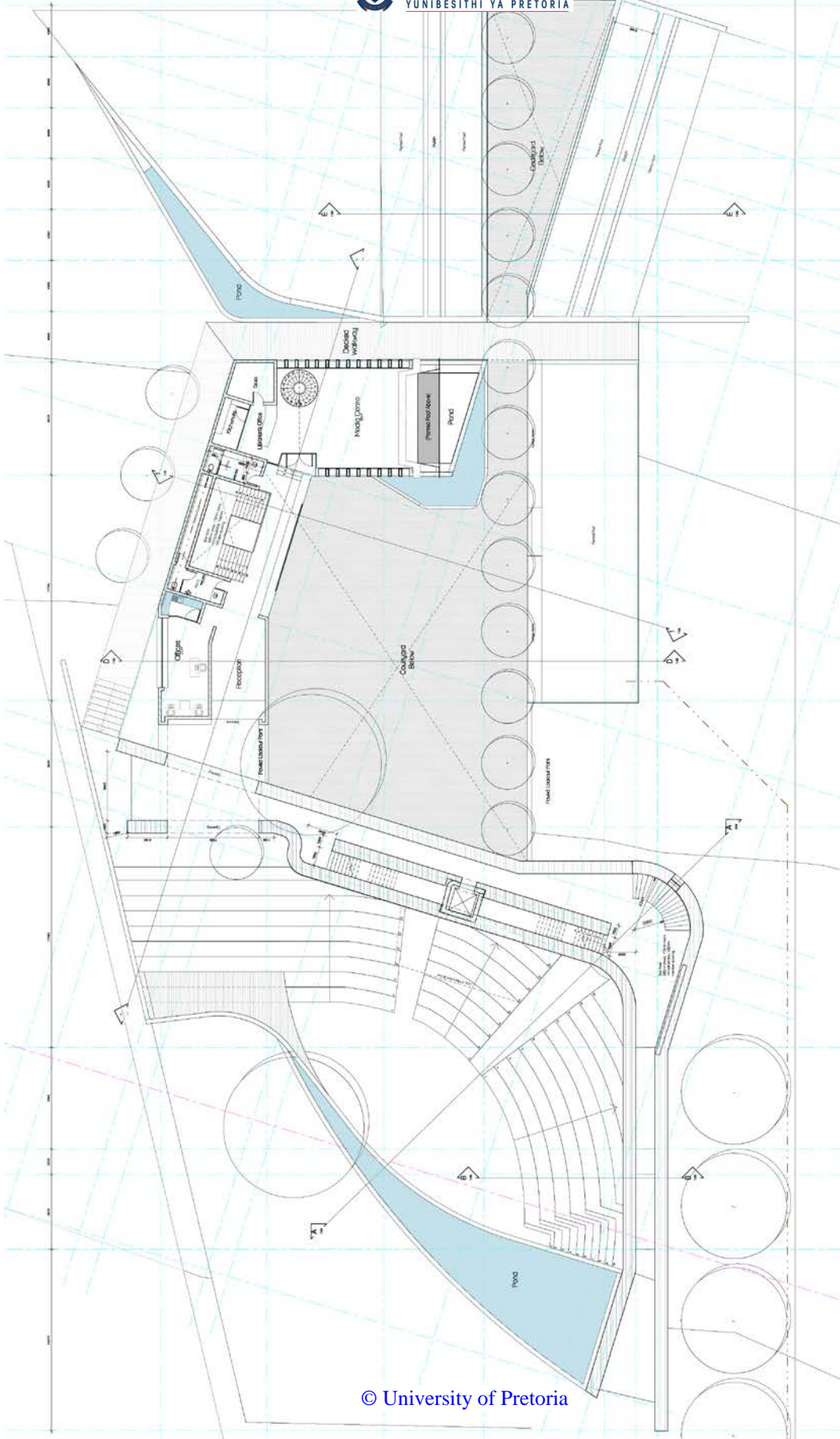


Figure 102 - Development of the First Floor Plan (NTS), 22
September 2016

9.1. Techné

Following the requirements for the project and the development thereof, the attitude towards the assembly of the building flowed from similar roots. The following points were highlighted in the previous chapter as being of importance. Accompanying these points are their consequential implication on the building assembly:

It needs to form a subtle part of the political discourse on the site, in its locality, relationship to context and legacy in the event of its demise.

Closeness with the ground, legacy contributing to park - construction of sub-surface structures, designing for re-use, waterproofing of basements, daylighting & ventilation of sub-surface spaces.

It needs to address publicness on all its sides. It needs to be surrendered to its public.

Deep skin & Visual access - A public building that can serve privacy of occupants while promoting transparency, contributive building facades.

Its institutional spaces should be fragile and susceptible to public appropriation and destruction. There may be fire.

Fragile & Responsive surfaces - Haptic nature of finishes and furnishing, designing for maintenance, designing for vandalism, materiality and touch, the impact of fire.

Its liminal spaces: edges, circulation spaces, generic spaces need to be its most celebrated and robust - they will serve as a monument to democracy amid the ruin.

Robust & complex structure - longevity and durability of materials, the effect of fire, materials and the impact of time, limits of spatial accommodation.

9.1.1. Monumentality & Rate of Decay as manifestation of democracy

From discussions regarding the monumentality and democratic legacy the building needs to contribute to the site, in the event of its abandonment or destruction (should it no longer serve the interest of the people) and the argument concerning the democracy of liminality the following hypotheses need to be stated outright:

If the monumentality of memorials serves to instill remembrance then a monument to democracy would memorialise that which is democratic.

If democracy lives in the liminal spaces, then those are the spaces that should be memorialised.

If ruins can serve as tools for collective memory and can act as tools for inspiration by reminding a nation of common values, then destroying a building designed to accommodate democracy and allowing its liminal spaces to remain (and be appropriated) will create a ruin that forms part of a discourse that cherishes democracy above all else.

The monumentality of an aspect of programme is associated with its contribution to the democratic nature of the space. This would imply that the aspects that contribute more to democracy need to be memorialized more. The act of memorial in a ruin is performed by the preservation of certain aspect, or the delay of their decay. The preservation of a building is not the work of an architect, but the architect's contribution will be to design the building to decay at different rates.

Democracy = Liminality

Monumentality $\propto \frac{1}{\text{Rate of Decay}}$

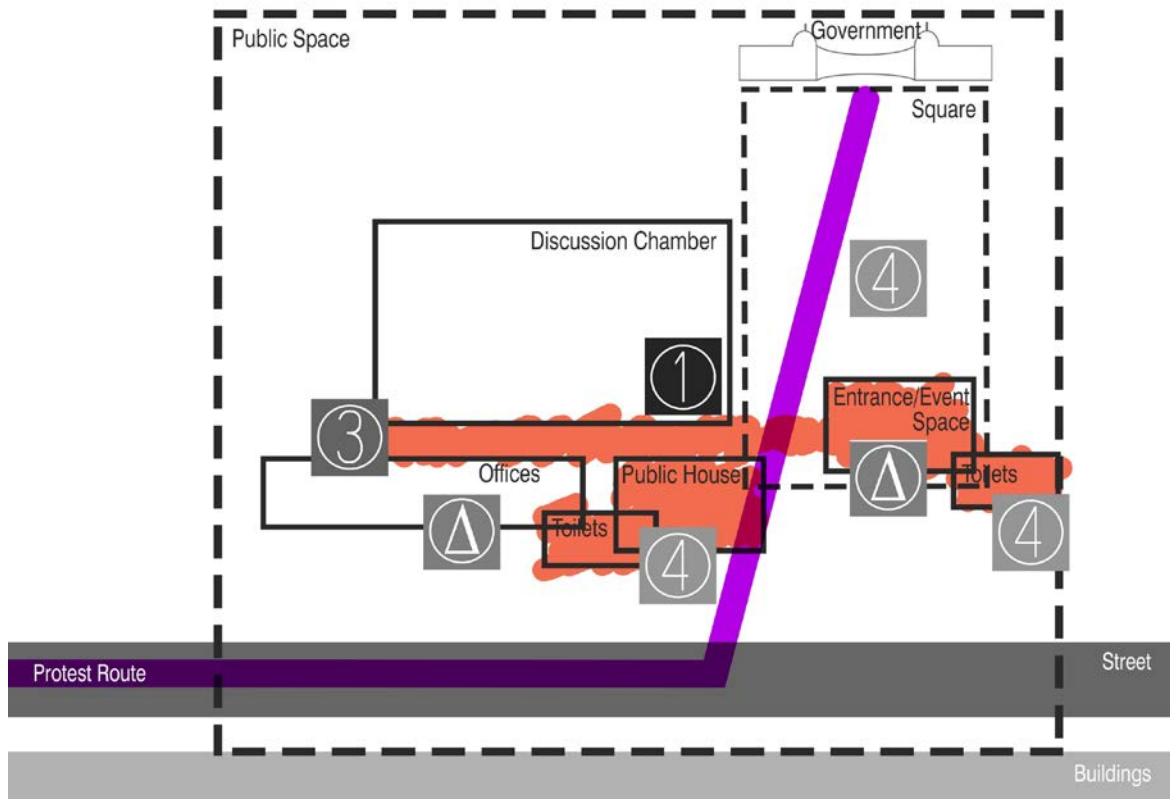


Democratic Spaces, e.g. circulation, public space, toilets etc.
(i.e. Mundane) = slower decay

Rates of decay:



The different rates of decay were identified as potential gradings of the spaces. These gradings were assigned to spaces in the building based on their accommodation of different aspects of the programme (below). The investigation then saw the identification of the basic elements of architecture to establish which materials were suitable for different elements and at which rates of decay.



Basic Elements of Architecture:





Floors

The treatment of the floor plane provides an opportunity for differentiating space without walls. Floors also imply the pace at which humans are encouraged to move in spaces. As with most finishes, they create atmosphere and naturally have an implication in term of temperature and sound in spaces.



Manipulation of the floor plane can designate space, sculpt furniture and express control over space. It can divide and unify spaces. It can allow liminal space to belong to other spaces.



The floor finishes to the left are shown in order of their rate of decay. For this scheme, the grading outlined previously of various materials and architectural elements was undertaken to establish a materials palette. Some of these investigations are shown below.

Roofs

The potential antagonization of government in the parliament building, combined with the nature of roofs to issue protection over occupants implies that the roof of the discussion chamber should be instantaneously destructible.



This raises questions of safety, durability and the ability of the roof to provide shelter. Some of the investigated materials are shown.

Walls

Walls serve as more than spatial dividers. The haptic qualities of different materials give certain impressions to the occupants of spaces.

The heaviness of rammed earth implies a belonging to the earth, to the context, it can be associated with power in that it needn't assert dominance in terms of scale, its authority is enforced by its occupation of space.



Copper wall cladding implies a fragility of space. A tentative voice in a space that is full with humans' unpredictability. The ability of copper to reflect the presence of people, to remain vibrant and reflective when regularly touched and become dull and coated with patina if left to age. It is also a material that will easily be the subject of vandalism, should a building lose its meaning to its audience.



