Technical Development

Technical Development

This chapter deals with the materiality, structure and technical development of the proposed building. The chapter also looks at the SANS 10400 requirements for an alternative typology such as this design, as well as at theoretical discourse regarding weathering and returning to nature.

The exploded axonometric that follows depicts both the programmatic and technical development of the architecture, as well as the conceptual understanding and implementation of parameters established by the author. The diagram shows tectonic and stereotomic elements of the structure and how they interact with one another. The structures are defined by solid monolithic walls which extend out of the natural geology of the ridge, while the roof structures become extensions of the surface condition of the ridge, while also covering the exposed structures.

By using the structural integrity of the natural granite ridge and allowing planted roofs to extend out of the natural slope, one is able to develop an architecture that, when viewed from above and on elevation, responds sensitively to the ridge. By glazing most of the southern facades, natural light is allowed to illuminate spaces, which also helps the structure to blend into the ridge and make use of the trees surrounding the building to form a façade on the southern edges.

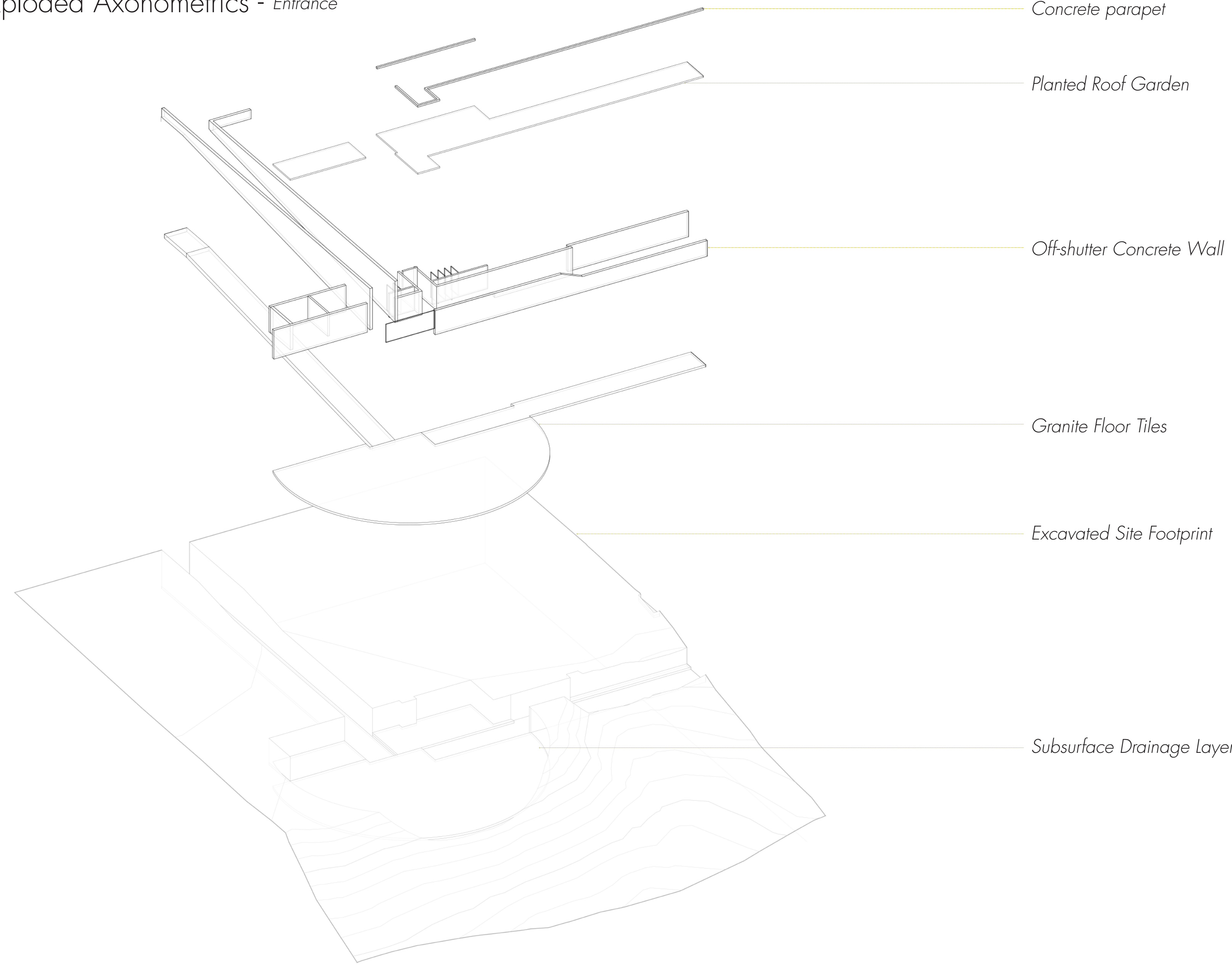
The building becomes a route in itself which fosters ritual practice within the city. The routes between the structures are more part of the natural ridge and park than of the building. They serve as a connection between the urban environment and the natural ridge.

Finally, the chapter will discuss the detailed resolution of the structural system, plan, section and details. Choice of material and material application will also be discussed.