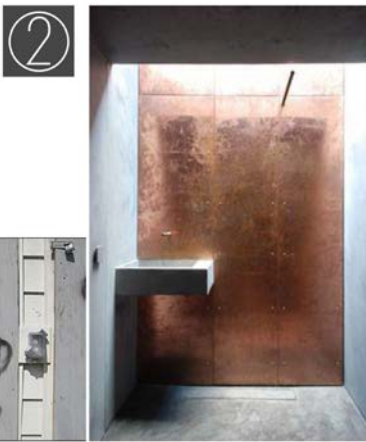
4



1



2



4



3

9.2. Development of Assembly

The following series of drawings depict the development of the building in terms of the requirements dictated in section 9.1. These drawings focus on liminality of spaces and therefore aim to resolve, most specifically, the spaces most commonly neglected, in a manner to increase the appeal of these spaces, to encourage longer durations of occupancy in them and therefore increase the likelihood of interaction and negotiation of space between users.

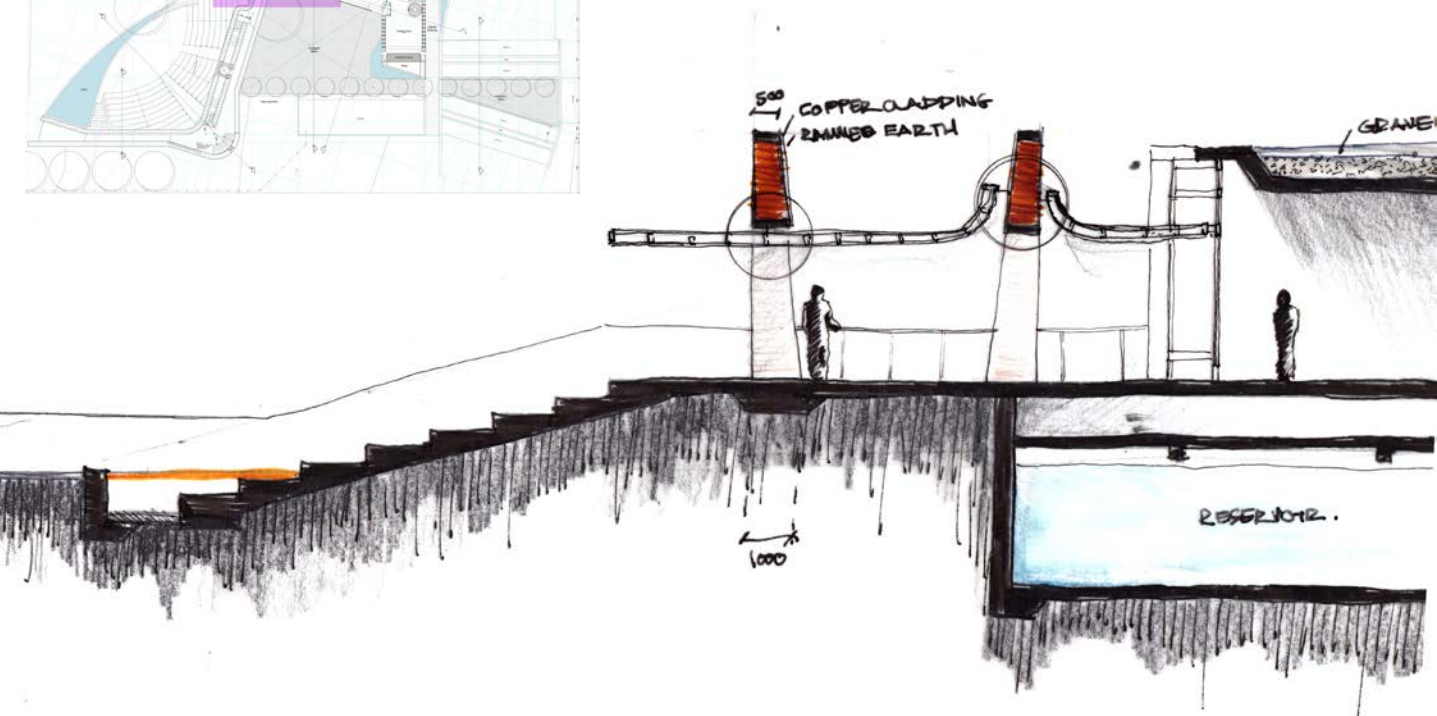
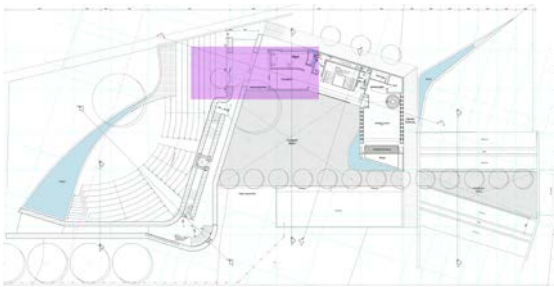
9.2.1. Building Entrance

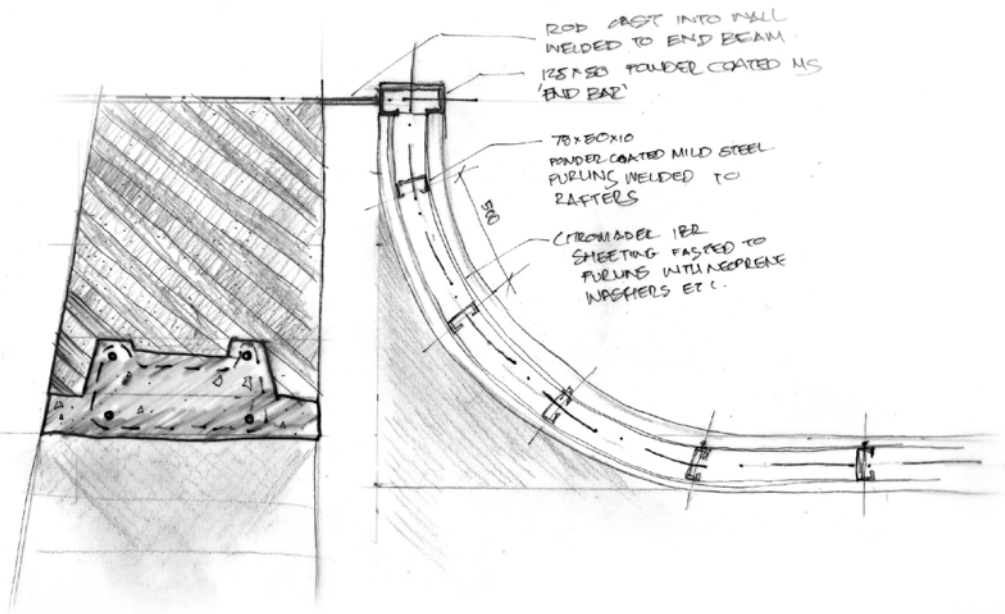
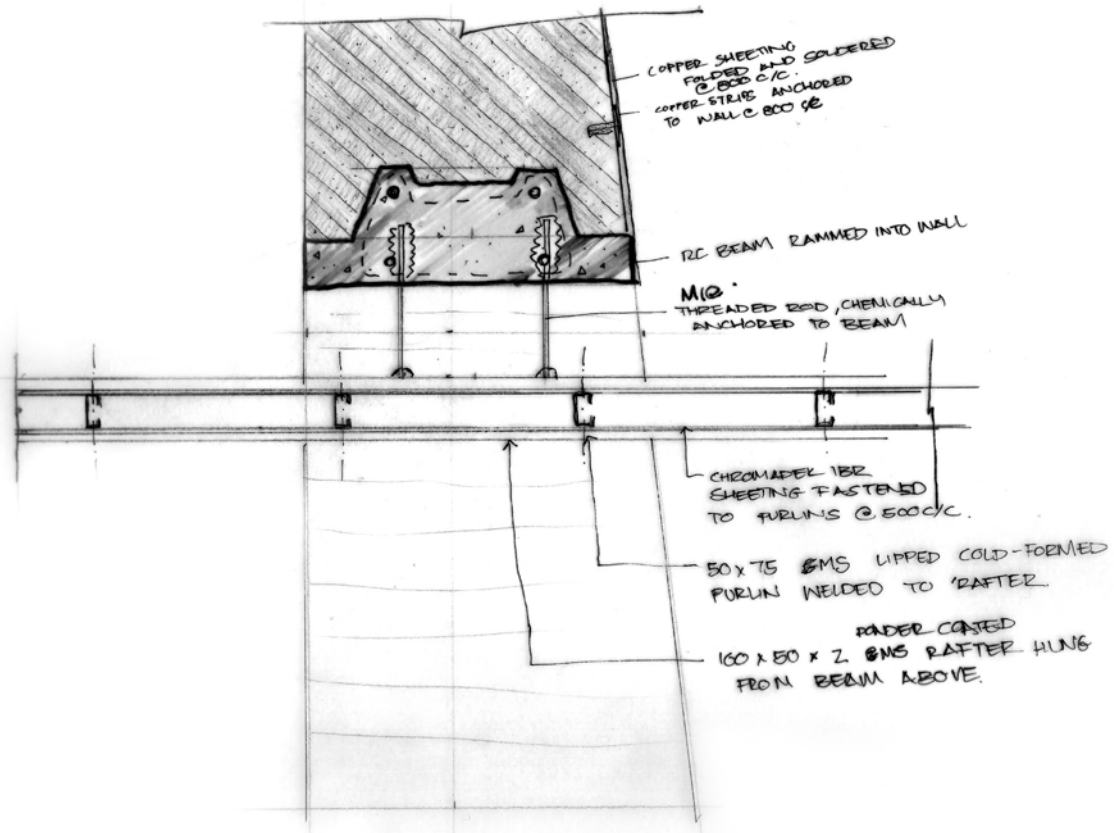
The notion of occupiable threshold and floating, transcendent roof plane lends itself to constructing a durable roof from materials that appear exceptionally light. The initial explorations of this roof saw it being aptly made of lightweight reinforced concrete. The meaning of concrete in the scheme, however, is that of permanence and the use thereof as roof may be misconstrued. The decision to use lightweight steel framing and metal roof sheeting that are bent into the needed profile to give the illusion of floating and asymptotic approach to the walls can be achieved this way, as illustrated.

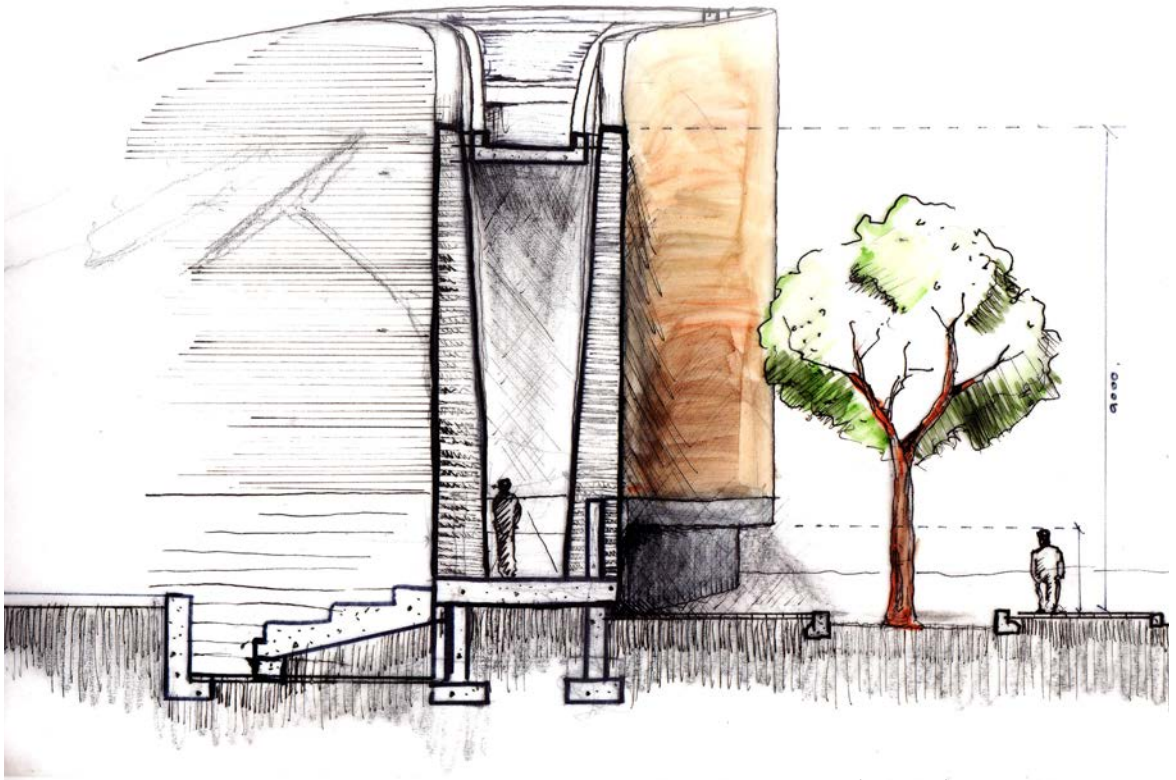
The resolution of this detail requires consideration of the natural light washing the wall in the space between wall and roof and the insertion of lights into the canopy to achieve a similar effect at night.

Figure 103 - Explorative section through the entrance, highlighting location of details

Figure 104 - Exploration of the details of canopy connections to wall opening.







9.2.2. Processional Corridor

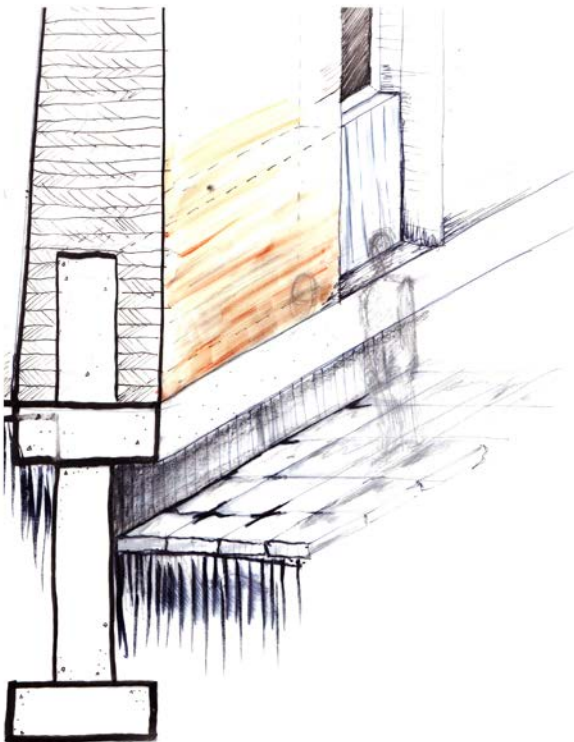
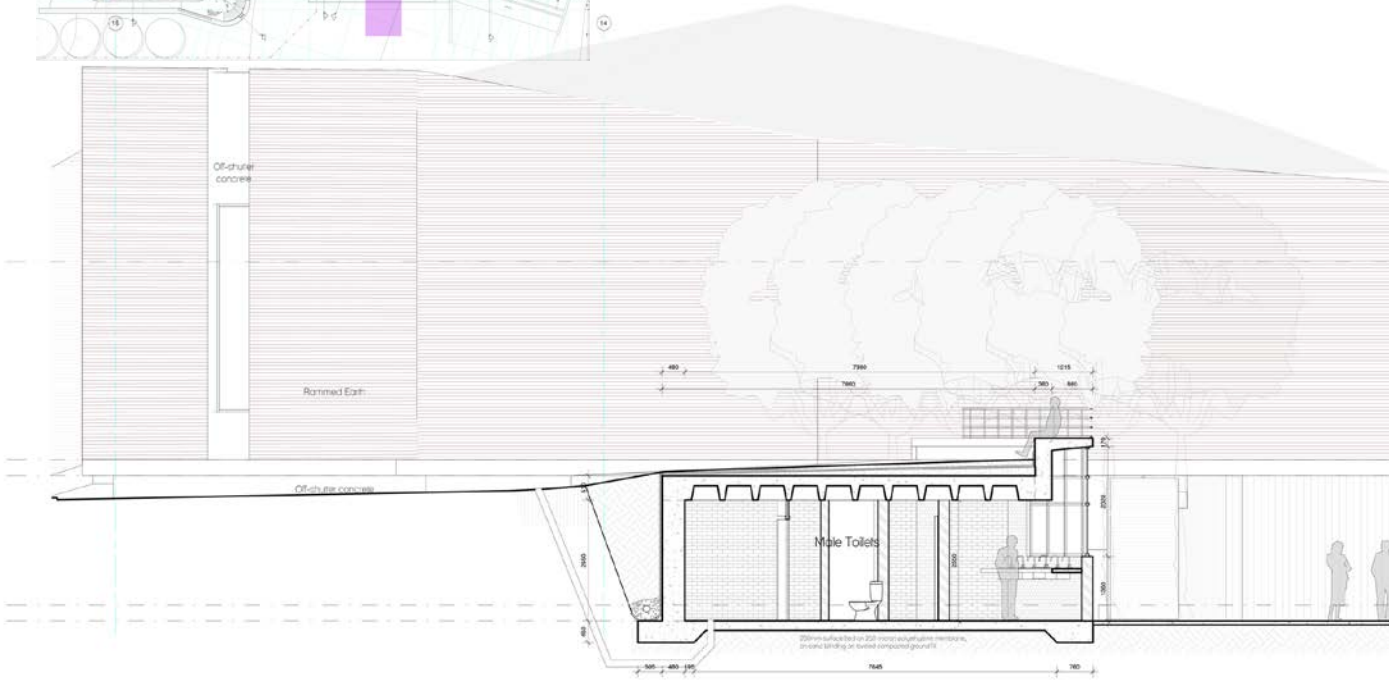


Figure 105 - Explorative section through the entrance, highlighting location of details

Figure 106 - Exploration of the details of canopy connections to wall opening.



9.2.3. Courtyard, Circulation and Toilets

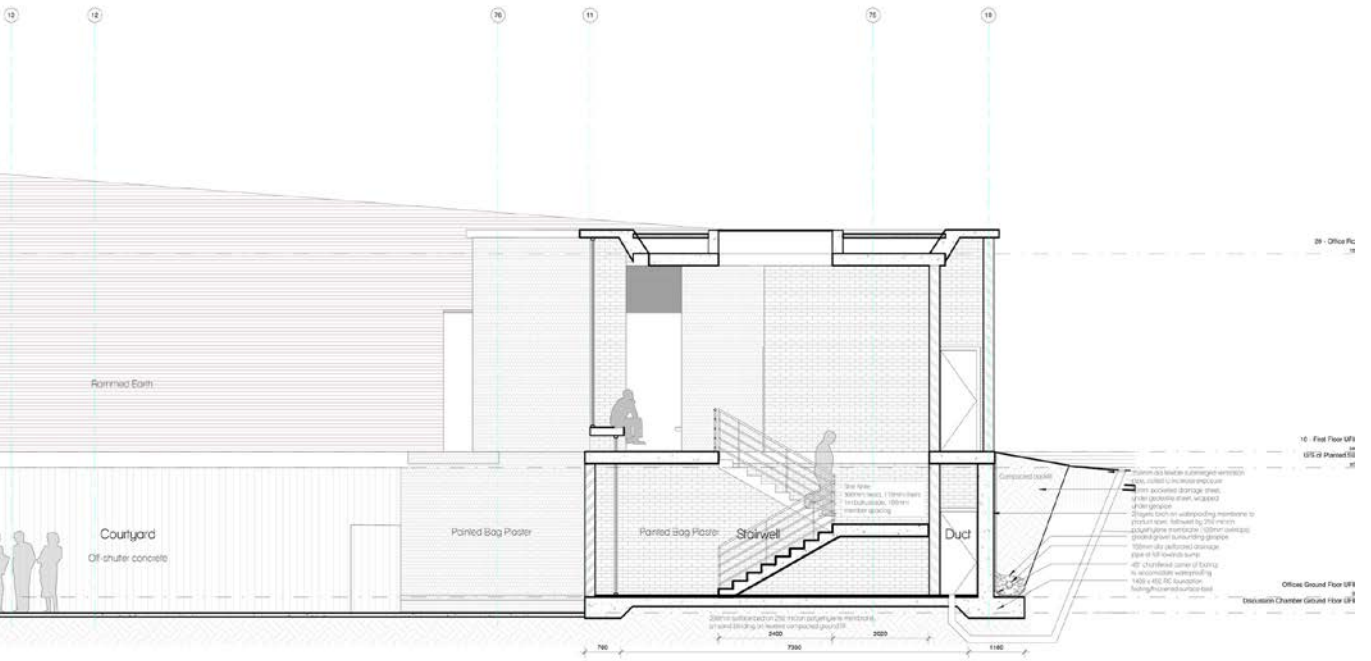
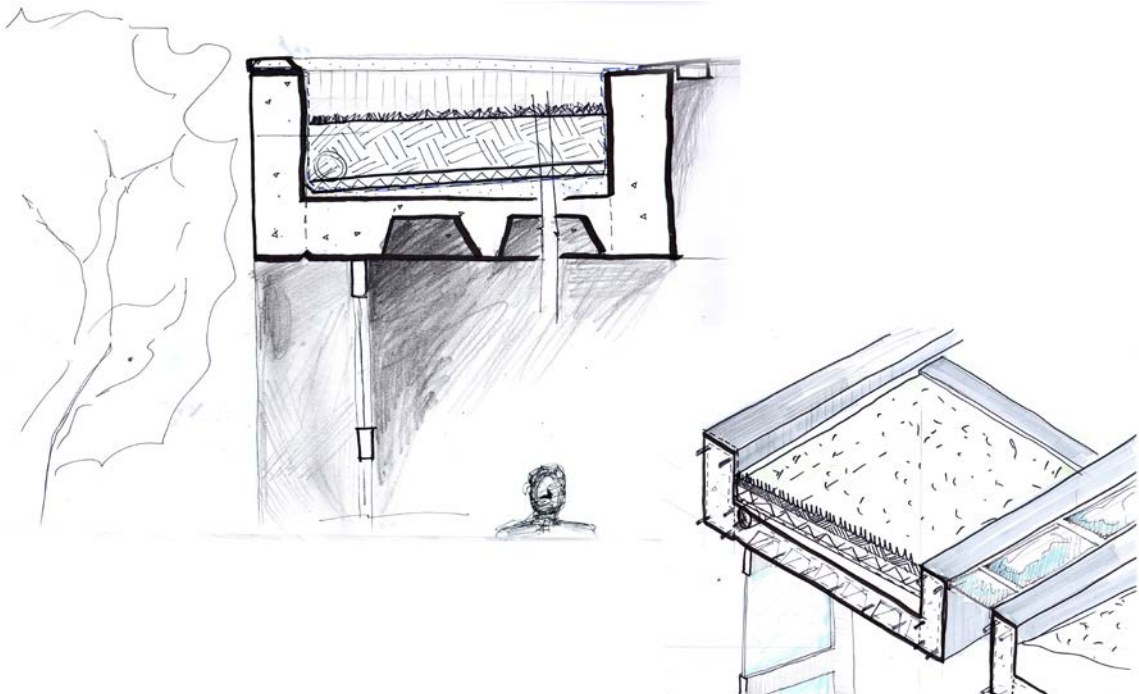
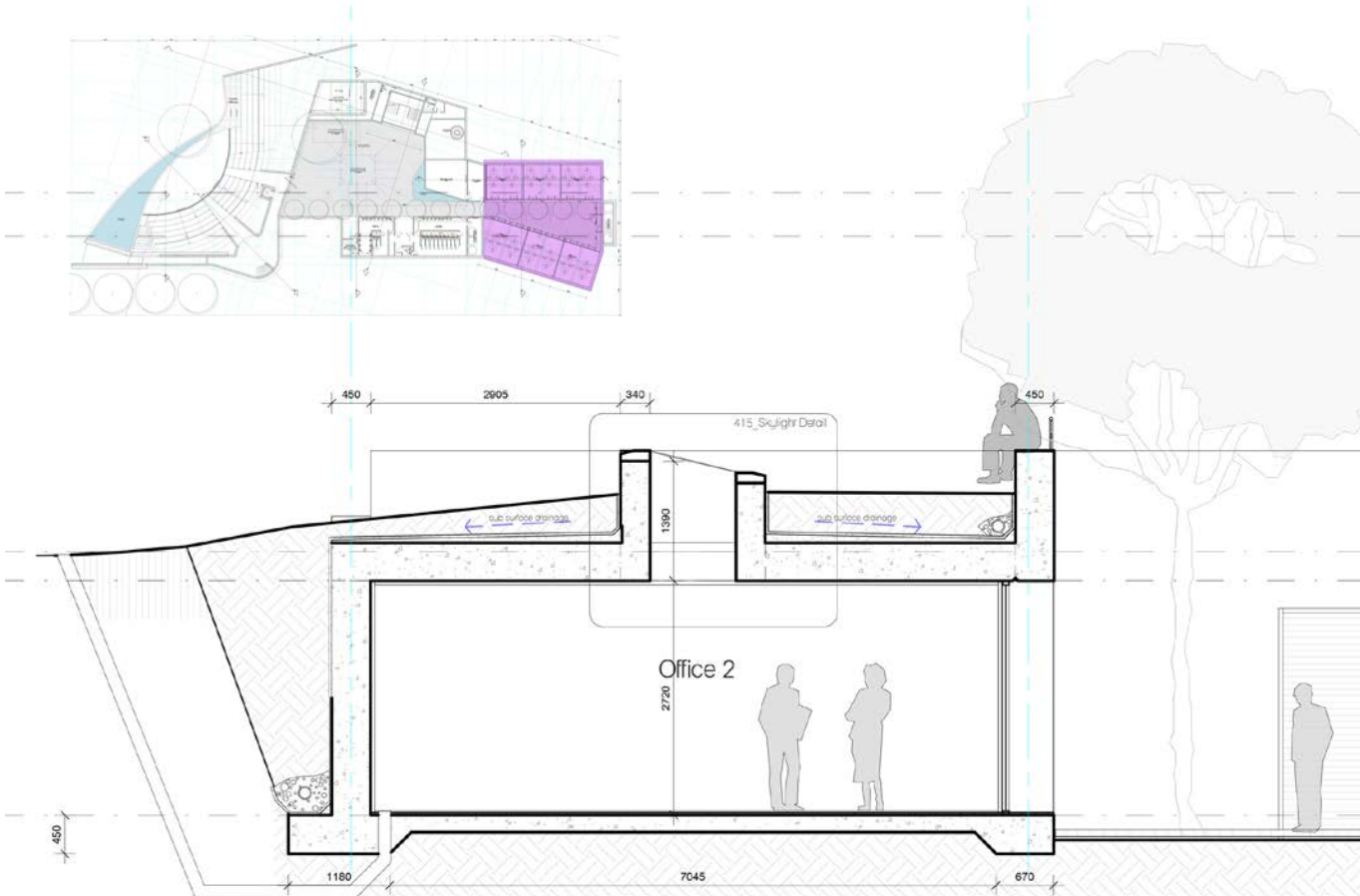