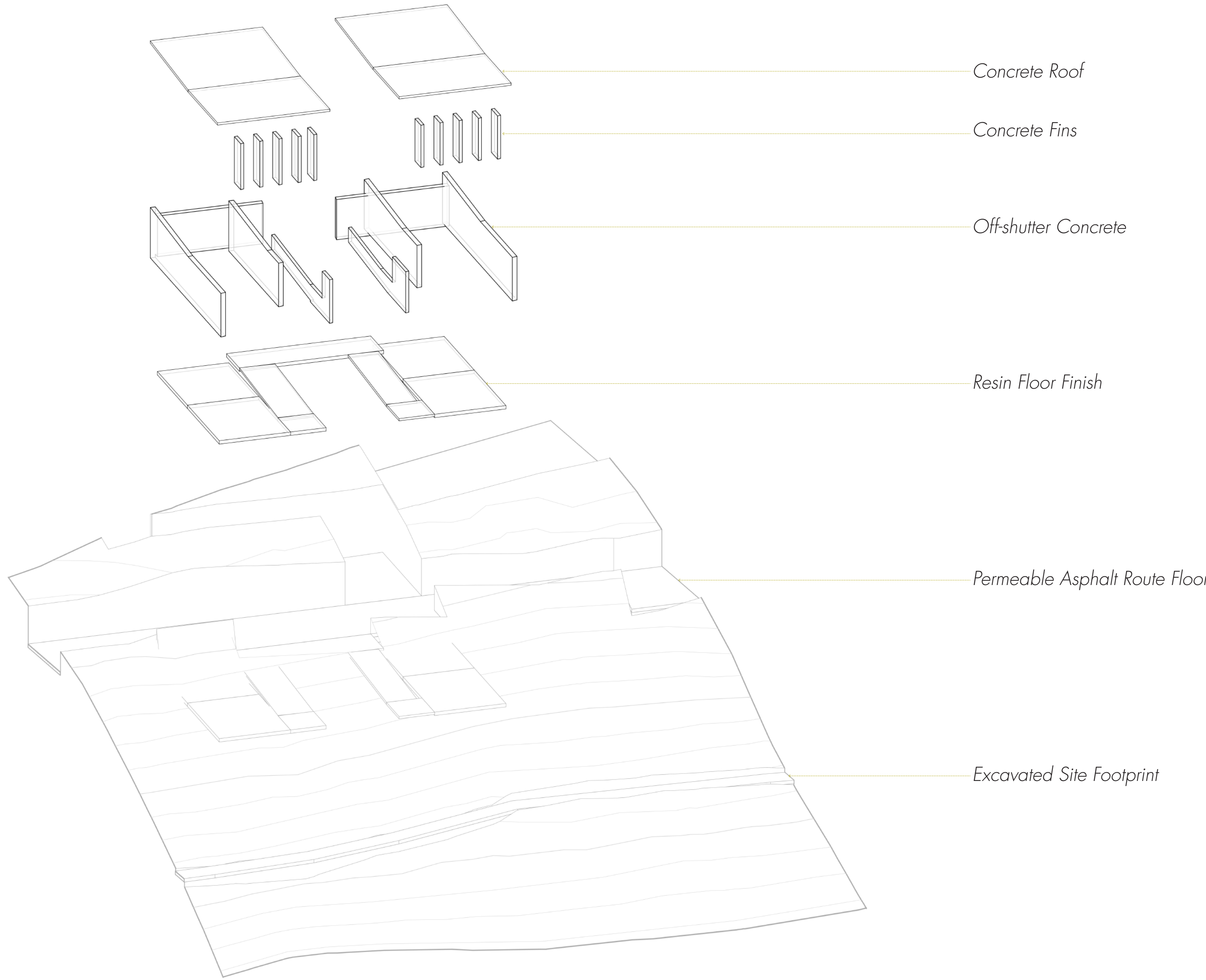
Exploded Axonometrics

The following series of exploded axonometric drawings aid in the explanation of the structure as a whole, as well as isolated structures submerged in the ridge landscape. In these axonometric diagrams the materiality of various elements, the reasons for material choices as well as the implications of these choices are depicted The diagrams also aid in the understanding of the nature of the design as a series of isolated, submerged structures within the ridge. More detailed exploded axonometrics of individual buildings follow the site axonometric to explain each building and its structural implications in more detail.