Figure 107 - Section through courtyard showing office building staircase and toilets (NTS), September 2016



9.2.4. Underground Offices

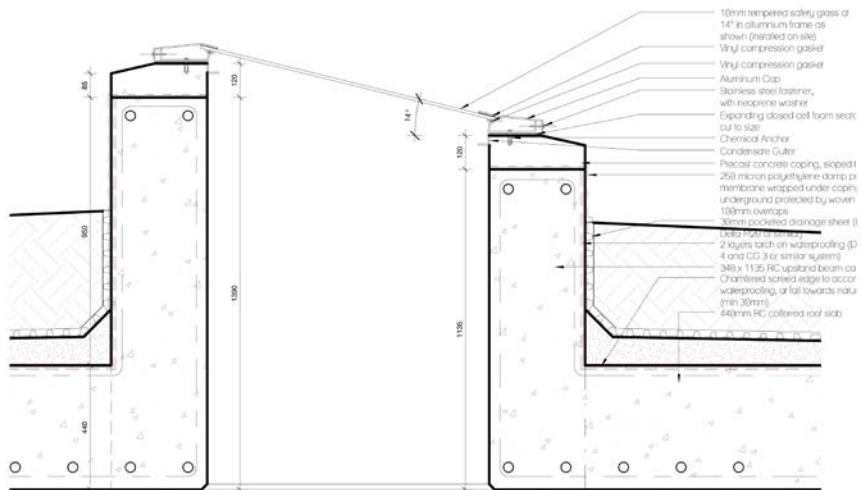
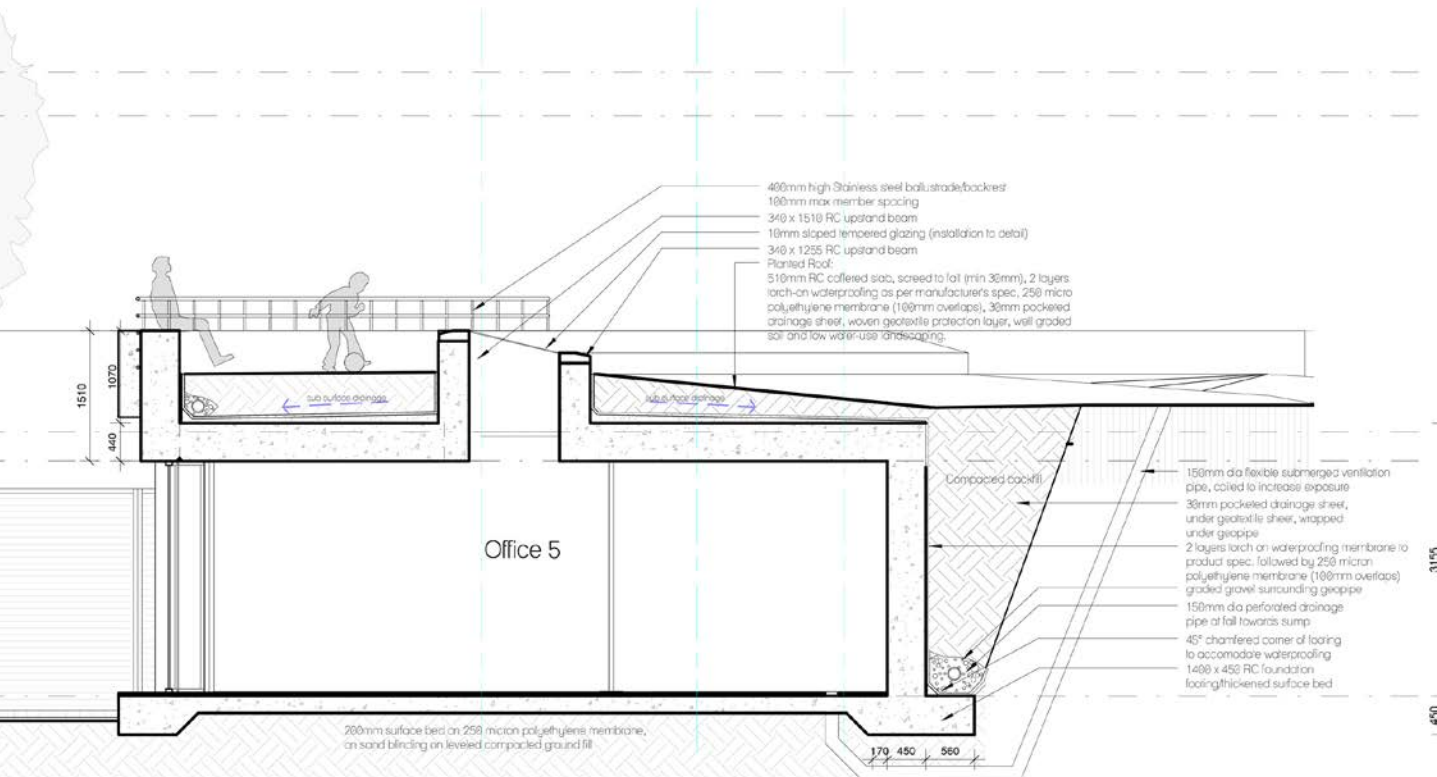


Figure 108 - Section through offices (NTS), 22 September 2016.

Figure 109 - Explorations of the slab edge overhead.

Figure 110 - Skylight detail (NTS), 22 September 2016

9.3. Sustainability

The importance of building green is highlighted time and again but never before has the need of a more responsible attitude towards the environment been called for. The importance of buildings that contribute positively to their context (social and environmental) is outlined in the constitution;

The Bill of Rights Act No. 108 of 1996, Section 24 reads as follows:

Everyone has the right

- a. to an environment that is not harmful to their health or well-being; and
- b. to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that
 - i. prevent pollution and ecological degradation;
 - ii. promote conservation; and
 - iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

(SA Government 1996)

It is for this reason that the National Standards regulation buildings in South Africa (SANS 10400) has very strict rules regarding environmental aspects of buildings. However, the requirements laid out in the regulations are passed on a deemed to satisfy basis and do not encourage innovation and ground breaking developments in the sustainable building practice. Despite this, however, more and more institutions are opting for green buildings, because of the benefits (of which environmental protection is only a small one).

Green building incorporates design, construction and operational practices that significantly reduce or eliminate the negative impact of development on the environment and people. Green buildings are energy efficient, resource efficient and environmentally responsible.
(GBCSA n.d.)

9.3.1. Sustainable Building Assessment

There are a number of manners in which buildings are assessed for sustainability in South African. The Green Building Council of South Africa is considered the authority on green building in South Africa and the Greenstar SA is the tool developed to measure sustainability performance of buildings in South Africa. The GBCSA is affiliated with the World Green Building Council (GBCSA n.d.).

Despite the Green Building Council's Greenstar rating considering the human factors of sustainable built environments (GBCSA 2008), the Sustainable Building Assessment tool (developed by Jeremy Gibberd of the CSIR looks specifically at the impact the construction of a project has on the socio-economic environment it sits within. This would imply consideration the impact a building has of the existing local community and not only on its occupants. Jeremy Gibberd (SBAT n.d.) believes this to prove the appropriateness of the tool for developing countries.