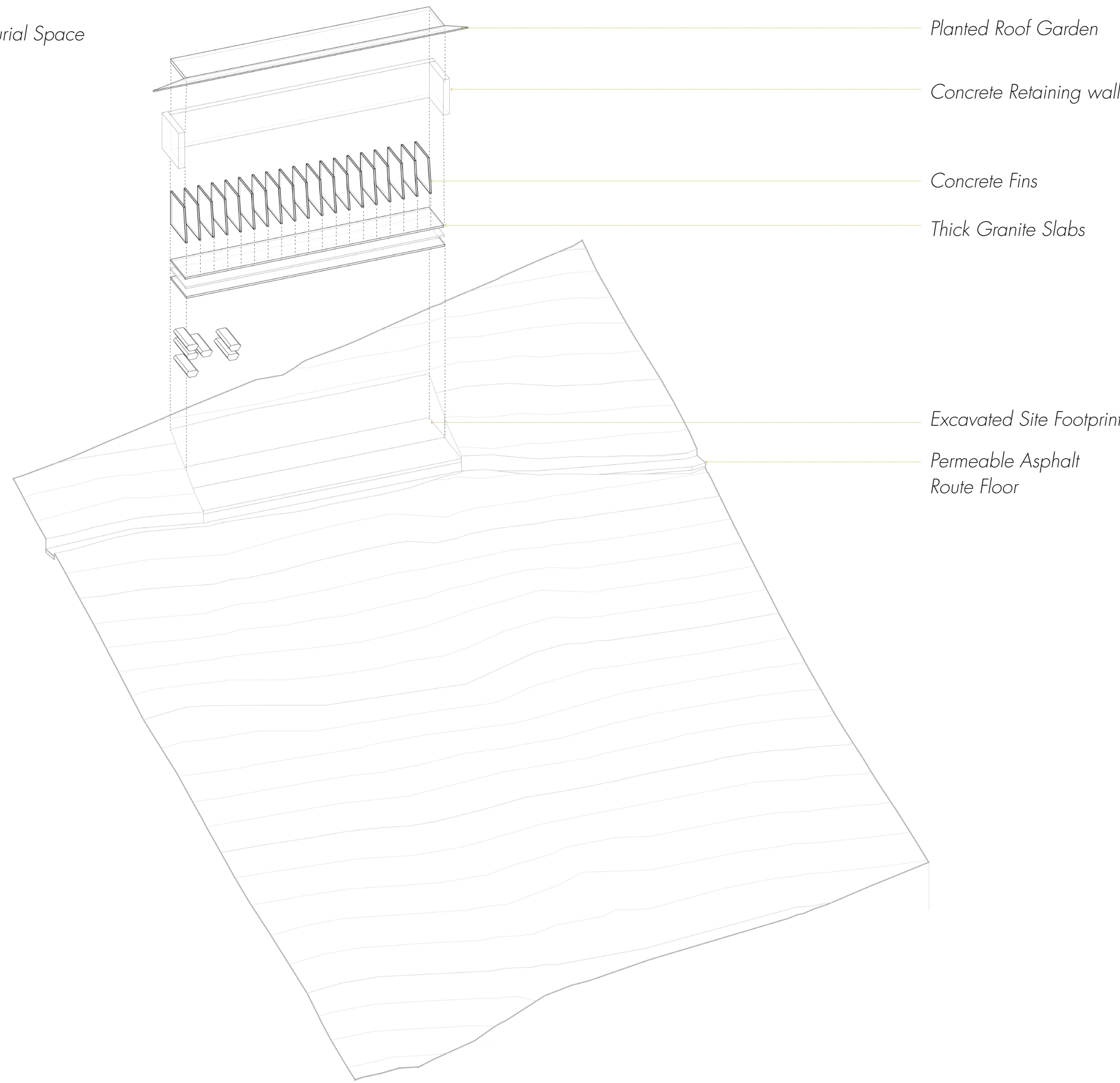
Exploded Axonometrics - *Entrance*

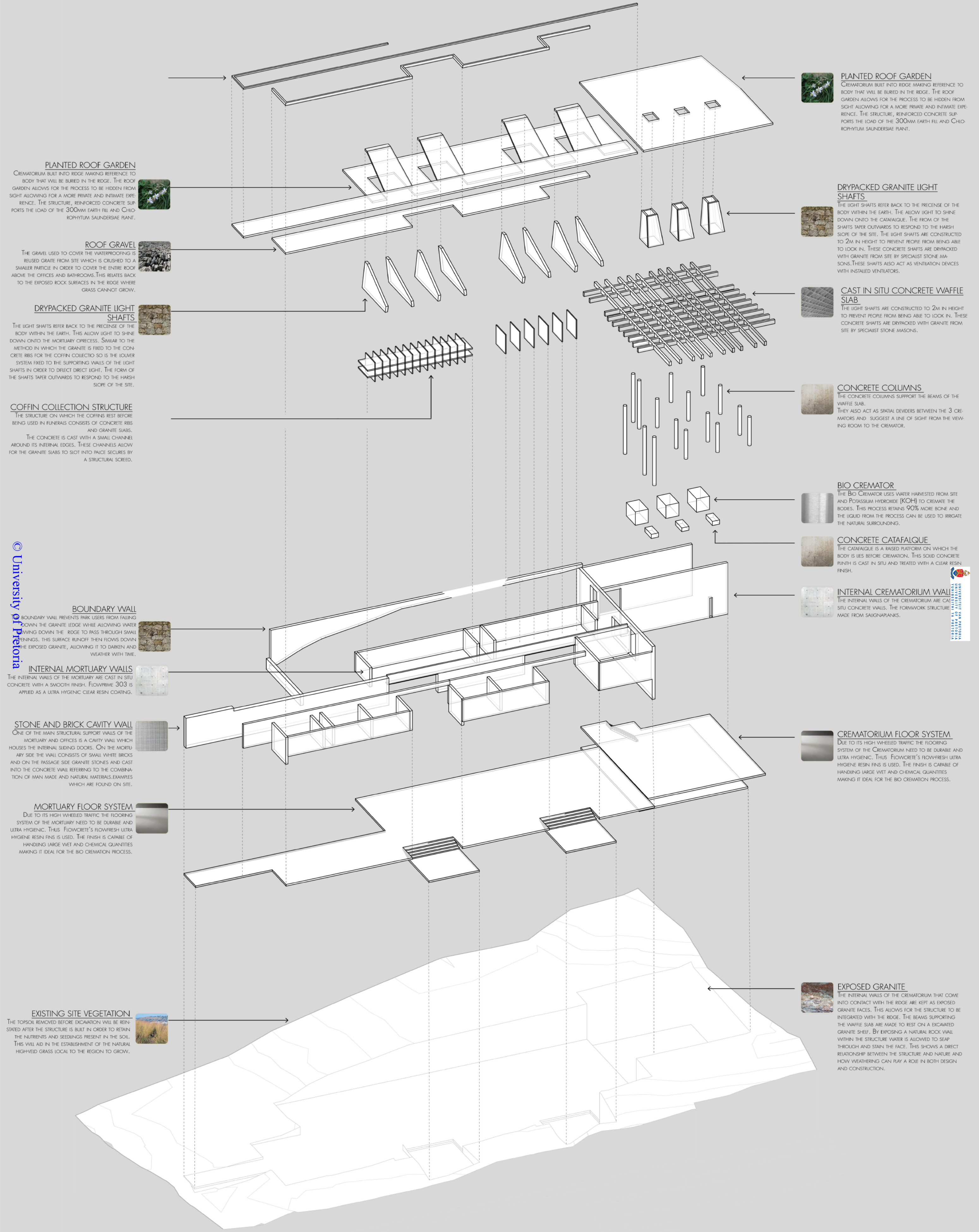


Exploded Axonometrics - *Bathhouse*

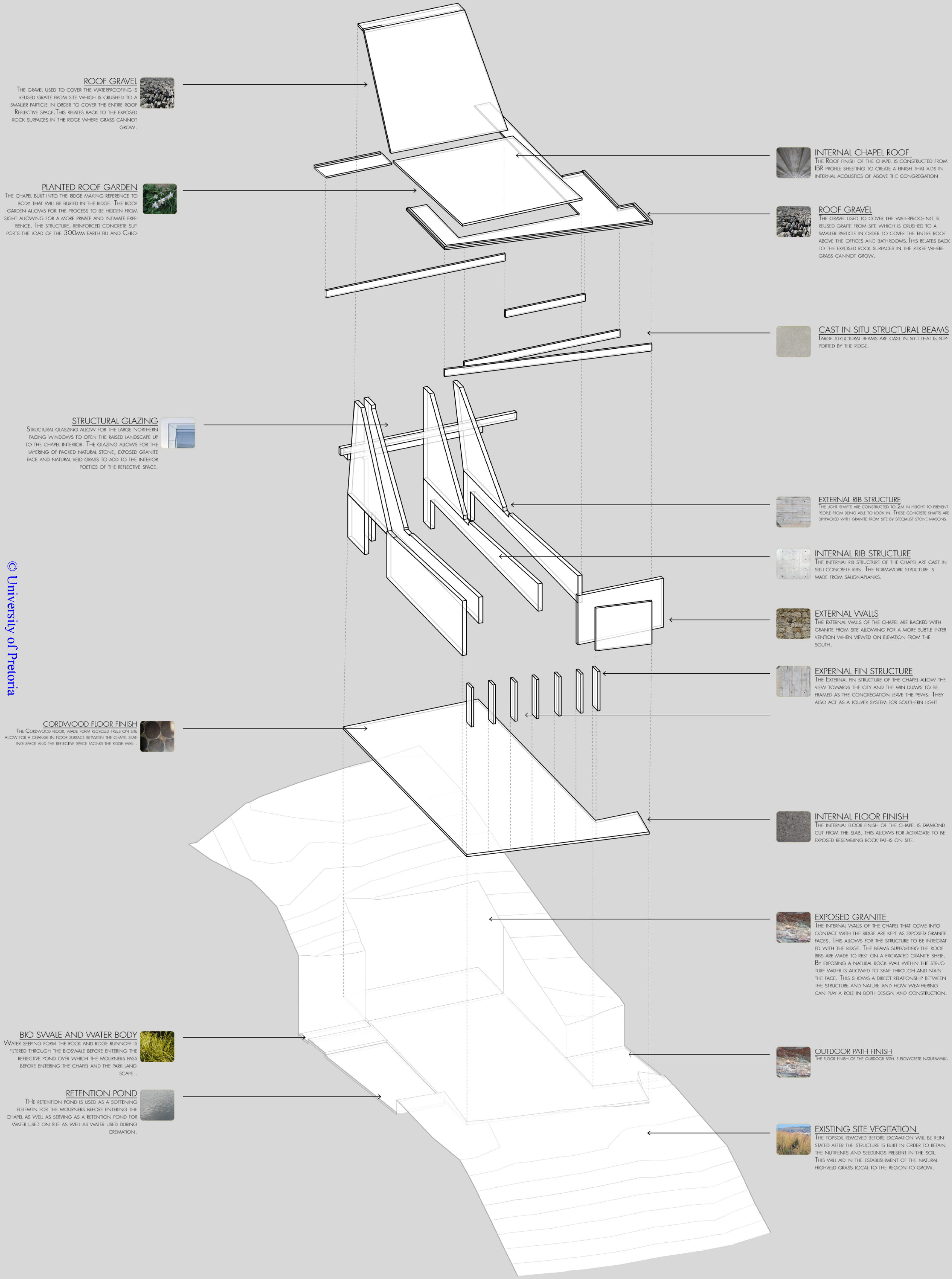


Exploded Axonometrics - *Burial Space*





PLANTED ROOF GARDEN
Crematorium built into ridge making reference to body that will be buried in the ridge. The roof garden allows for the process to be hidden from sight allowing for a more private and intimate experience. The structure, reinforced concrete supports the load of the 300mm earth fill and Chlorophytum saundersiae plant.
ROOF GRAVEL
The gravel used to cover the waterproofing is reused graite from site which is crushed to a smaller particle in order to cover the entire roof above the offices and bathrooms.This relates back to the exposed rock surfaces in the ridge where grass cannot grow.
DRYPACKED GRANITE LIGHT SHAFTS
The light shafts refer back to the precense of the body within the earth. This allow light to shine down onto the mortuary oprecess. Similar to the method in which the granite is fixed to the concrete ribs for the coffin collectio so is the louver system fixed to the supporting walls of the light shafts in order to difect direct light. The form of the shafts taper outwards to respond to the harsh slope of the site.
COFFIN COLLECTION STRUCTURE
The structure on which the coffins rest before being used in funerals consists of concrete ribs and granite slabs.
The concrete is cast with a small channel around its internal edges. These channels allow for the granite slabs to slot into paice secures by a structural screed.
BOUNDARY WALL
Boundary wall prevents park users from falling down the granite ledge while allowing water flowing down the ridge to pass through small openings. This surface runoff then flows down the exposed granite, allowing it to darken and weather with time.
INTERNAL MORTUARY WALLS
The internal walls of the mortuary are cast in situ concrete with a smooth finish. Flowprime 303 is applied as a ultra hygenic clear resin coating.
STONE AND BRICK CAVITY WALL
One of the main structural support walls of the mortuary and offices is a cavity wall which houses the internal sliding doors. On the mortuary side the wall consists of small white bricks and on the passage side granite stones and cast into the concrete wall referring to the combination of man made and natural materials.Examples which are found on site.
MORTUARY FLOOR SYSTEM
Due to its high wheeled traffic the flooring system of the mortuary need to be durable and ultra hygienic. Thus Flowcrete's flowfresh ultra hygiene resin fins is used. The finish is capable of handling large wet and chemical quantities making it ideal for the bio cremation process.
EXISTING SITE VEGETATION
The topsoil removed before excavation will be reinstated after the structure is built in order to retain the nutrients and seedlings present in the soil. This will aid in the establishment of the natural highveld grass local to the region to grow.
PLANTED ROOF GARDEN
Crematorium built into ridge making reference to body that will be buried in the ridge. The roof garden allows for the process to be hidden from sight allowing for a more private and intimate experience. The structure, reinforced concrete supports the load of the 300mm earth fill and Chlorophytum saundersiae plant.
DRYPACKED GRANITE LIGHT SHAFTS
The light shafts refer back to the precense of the body within the earth. The allow light to shine down onto the catafalque. The from of the shafts taper outwards to respond to the harsh slope of the site. The light shafts are constructed to 2m in height to prevent people from being able to look in. These concrete shafts are drypacked with granite from site by specialist stone masons.These shafts also act as ventilation devices with installed ventilators.
CAST IN SITU CONCRETE WAFFLE SLAB
The light shafts are constructed to 2m in height to prevent people from being able to look in. These concrete shafts are drypacked with granite from site by specialist stone masons.
CONCRETE COLUMNS
The concrete columns support the beams of the waffle slab.
They also act as spatial deviders between the 3 cremators and suggest a line of sight from the viewing room to the cremator.
BIO CREMATOR
The Bio Cremator uses water harvested from site and Potassium hydroxide (KOH) to cremate the bodies. This process retains 90% more bone and the liquid from the process can be used to irrigate the natural surrounding.
CONCRETE CATAFALQUE
The catafalque is a raised platform on which the body is lies before cremation. This solid concrete plinth is cast in situ and treated with a clear resin finish.
INTERNAL CREMATORIUM WALL