Because of the nature of the scheme and its focus on social and economic factors of the city, the SBAT has been selected as an appropriate measure of the building's performance. Despite being developed with residential use in mind the tool is useful in establishing where the shortcomings of a project fall, as was the case upon the evaluation of the building.

Figure 111 - The outcomes page from the SBAT (20 October 2016).
With adjustment to certain aspects, the result may prove more apt.

SUSTAINABLE BUILDING ASSESSMENT TOOL RESIDENTIAL

1.04

| |
|---|
| Achieved |
| SB SBAT REPORT 3.8 |

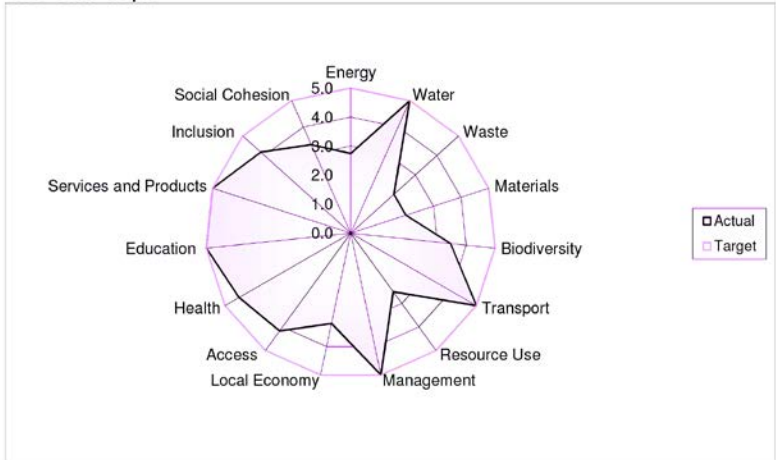
SB1 Project

Parliamentary Building

SB2 Address

Stanza Bopape Street, Pretoria, South Africa

SB3 SBAT Graph



| SB4 Environmental, Social and Economic Performance | Score |
|--|------------|
| Environmental | 3.0 |
| Economic | 4.0 |
| Social | 4.4 |
| SBAT Rating | 3.8 |

| SB5 EF and HDI Factors | Score |
|------------------------|-------|
| EF Factor | 3.2 |
| HDI Factor | 4.2 |

| SB6 Targets | Percentage |
|---------------|------------|
| Environmental | 61 |
| Economic | 79 |
| Social | 88 |

Conclusions

The achieved rating is relatively low if one considers the focus on sustainability in the current discourse of the built environment at present. This could be explained by the tool’s focus on residential projects, but it is more likely ascribed to the implementation of materials. The SBAT assigns high values to the use of timber elements in the building, of which there is a limited application in the building, apart from as finishing and furnishing. Despite this, however, perhaps the inclusion of timber framed drywalling systems could increase the rating in this regard. Because of the very specific types of materials and finishes required, the likelihood of increasing the materials aspect of the rating is slim.

The building also performs badly with regards to energy. Because of its sporadic use throughout the year and its relative abandonment at night, there is no need for the building to store any alternative energy. By implementing good daylight practices and limiting the energy demand, a small number of photovoltaic cells will be sufficient in producing the required energy. The storage of energy is both costly and harmful to the environment (batteries used to store charge are harmful when disposed of) and the decision to use the city energy grid when the PV cells are not sufficient has thus been taken.

Perhaps a thorough investigation into the project and the application of a more appropriate tool could deliver better results, but the project seems to serve its community in a manner that makes little impact on the natural environment; which was its aim.

9.4. Building Systems

The entire parliamentary precinct forms a complex system of interdependent functions – their proximity and similarity imply their connection. The precinct is, in its entirety, a public space which creates challenges with regards to our traditional understanding of services.

Traditionally, a public building located in a city will naturally have street frontage. The sides of buildings are hardly seen because each building in a line tries to maximize its street frontage. The implementation of buildings lines on city streets, sees to it that buildings have service spaces along their backs and sides. These alleyways are notorious for being dirty and would be where you find an open manhole, a plumber's rod and the accompanying smell.

The parliamentary precinct, with regards to its serviceability, poses two problems. The first is its location between two streets and in the most public realm. The buildings within the precinct can, therefore, have no back or sides. Every side is a front. Architectural best practice has taught us that the services of a building should never be located at the front of a building. This leaves the debate at a crossroads – to reveal the systems and celebrate them, or to turn them

inward and embed them in the skin of the building.

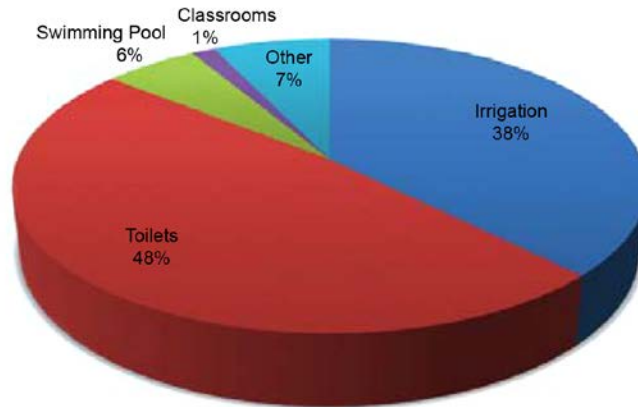
For the focus of this scheme not all systems and environmental comfort factors have been scrutinised. It was necessary to delimit the investigation to ensure thoroughness. The issues under discussion below highlight the considered systems and strategies.

9.4.1. Water System

In 2010, the United Nations declared access to clean water and sanitation a human right (UN, (n.d.). This right leaves it within the government's responsibility to provide all citizens with between 50 and 100litres of water per day, within 1000m from their homes to be collected within 30mins and should cost less than 3% of the household income (UN n.d.). According to government South Africa is currently experiencing one of the most devastating droughts in many years, which makes each and every drop of water critical for the survival and well-being of its citizens (South African Government 2016). Considering South Africa's current water shortage, it is crucial for the built environment to limit its impact on the existing water supply and to promote sustainable water use practice by its occupants.

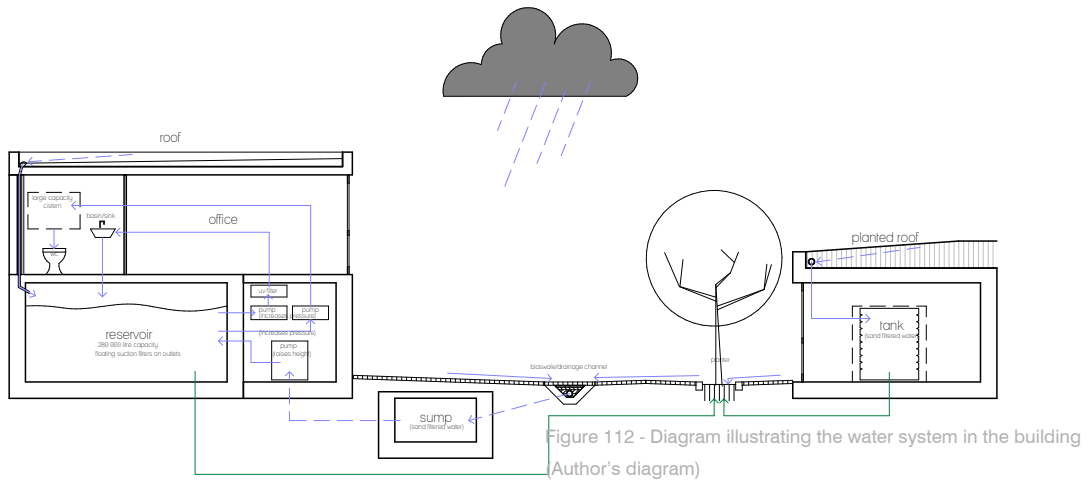
There are numerous resources and products available to limit the water consumption of buildings. Sanitary fixtures account for almost half the water use of an institutional building (see figure). This would imply that the implementation of grey water systems that recycle water from handwashing, and the implementation of toilets and urinals that use less water per flush, could drastically impact the water consumption of a building. The design of landscaping that uses low water demanding plants can also impact on the water requirements.

Institutional Example
Typical Water Use for a High School with 1200 Learners (with sportsfield)



The South African National Standards 10400 Section R governs the disposal of stormwater runoff so as to prevent damage to structure by excessive rainwater. There is allowance made for rationally designed systems that would implement this runoff, despite little elaboration being present; the section titled R2 Saving states that the regulations to not imply the need for gutters and downpipes per se, provided the installation of a system that sufficiently protects the structure is in place (SABS 2011:R). This system must also not cause damage to any other structures by discharging the water (SABS 2011:R).

Thus far, the application of systems that utilize surface runoff to decrease the demand on water supply, is not legally required. However, such a system has been implemented in the scheme discussed herein, to test the likelihood of a theoretical zero demand on local resources. This system, in combination with greywater systems and the implementation of a reduced water demand, is illustrated below.



- The system, firstly, features the implementation of low flush toilets and urinals wherever their positions are indicated.
- Because of the position of the building mostly below ground and the exposure of the courtyard surface to rainwater, it is not only a part of water saving that required the harvesting of surface water runoff, but also in compliance with SANS 10400 Section R, in order to protect the structure it is crucial to remove all rainwater from the courtyard as quick as possible.
- This led to the incorporation of drainage channels in the courtyard which lead to an intermediary sump below the courtyard. The implementation of the sump is to increase the speed of drainage from the courtyard in the event of flash flood.
- From the sump, water is pumped into the main reservoir where it is stored over longer periods.
- From the reservoir, water passes through a series of in line filtration processes when required. The pressure is also increased.
- Bearing in mind the high traffic times that will occur in the buildings toilets, there are large cisterns located closer to the demand.
- Soil from water closets and urinals will pass to a storage tank from where it will be raised to the level of the municipal sewer connection in Stanza Bopape street.
- Water from hand wash basins will be filtered in line for particles and grease, and re-enter the reservoir.
- The additional surface runoff, from planted roofs, is collected directly in tanks which are left unfiltered and used for drip irrigation of the landscaping in the courtyard and for ponds on the premises.