The internal walls of the crematorium are cast in situ concrete walls. The formwork structure made from saligna planks.
CREMATORIUM FLOOR SYSTEM
Due to its high wheeled traffic the flooring system of the crematorium need to be durable and ultra hygienic. Thus Flowcrete's flow-fresh ultra hygiene resin fins is used. The finish is capable of handling large wet and chemical quantities making it ideal for the bio cremation process.
EXPOSED GRANITE
The internal walls of the crematorium that come into contact with the ridge are kept as exposed granite faces. This allows for the structure to be integrated with the ridge. The beams supporting the waffle slab are made to rest on a excavated granite shelf. By exposing a natural rock wall within the structure water is allowed to seap through and stain the face. This shows a direct relationship between the structure and nature and how weathering can play a role in both design and construction.


ROOF GRAVEL
The gravel used to cover the waterproofing is reused graite from site which is crushed to a smaller particle in order to cover the entire roof Reflective space.This relates back to the exposed rock surfaces in the ridge where grass cannot grow.
PLANTED ROOF GARDEN
The chapel built into the ridge making reference to body that will be buried in the ridge. The roof garden allows for the process to be hidden from sight allowing for a more private and intimate experience. The structure, reinforced concrete supports the load of the 300mm earth fill and Chlo
STRUCTURAL GLAZING
Structural glaszing allow for the large northern facing windows to open the raised landscape up to the chapel interior. The glazing allows for the layering of packed natural stone, exposed granite face and natural veld grass to add to the interior poetics of the reflective space.
CORDWOOD FLOOR FINISH
The Cordwood floor, made form recycled trees on site allow for a change in floor surface between the chapel seating space and the reflective space facing the ridge wall .
BIO SWALE AND WATER BODY
Water seeping form the rock and ridge runnoff is filtered through the bioswale before entering the reflective pond over which the mourners pass before entering the chapel and the park landscape..
RETENTION POND
The retention pond is used as a softening eleemtn for the mourners before entering the chapel as well as serving as a retention pond for water used on site as well as water used during cremation.
INTERNAL CHAPEL ROOF
The Roof finish of the chapel is constructed from IBR profile sheeting to create a finish that aids in internal acoustics of above the congregation
ROOF GRAVEL
The gravel used to cover the waterproofing is reused graite from site which is crushed to a smaller particle in order to cover the entire roof above the offices and bathrooms.This relates back to the exposed rock surfaces in the ridge where grass cannot grow.
CAST IN SITU STRUCTURAL BEAMS
Large structural beams are cast in situ that is supported by the ridge.
EXTERNAL RIB STRUCTURE
The light shafts are constructed to 2m in height to prevent people from being able to look in. These concrete shafts are drypacked with granite from site by specialist stone masons.
INTERNAL RIB STRUCTURE
The internal rib structure of the chapel are cast in situ concrete ribs. The formwork structure is made from saligna planks.
EXTERNAL WALLS
The external walls of the chapel are backed with granite from site allowing for a more subtle intervention when viewed on elevation from the south.
EXPERNAL FIN STRUCTURE
The External fin structure of the chapel allow the view towards the city and the min dumps to be framed as the congregation leave the pews. They also act as a louver system for southern light
INTERNAL FLOOR FINISH
The internal floor finish of the chapel is diamond cut from the slab. this allows for agragate to be exposed resembling rock paths on site.
EXPOSED GRANITE
The internal walls of the chapel that come into contact with the ridge are kept as exposed granite faces. This allows for the structure to be integrated with the ridge. The beams supporting the roof ribs are made to rest on a excavated granite shelf. By exposing a natural rock wall within the structure water is allowed to seap through and stain the face. This shows a direct relationship between the structure and nature and how weathering can play a role in both design and construction.
OUTDOOR PATH FINISH
The floor finish of the outdoor path is flowcrete naturawalk.
EXISTING SITE VEGITATION
The topsoil removed before excavation will be reinstated after the structure is built in order to retain the nutrients and seedlings present in the soil. This will aid in the establishment of the natural highveld grass local to the region to grow.