Using the values and assumptions above, the initial calculations produced the following results:

| MONTH | AVE RAINFALL , P (m) | CATCHMENT YIELD (m ³) (Yield = | ALTERNATIVE WATER SOURCE (m ³) | TOTAL WATER YIELD (m ³) |
|--------------------|-------------------------|--|--|--|
| January | 0.15 | 214.32 | 16.74 | 231.06 |
| February | 0.08 | 107.16 | 15.12 | 122.28 |
| March | 0.08 | 117.16 | 16.74 | 133.90 |
| April | 0.05 | 71.44 | 16.20 | 87.64 |
| May | 0.01 | 17.15 | 16.74 | 33.89 |
| June | 0.01 | 11.43 | 16.20 | 27.63 |
| July | 0.00 | 5.72 | 16.74 | 22.46 |
| August | 0.01 | 8.57 | 16.74 | 25.31 |
| September | 0.02 | 28.58 | 16.20 | 44.78 |
| October | 0.07 | 104.30 | 16.74 | 121.04 |
| November | 0.10 | 148.60 | 16.20 | 164.80 |
| December | 0.15 | 214.32 | 16.74 | 231.06 |
| ANNUAL AVE. | 0.70 | 1048.74 | 197.10 | 1245.84 |

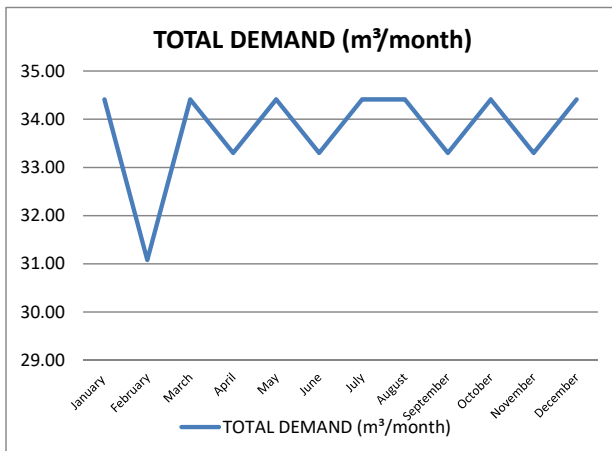
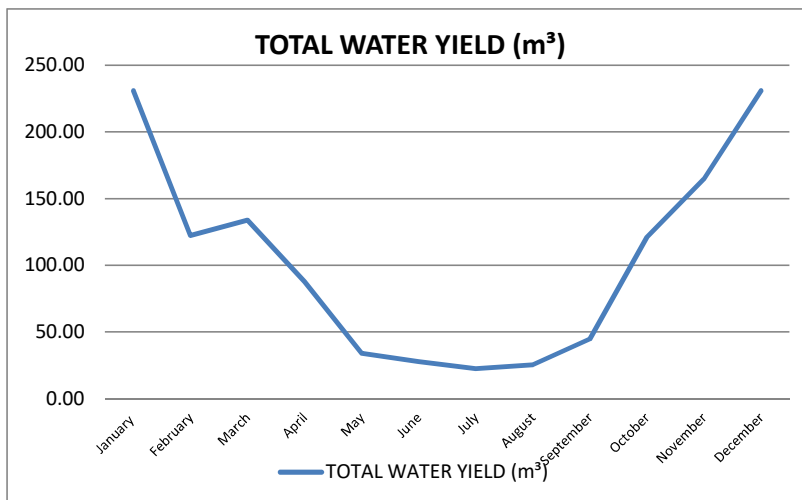
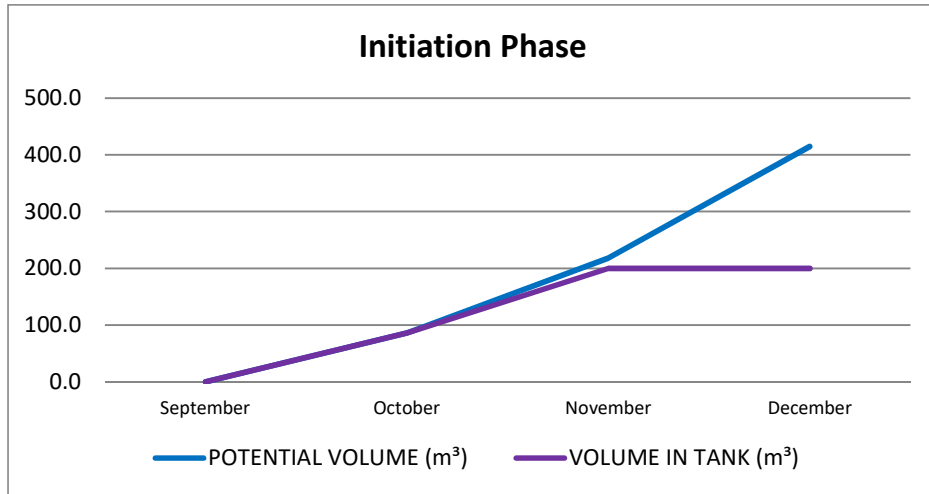


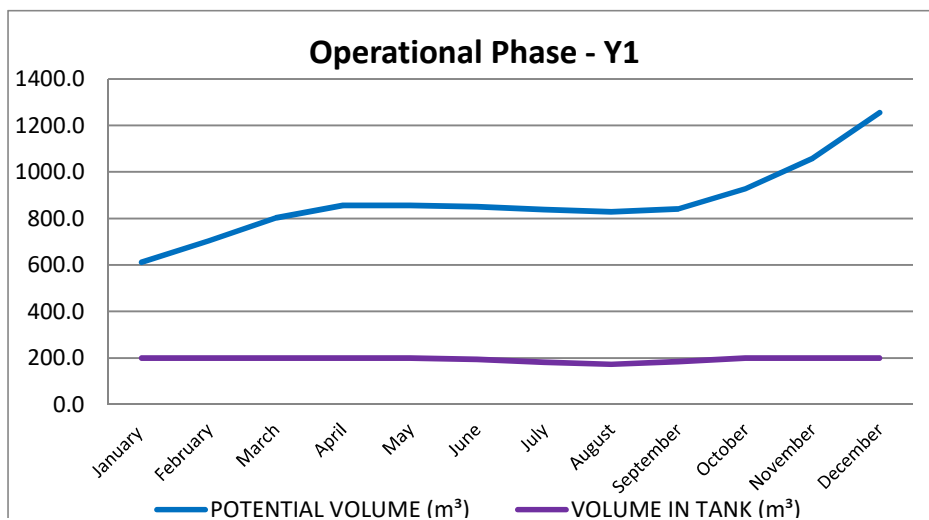
Figure 114 - Tables and graphs illustrating the anticipated yield from the maximum catchment area and the demand of the building by permanent staff. Rainfall data obtained from <http://www.pretoria.climatemps.com/precipitation.php>.



WATER BUDGET

YEAR 1

| MONTH | YIELD (m ³ /month) | DEMAND (m ³ /month) | MONTHLY BALANCE | POTENTIAL VOLUME (m ³) | VOLUME IN TANK (m ³) |
|-----------|-------------------------------|--------------------------------|-----------------|------------------------------------|----------------------------------|
| January | 231.1 | 34.4 | 196.7 | 611.4 | 200.0 |
| February | 122.3 | 31.1 | 91.2 | 702.6 | 200.0 |
| March | 133.9 | 34.4 | 99.5 | 802.1 | 200.0 |
| April | 87.6 | 33.3 | 54.3 | 856.5 | 200.0 |
| May | 33.9 | 34.4 | -0.5 | 855.9 | 199.5 |
| June | 27.6 | 33.3 | -5.7 | 850.3 | 193.8 |
| July | 22.5 | 34.4 | -12.0 | 838.3 | 181.9 |
| August | 25.3 | 34.4 | -9.1 | 829.2 | 172.8 |
| September | 44.8 | 33.3 | 11.5 | 840.7 | 184.2 |
| October | 121.0 | 34.4 | 86.6 | 927.3 | 200.0 |
| November | 164.8 | 33.3 | 131.5 | 1058.8 | 200.0 |
| December | 231.1 | 34.4 | 196.7 | 1255.5 | 200.0 |



The system works on the basis of an initiation phase which is required to start the system. The initiation phase occurs during the rainy months in which no water is removed from the system; it is used to build up a reserve of water. After this the system can function without a sufficient deficit. Despite the size of the reservoir, 69m² at 2.9m high, there is still a deficit during the dry months. The operational phase graph above illustrates the amount of rainfall that could be yielded given the catchment area and the amount actually captured in a reservoir of the given size (200m³).

There is an 800m³ of water not being harvested in December because of limited storage capacity. It would be unnecessary to build a reservoir that can store 800m³ of water since the reservoir only needs to be 212m³ to meet the demand. However, the paved courtyard area yields 433.94m³ which, in addition with grey water recycling yields 631.04m³ per year. The annual demand is only 405.15m³ which renders the process of only harvesting grey water and rain water from the paved courtyard sufficient for the demand of the permanent staff in the building. However, there will still be an excess of 166m³ of water in the wettest months from this system.

WATER BUDGET YEAR 1

| MONTH | YIELD (m ³ /month) | DEMAND (m ³ /month) | MONTHLY BALANCE | POTENTIAL VOLUME (m ³) | VOLUME IN TANK (m ³) |
|-------------|-------------------------------|--------------------------------|-----------------|------------------------------------|----------------------------------|
| January | 105.4 | 34.4 | 71.0 | 211.9 | 200.0 |
| February | 59.5 | 31.1 | 28.4 | 240.3 | 200.0 |
| March | 65.2 | 34.4 | 30.8 | 271.1 | 200.0 |
| April | 45.8 | 33.3 | 12.5 | 283.5 | 200.0 |
| May | 23.8 | 34.4 | -10.6 | 273.0 | 189.4 |
| June | 20.9 | 33.3 | -12.4 | 260.6 | 177.1 |
| July | 19.1 | 34.4 | -15.3 | 245.3 | 161.7 |
| August | 20.3 | 34.4 | -14.1 | 231.2 | 147.6 |
| September | 28.0 | 33.3 | -5.3 | 225.9 | 142.4 |
| October | 59.9 | 34.4 | 25.5 | 251.4 | 167.8 |
| November | 77.7 | 33.3 | 44.4 | 295.8 | 200.0 |
| December | 105.4 | 34.4 | 71.0 | 366.8 | 200.0 |
| ANNUAL AVE. | 631.0 | 405.2 | 225.9 | | |

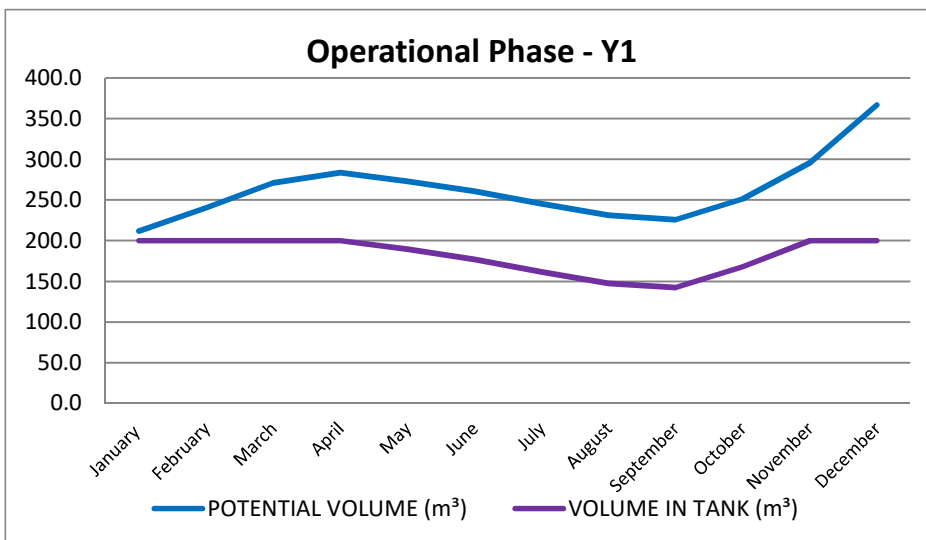


Figure 115 - Tables and graphs illustrating the sizing of the reservoir after reducing the catchment area.