Technical Concept

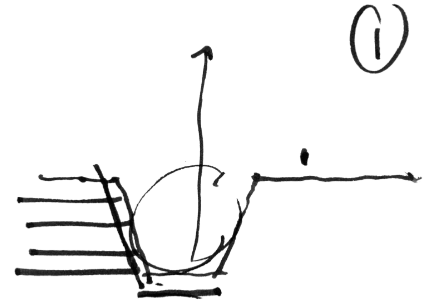
The natural granite w hich makes up most of the Yeoville Ridge is a major influence, both on design and construction. By combining the typologies of the naturalistic rural cemetery and the formalistic urban cemetery one is able to establish a new, more contextual typology for burial in the city of Johannesburg and, more importantly, the Witwatersrand. By making incisions into the natural granite rock of the ridge, the the ridge can be used not only as a structural support system, but also to become a subterranean burial park that becomes a city of the dead that is accessible to the living – a calm and isolated space within the chaos of Johannesburg.
And more importantly the witwatersrand. By making incisions into the natural granite rock
Of the ridge the structure is able to use the ridge not only as a structural support system but become a sub-terranean
Burial park that becomes a city of the dead that is accessible for the living. A calm and isolated
Space within the chaos of johannesburg.
The use of materials that show weathering allow the structure to age. This refers to the notion of time
And decay and how life in itself is not infinate. The weathering of the structure relates back to nature and
How it is not static, this notion awakens reality within the user and arouses intrique as does most buildings
In decay. They ultimitly awaken nostalgia within those experiencing it.
By creating a building that decays as a result of the landscape the architecture is able to successfully
Become a mediator between the living and the dead. A sensitive intervention that decays back to the earth.it
Merges with the landscape.
The construction of the structure allows for exposure of man made and atural elements throughout the
Route.

Theory - *Weathering*

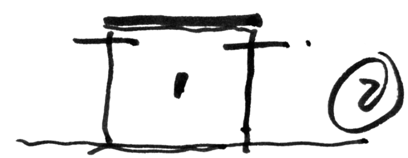
Erosion of a surface through weathering exposes newer surfaces of the same material in its depth, at once erasure of one surface and the revelation of another. Exposure also involves sedimentation and the gathering of residual deposits, the combination of which – subtraction and addition – is a testimony to the time of a building, "creating the present form of the past life but according to its past as such." In this sense architectural duration implies a past that is caught up in the present and anticipates the future.
(Mostafavi & Leatherbarrow 1993:64)

Weathering as we know it is seen quite differently from what Mostafavi and Leatherbarrow suggest. When this process is allowed to continue uninterrupted, it enables the building to develop a second skin which ultimately becomes natural or Nature. This tension created between the natural (site and location) and the man-made (art) is ultimately what Tadao Ando speaks of when he explains his understanding of nature and the constructed site (Ando 1996).

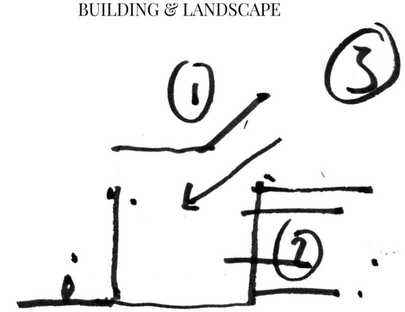
LANDSCAPE



BUILDING



BUILDING & LANDSCAPE



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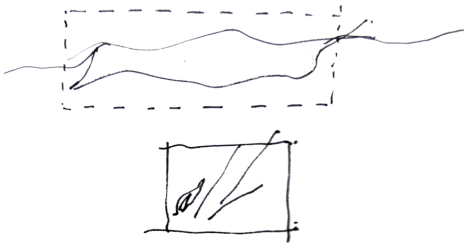
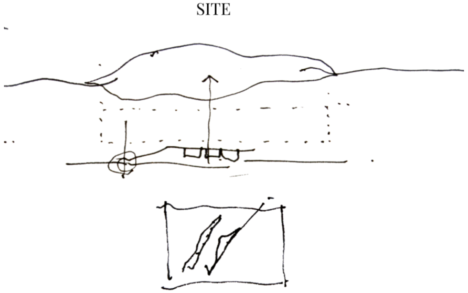
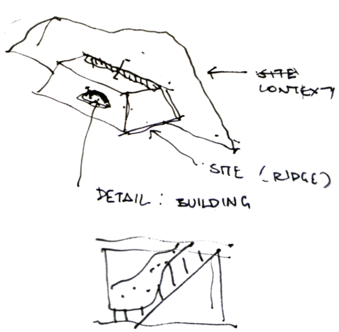
CONTEXT



SITE



BUILDING / DETAIL



Thus, considering the text by Mostafavi and Leatherbarrow (1993), weathering ultimately produces something which is already there through the process of extraction. This process ultimately transforms the roles of art and nature. In the design process, art is assumed to be the dominant force which shapes nature, over the lifetime of the construction. However, nature reforms the finished artwork (Mostafavi & Leatherbarrow 1993:64).

What is the value of this accumulation of dirt, or this erosion of a finished edge? Is it not tragic? Alternatively, does it not show the rightful claim nature has on all works of art? Is not this return of matter to its source, as a coherent body, already implied in its constitution, insofar as every physical thing carries within its deepest layers a tendency towards its own destruction – death as birth right? If tragic, this metamorphosis is just. The value, then, of works that suffer strains and abrasions is the revelation of the eventuality of this final justice.

(Mostafavi & Leatherbarrow 1993:69)

This relates directly to the process of death and how a piece of art – as a result of weathering – is taken back to its location, the place where it was first taken from. Thus, during and after the construction of a building, it naturally takes on the characteristics of the site, the textures, colours, surface patterns and smells on which it is constructed. These adopted characteristics which the piece of art or building gathers from the site are in turn given back to the landscape. The building as a geological element allows the site to form around it and become one with the structure. In this way both nature and man-made art become aware of one another, and respond accordingly in a sensitive manner (Mostafavi & Leatherbarrow, 1993:72).

In conclusion it is clear that whatever the design develops into, the process of weathering is an inevitable one that adds to the experiential qualities of the spaces.

This idea relates back directly to the proposal of a crematorium and funerary route nestled within the landscape, creating a connection between nature and the man-made structure. By designing for the inevitable effect of weathering on elements such a granite, concrete and stone walls, one is able to enhance the experience of the space and, most importantly, relate it back to the process taking place in the programme. Just as the process of death is one of weathering in itself, so should the structure that facilitates the burial process also become weathered due to time. The structure then ultimately becomes a monument of the past funerary processes in the landscape, returning to the landscape like those whom it has catered for, and so becoming a ruined folly within the ridge as a geological agent on the Witwatersrand.

Roof

Concrete

As an element in all the structures, concrete forms an integral part of the various roof structures, finished in accordance to variations in programmatic use.

The finish of the chapel roof varies. The northern pitched roof of the chapel tower is finished with bluegum plank formwork for a smooth, reflective finish, while the roof structure above the seating is cast in situ with thin timber purlins spaced at??? Centres in order to allow for acoustic displacement. With the concrete finish of the internal roof structure exposed, the space can respond directly to its surrounding urban context as well as to the geology of the ridge. Wood is a material that is able to merge seamlessly with stone in order to create harmony between man and nature.

Green roof

The roofs of the chapel (above the seating) and of the mortuary are planted with various indigenous grasses listed in the planting palette. Conceptually the planted roof allows the structure to merge with the landscape. Viewed from above these roofs soften the impact the structures have on the ridge, but replace the footprint removed from the submersion of the various structures. The earth layers of these green roofs improve insulation of the structures below and also protect the roof structure from water leakage.

Granite Rock

The granite which is excavated from the site in order to submerge the structures is crushed and used as a gravel alternative to cover the waterproofing on exposed flat roof structures. The pitched tower roof of the chapel is packed with roughly cut granite slabs to cover the waterproofing, but also to conceptually fit into the exposed rock of the ridge, becoming an exterior extension of the exposed rock face in the chapel. The packed granite slabs above the mortuary coffin collection area and fridges are seen as extensions of the internal geology of the ridge itself.

Structure

Concrete

One of the main materials used as structural element in all the structures is ???MPa cast in situ concrete. The fin structures span the length of the chapel while supporting its entire roof structure. A similar fin system supports the roof of the mortuary while defining smaller slots in the coffin collection area and mortuary cooling space. A concrete waffle slab system is implemented as roof structure for the crematorium to support the large green roof. The robustness and finish of the concrete elements enhance the spatial experience of the spaces and the changes in volume, and support the conceptual approach and the representation of monumentality.

Granite Rock

Exposed granite rock is used in the chapel, crematorium and bathhouse as an internal wall finish, but more importantly as a structural support for the roof structures and walls to slot into. The concrete fins supporting the chapel roof slot into deeply excavated grooves in the exposed rock, whereas the waffle slab beams of the crematorium are supported by the rock. These beams are laid 1.5 m into the cut rock, allowing for weathering to occur without weakening the structural integrity of the granite and concrete beams.

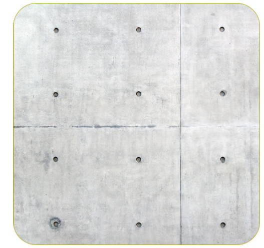
Structural Glazing

Structural fin glazing is used at the top of the pitched-roof chapel tower to allow natural light to penetrate the space, enabling light to shine directly onto the catafalque and down the granite rock face. The pitch of the chapel roof is at such an angle that light will never directly shine into the eyes of the seated congregation. A structural fin glazing system is also used in the coffin collection and mortuary spaces to admit natural light.

Wall

Concrete

Most of the building's walls consist of thick bluegum-shuttered cast in situ concrete. These walls add to the robustness of the structure and relate directly to the structures in the immediate surroundings – structures such as Ponte City, the old Jewish Synagogue, the concrete Yeoville water tower and the overpass system along Joe Slovo Drive.



Granite

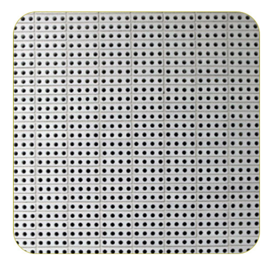
The exposed natural granite of the ridge is used as internal walls for the crematorium, chapel and mortuary bathhouse. These walls are conceptually used to indicate spaces where interaction between the mourners and the body of the deceased takes place. These exposed walls also allow the man-made structure to become dependent on the natural ridge, so that the space resembles a cave or tunnel like space submerged within the ridge, making reference to the mining history of Johannesburg.

Glazing

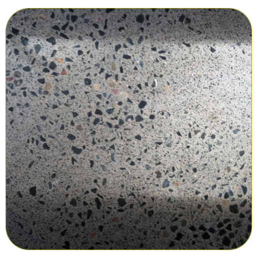
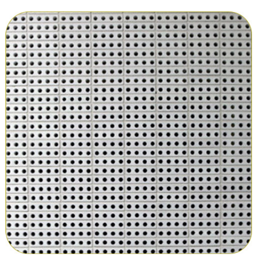
Structural fin glazing is used on the southern facades of the chapel and mortuary bathhouse. These glazed panels fit in between concrete fins which prevent direct sunlight from entering the spaces. The reasoning for opening the southern façade of these structures is to allow the user to view the urban landscape as well as the mining landscape in the distance. After having followed the route from structure to structure, the user is finally rewarded with an unobstructed view towards the city.

Brick

Structural fin glazing is used on the southern facades of the chapel and mortuary bathhouse. These glazed panels fit in between concrete fins which prevent direct sunlight from entering the spaces. The reasoning for opening the southern façade of these structures is to allow the user to view the urban landscape as well as the mining landscape in the distance. After having followed the route from structure to structure, the user is finally rewarded with an unobstructed view towards the city.





Floor

Timber

Cordwood floors are installed in the office spaces of the mortuary and the park, as well as in the prayer area of the chapel and viewing room within the crematorium. The wood used for the floors is recycled from bluegum trees on site, which have been removed as part of the rehabilitation process of the ridge. The use of cordwood was investigated by the author while visiting the Coromandel Manor Estate by architect Marco Zanuso. In the Coromandel house cordwood was used between the internal fireplace and the "stoep" area overlooking the valley. This use of a natural material in an alternative manner was extremely interesting and allowed for the space to be experienced differently from the rest of the wood-floored spaces in the house.

Resin finish

Due to hygiene requirements, the coffin collection area, mortuary and crematorium require a floor finish that is easily washed and sterilised. By finishing the floor surface and skirting with white polished resin, these requirements are met. The choice of colour aids in making areas that are dirty visible, thus making the cleaning process easier. The floor structure slopes to an enclosed drainage system which drains into the effluence tanks in the service space, allowing for UV treatment to take place later before the water is stored in the irrigation reservoir.

Power floated Concrete screed

Polished power-floated concrete screed floors are used in the passageway between the mortuary and the offices, as well as in the mortuary bathhouse. This material is used as a transition material between the hygiene-specific mortuary and the offices. Due to its relatively low maintenance it is also used for spaces with heavy traffic.

Granite tiles

Granite tiles are used in conjunction with porous coloured asphalt as floor material for the routes throughout the site. This material allows for water to drain freely into gutters, from where it is then pumped into the subterranean water reservoir. The floor surface of the chapel is covered in granite tiles which respond to the geology that has been removed in the construction of the chapel. Granite rock tiles are also used as surface material for the courtyard space at the entrance to the park.

fig 11.1. Photograph of Granite sample excavated from site. (by Author, 2015)

fig 11.2. Photograph of Granite sample excavated from site. (by Author, 2015)

fig 11.3. Photograph of Granite sample excavated from site. (by Author, 2015)

SANS 10400 Requirements

SANS 10400 was consulted at the beginning stages of design in order to create a more functional and technical guideline for design. Research undertaken of various sections within the SANS document are discussed below. This research has become a foundation for the technification process of the project.