Should the grey water harvesting be regulated, with a bypass valve that only allows it into the reservoir if there is a need, the system may safely accommodate the courtyards' annual yield of 433.94m³ which is in excess of the annual demand of 405.15m³. This would imply an additional system for the application of grey water for irrigation purposes, or an additional reservoir for the storage of more water, so that the sporadic use of the assembly chamber could also be catered for. Using similar assumptions as above, the size of such a reservoir has been calculated below using the following assumptions:

The times at which parliament is in recess have been reflected in the number of people used to calculate demand. A full month renders occupation at 530 persons per day, a half month at 280 and a recess month only at 30.

The individual demand is also reduced during fuller months (based on the probability of bathroom visits decreasing as the number of people increases).

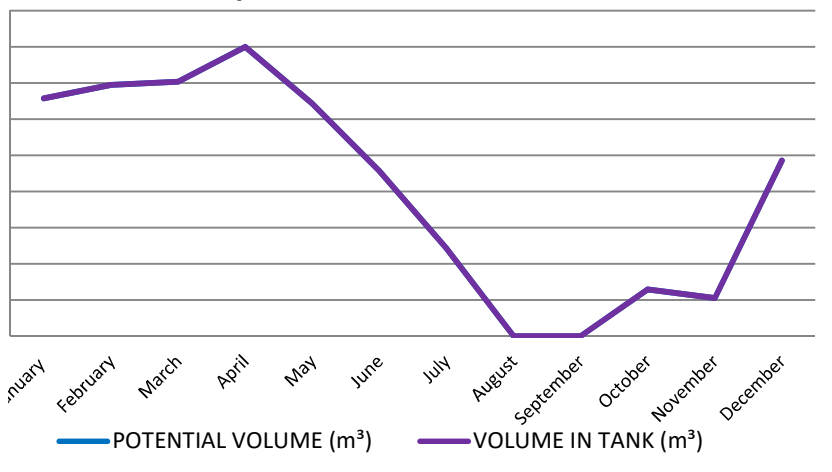
The water generated as grey water is reduced as well.

The total annual demand is calculated as 2373.53m³ with the total possible yield as 2184.74m³ (based on a 1136m³ assumed yield from grey water. This would show that there is a deficit in the yield to meet the demand. None the less, sizing the additional tank at 400m³ (approximately 13m x 10m x 3m) will still render the system at a loss just after the dry months.

WATER BUDGET YEAR 1

| MONTH | YIELD (m ³ /month) | DEMAND (m ³ /month) | MONTHLY BALANCE | POTENTIAL VOLUME (m ³) | VOLUME IN TANK (m ³) |
|--------------------|-------------------------------|--------------------------------|-----------------|------------------------------------|----------------------------------|
| January | 292.3 | 206.5 | 85.9 | 328.6 | 328.6 |
| February | 241.2 | 222.6 | 18.6 | 347.1 | 347.1 |
| March | 251.2 | 246.5 | 4.7 | 351.8 | 351.8 |
| April | 81.4 | 33.3 | 48.1 | 400.0 | 400.0 |
| May | 95.1 | 173.6 | -78.5 | 321.5 | 321.5 |
| June | 145.4 | 238.5 | -93.1 | 228.5 | 228.5 |
| July | 139.7 | 246.5 | -106.7 | 121.7 | 121.7 |
| August | 86.6 | 321.2 | -234.6 | 0.0 | 0.0 |
| September | 162.6 | 238.5 | -75.9 | 0.0 | 0.0 |
| October | 238.3 | 173.6 | 64.7 | 64.7 | 64.7 |
| November | 226.6 | 238.5 | -11.9 | 52.8 | 52.8 |
| December | 224.3 | 34.4 | 189.9 | 242.7 | 242.7 |
| ANNUAL AVE. | 2184.7 | 2373.5 | -188.8 | | |

Operational Phase - Y1



From the calculations above it can be noted that the likelihood of an entirely self-sufficient water system in a large public building is unlikely. However, small changes to the water system, from the application of water use reducing fixtures and grey water recycling (even if only for irrigation) makes a drastic impact on the use of water in a building like this.

The system was envisioned from the conception of the project which also proved its application more appropriate and suited to the scheme. The water strategy of the scheme applies the philosophy of minimum external water input and aims to operate based on the potential of rainwater harvesting and grey water application as usable water for irrigation and for both potable and non-potable water supplies. It is believed that, on further investigation, the system, if treated as inter-dependant with the other buildings in the precinct, an entirely self-sufficient system may be created.

9.4.2. Indoor Environmental Comfort

The value of well-functioning office spaces is invaluable in our current society, where often economic hardship in combination with poor work environments affect staff adversely. According to the Green Building Council, an improvement in Indoor Environmental comfort can increase productivity by up to 20%. This can be achieved by increasing ventilation, control over temperature and lighting, the use of natural light and the absence of toxic materials (GBCSA.org n.d.).

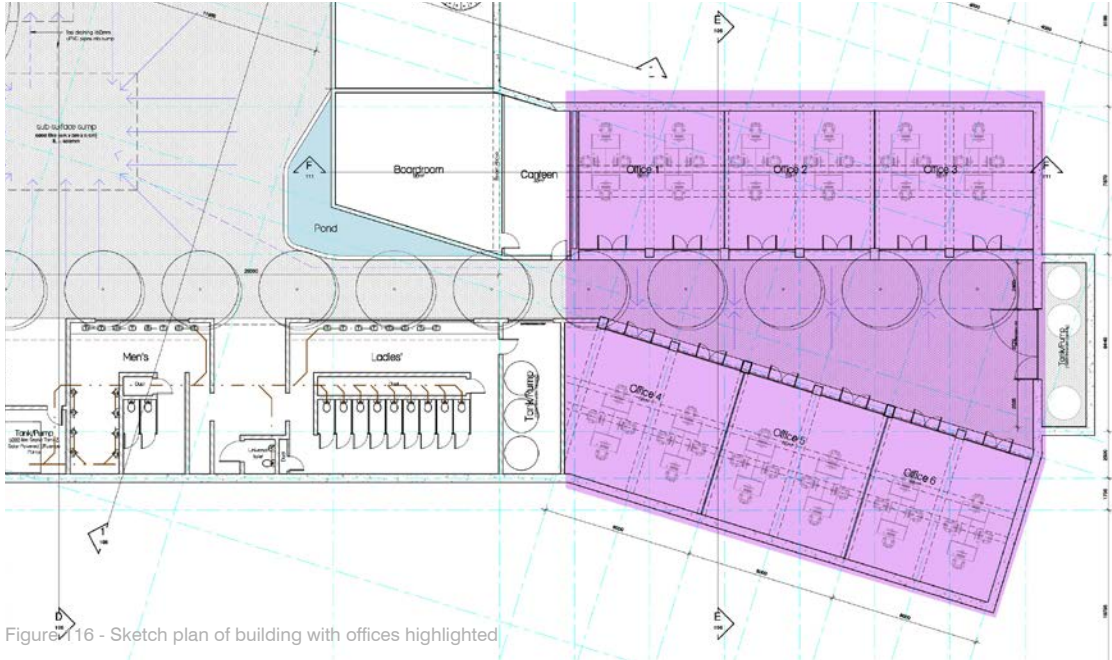


Figure 116 - Sketch plan of building with offices highlighted

Daylighting

In large buildings *electric lighting accounts for 35 - 50% of total electrical energy consumption* (Autodesk 2015). This would mean that the benefits of a thorough daylighting system is beneficial for the occupants and the operational cost of the building. To develop a daylighting strategy for the building a series of iterations of the building section were undertaken, each tested using indoor an environmental modelling computer programme, Sefaira . The software produces two visualisations, illustrating two aspect of daylight analysis of the spaces.

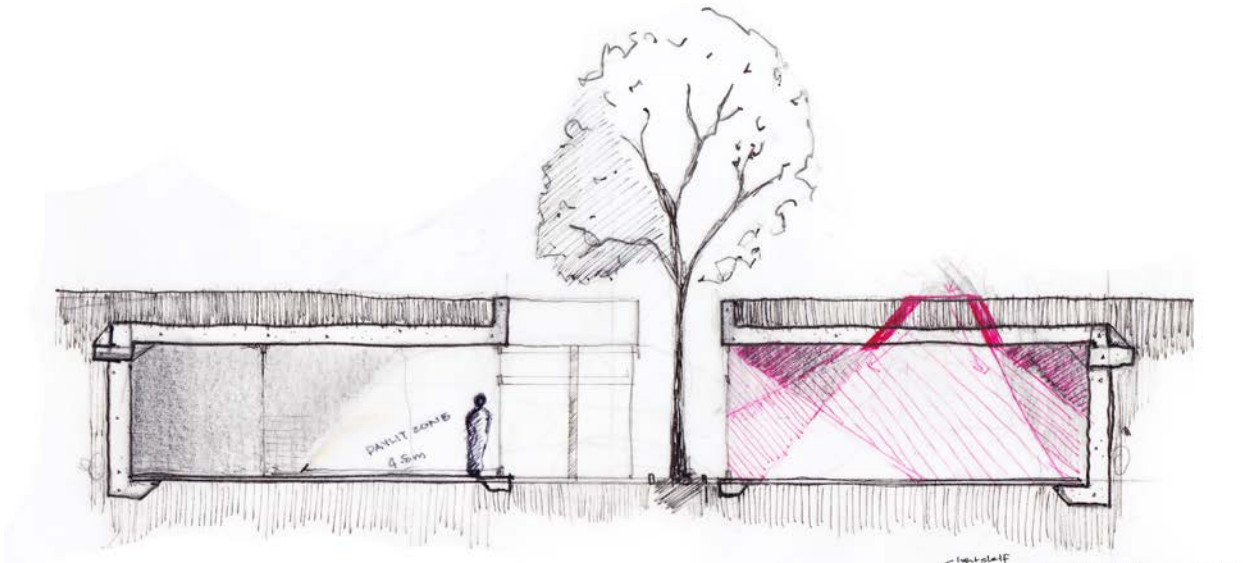
The first is an Spatial Daylight Autonomy value (sDA) which is used to evaluate whether a space receives enough usable daylight throughout the year. The diagram produced shows a colour variation on the plan of a building - ranging from dark blue to yellow. Yellow spaces receive illumination at the work surface height given (850mm) 100% of the year. The colour grading proceeds to green at 75% of the time and then darker blue as the illuminated work surface percentage throughout the year decreases.

Percentage of occupied hours where illuminance is at least 300 lux, measured at 0.85 meters above the floor plate.



The second is called Annual Sunlight Exposure (ASE) helps to identify whether a space is subject to overlighting. The visualisation colours the plan to reveal which spaces are overlit and which are underlit on average. Yellow spaces will be subject to glare while blue spaces will require task lighting. The clear spaces are perfectly lit for work surfaces.

Figure 117 - The gradation key of the sDA visualisation.



Office Concept

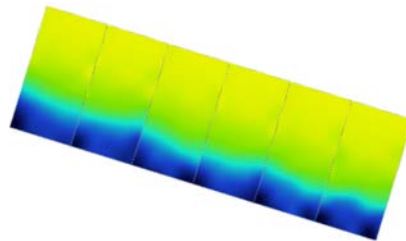
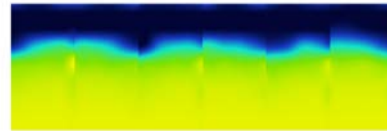
The first daylighting study was performed on the conceptual section of the offices.