PART A

Table 1: Building classification
A4 – Worship:
Occupancy where persons assemble for the purpose of worshipping

Table 2: Occupancy Planning
Number of fixed seats or 1 person per m2 if there are no fixed seats
Estimated number of users: +-100

Part O

Table 2 — Air requirements for different types of occupancies
Public Halls:
Churches
Air changes per hour : 10
L/s per Person : 7.5Ls
7.5Ls x 100 = 750Ls for Chapel

Part P

Table 4 and 6: Provision of sanitary fixtures for personnel

Required		Provided
Male:		
3WC Pans	-	4 WC Pans
5 Urinals	-	4 WC Urinals
4 Wash hand basins	-	8 Wash hand basins
Female:		
7 WC Pans	-	8 WC Pans
4 Wash hand basins	-	10 Wash hand basins
Disabled:		
2 WC Pans	-	2 WC Pans
2 Wash hand basins	-	2 Wash hand basins

Bio Cremation Process

1. Load - Body in silk robe is places in stainless steel casket tray and loaded into Bio Cremator Doors close automatically
2. Preparation - Body is automatically weighed. Water and alkali amount is calculated and added to vessel
3. Fill - Amount of water and alkali is proportionally added to cremator
4. Heating and cycling - vessel is heated to 170°C by steam passed through internal coils. Solution of alkali and water is constantly mixed
5. Cooling - Remains are rapidly cooled by circulating cooled water through Bio Cremator.
6. Drainage - when cremation process is complete the water is drained leaving only Bio remains.
7. Rinsing - The Bio remains are rinsed with hot water for cleansing purposes
8. Bone Removal and Drying - Bones are the removed from the cremator and dried and processed into a fine pure white ash. The ash can be kept by the family or buried in the ridge cemetery

Bio cremation was developed as an alternative method of cremation that, instead of destroying or capturing harmful emissions, seeks to prevent the creation of emissions altogether. It was first developed in 1998 at the University of Florida and was known as the first "institutional" human system. The world's first bio cremation centre was established in 2009 in St Pete, Florida, in the United States.

The process, otherwise known as Alkaline Hydrolysis, uses a mixture of water (H2O) and Potassium Hydroxide (KOH) to break down (hydrolyse) organic human tissue. 400 Litres of water is mixed into a concentrated solution of KOH which is determined by the weight of the body. The bio cremator itself is used to weigh the body as well as mix the correct amounts of H2O and KOH. After the body has been weighed and the H2O and KOH have been mixed, the remains are heated to 140°C. This process of heating is achieved through a strong exothermic reaction between H2O and KOH. Similar to traditional flame cremation, bio cremation reduces the body to its basic elements of bone fragments and ash. After the process, which takes between 2-3 hours (similar to flame cremation) has been completed, a sterile liquid is released which can be discarded in a normal drainage system or put through a UV filtration process which kills off any excess bacteria not destroyed by KOH. This process, which is closer to the natural decomposition of the body, is used to accelerate natural decomposition.

In traditional earth burial (B2B), the body on average takes between 5 to 20 years to decompose. The speed of this natural process is determined by the manner in which the body was prepared, the material type of the casket, the type of vault in which the body is buried, and the soil type. Just as KOH is the main catalyst for the decomposition of the body in bio cremation, soil and microorganisms or O2 are the catalysts for earth decomposition.

The process of bio cremation retains 20-30% more bone fragments, uses less energy, is recyclable, creates neither air nor mercury emissions, and the need for surgery to remove medical implants that may be recycled, is diminished.

System Design Focus – Water

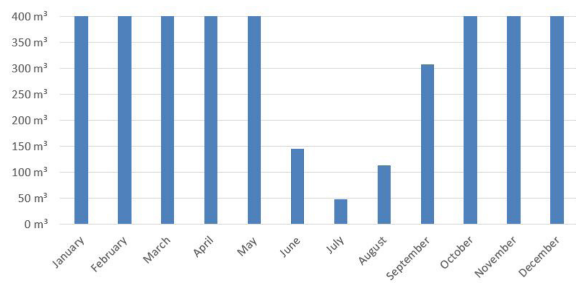
Due to the nature of the programme, the geological location of the site and its topographic layout, it naturally led the focus to the systematic design of water as a theme. The intention of this system has two main components:

1 - Site rehabilitation and irrigation
2 - Minimised water requirements from Rand Water

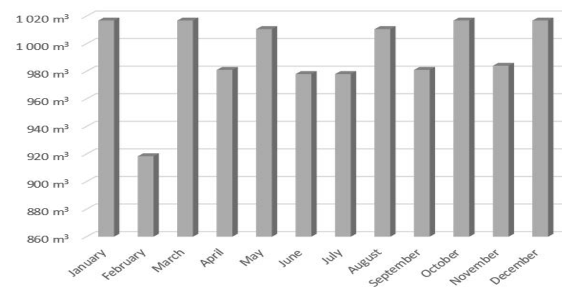
By being able to collect surface runoff from large areas of the natural ridge as well as paved surfaces and roofs, it is possible to treat and recycle water, which can then be fed back into the system as required in the proposed structure.
The sterile liquid released by the cremation process would strictly only be used for irrigation of the natural ridge landscape, and would undergo an additional UV filtration process as a precautionary measure against harmful bacteria.
Thus, according to the proposed strategy, the structure should be able to cremate a certain number of bodies.
By using harvested rainwater, it would also be able to provide ample water for sanitation as well as drinking fountains along the route.

By calculating the building's water budget according to the principles and guidelines set out by the Council for Scientific and Industrial Research South Africa (CSIR), it is made clear how the water strategy of the structure and the entire site as park could be optimised.
By combining the domestic demand of the structure with that of the requirements of the site along with climate data, one is able to calculate and explore water storage and recycling options.