The section initial showed a basic below-ground building with landscaped roof and storefront opening (Section above). Using basic daylighting rules of thumb the space could be daylit up to half the depth of the building (where the height of the sidelight = d and the depth of illuminance is $1.5d$). The right hand side of the diagram illustrating the rules of thumb shows how a light shelf may increase the depth of illuminance up to $2d$.

The diagrams to the right are visualisations of the sDA value and ASE values in the spaces. The 300lux illuminance is almost two thirds of the space, while one third of the southern building is adequately lit without glare and the Northern building is adequately lit without glare on approximately to thirds of the plan.



sDA of the spaces - concept



ASE of the spaces - concept

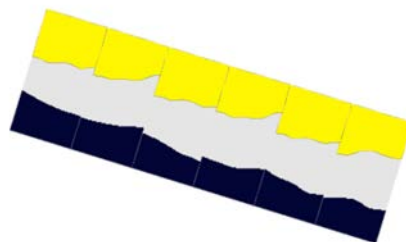
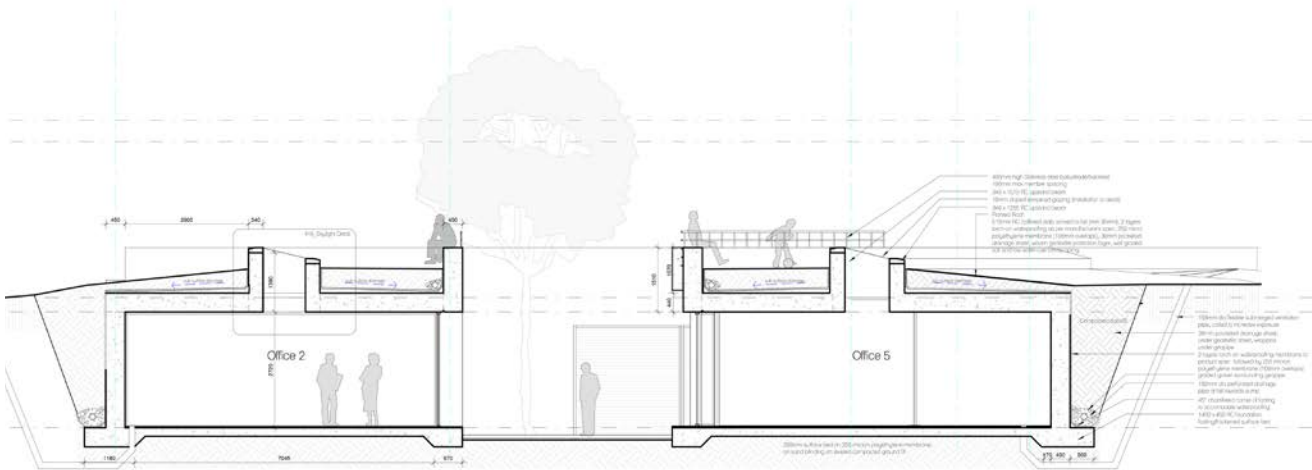


Figure 118 - Conceptual section of the office spaces.

Figure 119 - Daylighting rules of thumb diagram

Figure 120 - sDA visualisation of the spaces.

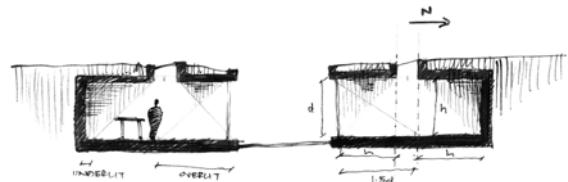
Figure 121 - ASE visualisation of the spaces.



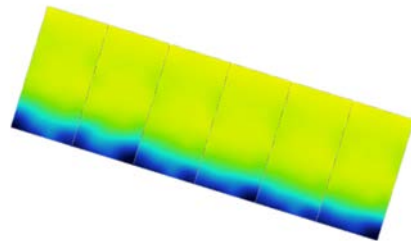
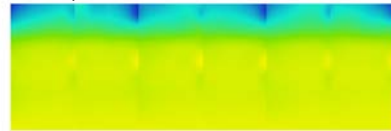
Office Iteration 1

The first iteration saw the introduction of skylights running the full length of the spaces and located in the middle of their depth. --

The daylighting prediction shown in the diagram anticipated a larger illuminated area which was proven by the sDA visualisation. However, the ASE visualisation began to show that majority of the lit space was overlit and would be spaces faced with glare.



sDA of the spaces - iteration 2



ASE of the spaces - iteration 1

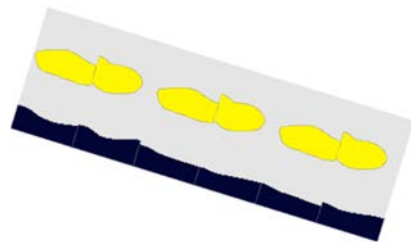


Figure 122 - Preliminary computer aided drawing showing the first iteration of the conceptual section (Section EE NTS).

Figure 123 - Predicted diagram applying the rules of thumb for iteration 1

Figure 124 - sDA visualisation of the spaces after the first iteration.

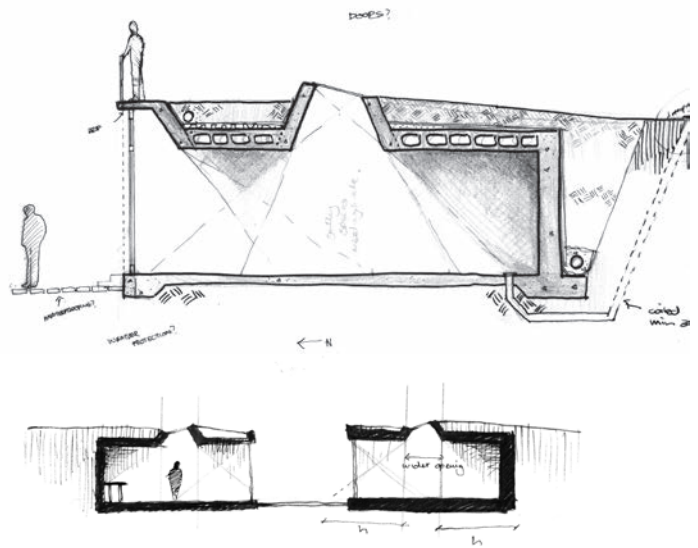
Figure 125 - ASE visualisation of the spaces after the first iteration.

Office Iteration 2

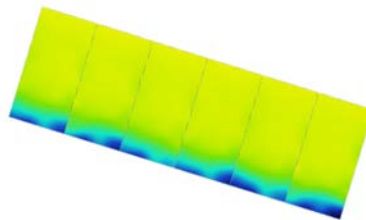
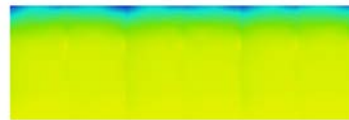
The second iteration was only a slight variation on the first, which is why they were both tested on Sefaira at the same time. The section shows how the skylight in iteration is only slightly altered to increase the size of the lower opening. This change was made to improve the appearance of the skylight from inside the space and increase the size of the opening in an attempt to spread the light further.

There is no specific rule of thumb illustrating this idea but the previous diagram was extrapolated and the prediction made as shown.

The sDA visualisation shows that majority of the area of the spaces is lit at above 300 lux at the given work surface. However, the skylights cause tremendous glare directly beneath them on the Southern building and almost all over in the northern building.



sDA of the spaces - iteration 2



ASE of the spaces - iteration 1

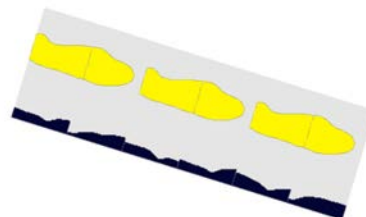


Figure 126 - Iteration 2, slight variation of iteration 1, where angle of internal walls of the skylight was altered to improve aesthetic and increased aperture (Northern portion of Section EE NTS).

Figure 127 - Predicted diagram applying the rules of thumb for iteration 2 - values extrapolated with discretion.

Figure 128 - sDA visualisation of the spaces after the second iteration. The change is only slight.

Figure 129 - ASE visualisation of the spaces after the second iteration.

Office Iteration 3

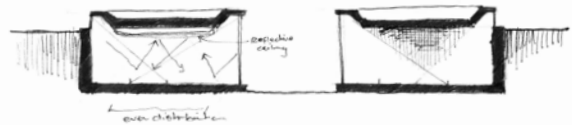
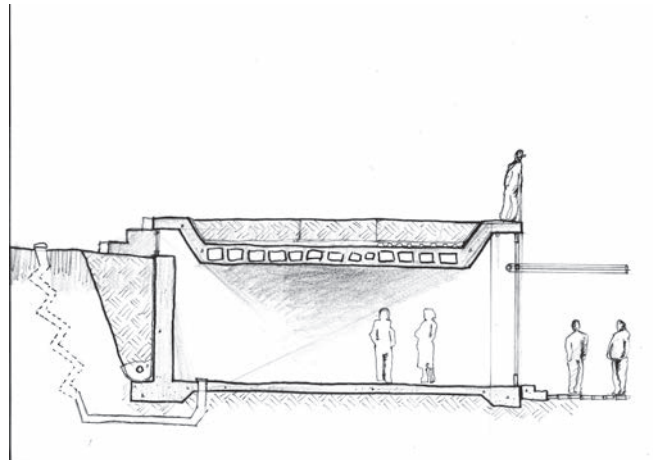
The 4th iteration saw the abandonment of the clerestories. This was partially due to their inclusion breaking the roof scape, which is occupiable and should be an extension of the park above, and in keeping with the manner in which the roof and building edges of the overall scheme had begun to develop. The intention was also to address the sharp overhead light that was penetrating the spaces from above.

The diagram prediction of how light would work in the spaces predicted even distribution of light on the work surface height. The left hand side of the diagram shows how introduction of a lightly coloured ceiling may use ambient and refracted light to soften light and produce a constant glow of light in the space.

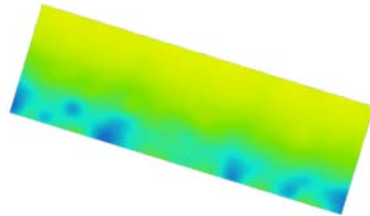
The visualisations reveal the iteration was partially a success. The southern build has no glare, and underlit space may be addressed using the refraction principle illustrated above, or these spaces can be programmed with functions requiring less light.

The Northern building, however still receives heavy glare on more than half its surfaces. Further iterations may be needed to identify the cause of this.

Possibly strategies include the application of solar shading devices along the facade, thus decreasing the allowed light from the store front or extending the overhang. These strategies will be investigated from here on.



sDA of the spaces - iteration 2



ASE of the spaces - iteration 1

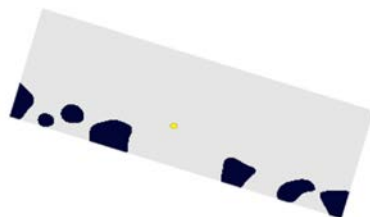


Figure 130 - Iteration 3, where skylights were abandoned and clerestories introduced (Southern portion of Section EE NTS).

Figure 131 - Predicted diagram applying the rules of thumb for iteration 3, depth of luminance from the clerestory were under-exaggerated.

Figure 132 - sDA visualisation of the spaces after the third iteration. Almost full illumination was achieved.

Figure 133 - ASE visualisation of the spaces after the second iteration, no glare in the Southern building.