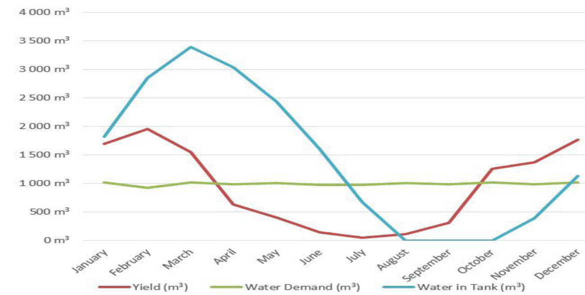
Average Monthly Precipitation (mm)



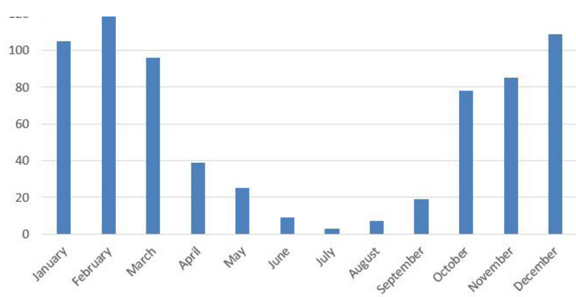
Cremation Total Demand (m^3)



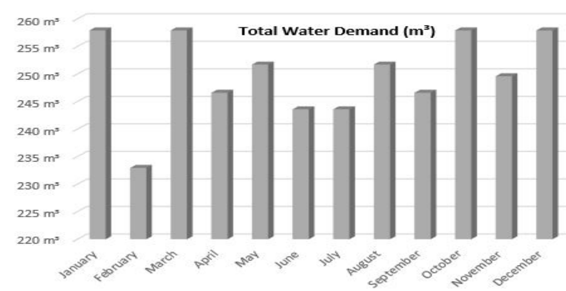
Cremation Water Tank Size Calculator (m^3)



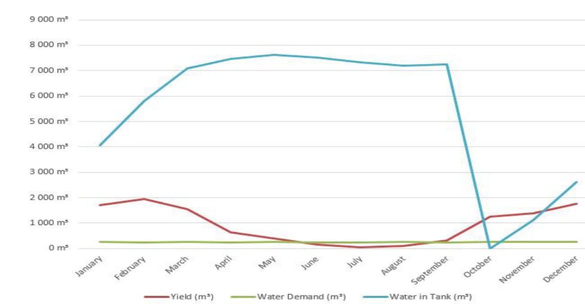
Average Monthly Yield (m^3)



User Total Demand (m^3)



User Water Tank Size Calculator (m^3)



Cremation - Domestic Demand (m^3)

	Planting Area (m^2)	Irrigation Depth per week (m)	Irrigation Depth per month (m)	IRRIGATION DEMAND (m^3)
January	70 m^2	0.040 m	0.177 m	12 m^3
February	70 m^2	0.040 m	0.160 m	11 m^3
March	70 m^2	0.040 m	0.177 m	12 m^3
April	70 m^2	0.030 m	0.129 m	9 m^3
May	70 m^2	0.020 m	0.089 m	6 m^3
June	70 m^2	0.020 m	0.086 m	6 m^3
July	70 m^2	0.020 m	0.086 m	6 m^3
August	70 m^2	0.020 m	0.089 m	6 m^3
September	70 m^2	0.030 m	0.129 m	9 m^3
October	70 m^2	0.040 m	0.177 m	12 m^3
November	70 m^2	0.040 m	0.171 m	12 m^3
December	70 m^2	0.040 m	0.177 m	12 m^3
YEAR	**70 m^2 (Average)**	**0.032 m (Average)**	**1.646 m (Total)**	**115 m^3 (Total)**

Cremation - Total Demand (m^3)

	IRRIGATION DEMAND (m^3)	DOMESTIC DEMAND (m^3)	TOTAL WATER DEMAND
January	12 m^3	1 004 m^3	**1 017 m^3**
February	11 m^3	907 m^3	**918 m^3**
March	12 m^3	1 004 m^3	**1 017 m^3**
April	9 m^3	972 m^3	**981 m^3**
May	6 m^3	1 004 m^3	**1 011 m^3**
June	6 m^3	972 m^3	**978 m^3**
July	6 m^3	972 m^3	**978 m^3**
August	6 m^3	1 004 m^3	**1 011 m^3**
September	9 m^3	972 m^3	**981 m^3**
October	12 m^3	1 004 m^3	**1 017 m^3**
November	12 m^3	972 m^3	**984 m^3**
December	12 m^3	1 004 m^3	**1 017 m^3**
YEAR	115 m^3 (Total)	11 794 m^3 (Total)	**11 909 m^3 (TOTAL)**

Cremation - Yield (m^3)

Yield (m^3) = P x A x C (Where P=precipitation (m), A=area (m^2), and C=run-off coefficient)

Area of Catchment: (Per surface)	Area (m^2)	Run-off Coefficient
Roofing	690.00 m^2	0.9
Paving	2 403.00 m^2	0.8
Veldgrass	28 234.00 m^2	0.4
Lawn	0.00 m^2	0.4
Planting	70.00 m^2	0.3
Gravel	1 671.00 m^2	0.7
Grey water	1 141.50 m^2	1
TOTAL:	**34 209.50 m^2**	0.47

MONTH	Precipitation **Average Monthly (mm)**	Area	Run-off **Coefficient**	Yield **P(m) x A(m^2) x C**
January	105 mm	34 210 m^2	0.47	1 698 m^3
February	121 mm	34 210 m^2	0.47	1 956 m^3
March	96 mm	34 210 m^2	0.47	1 552 m^3
April	39 mm	34 210 m^2	0.47	631 m^3
May	25 mm	34 210 m^2	0.47	404 m^3
June	9 mm	34 210 m^2	0.47	146 m^3
July	3 mm	34 210 m^2	0.47	49 m^3
August	7 mm	34 210 m^2	0.47	113 m^3
September	19 mm	34 210 m^2	0.47	307 m^3
October	78 mm	34 210 m^2	0.47	1 261 m^3
November	85 mm	34 210 m^2	0.47	1 374 m^3
December	109 mm	34 210 m^2	0.47	1 762 m^3
YEAR	696 mm	**34 210 m^2**	0.47	**11 254 m^3**

User - Domestic Demand (m^3)

	Number of Individuals	Water / capita / day (Litres)	Total Water / month (Liters)	DOMESTIC DEMAND (m^3)
January	110	72 l	245 520 l	246 m^3
February	110	72 l	221 760 l	222 m^3
March	110	72 l	245 520 l	246 m^3
April	110	72 l	237 600 l	238 m^3
May	110	72 l	245 520 l	246 m^3
June	110	72 l	237 600 l	238 m^3
July	110	72 l	237 600 l	238 m^3
August	110	72 l	245 520 l	246 m^3
September	110	72 l	237 600 l	238 m^3
October	110	72 l	245 520 l	246 m^3
November	110	72 l	237 600 l	238 m^3
December	110	72 l	245 520 l	246 m^3
YEAR	**110 (Average)**	**72 l (Average)**	**240 240 l (Total)**	**2 883 m^3 (Total)**

User - Total Demand (m^3)

	IRRIGATION DEMAND (m^3)	DOMESTIC DEMAND (m^3)	TOTAL WATER DEMAND
January	12 m^3	246 m^3	**258 m^3**
February	11 m^3	222 m^3	**233 m^3**
March	12 m^3	246 m^3	**258 m^3**
April	9 m^3	238 m^3	**247 m^3**
May	6 m^3	246 m^3	**252 m^3**
June	6 m^3	238 m^3	**244 m^3**
July	6 m^3	238 m^3	**244 m^3**
August	6 m^3	246 m^3	**252 m^3**
September	9 m^3	238 m^3	**247 m^3**
October	12 m^3	246 m^3	**258 m^3**
November	12 m^3	238 m^3	**250 m^3**
December	12 m^3	246 m^3	**258 m^3**
YEAR	115 m^3 (Total)	2 883 m^3 (Total)	**2 998 m^3 (TOTAL)**

User - Yield (m^3)

Yield (m^3) = P x A x C (Where P=precipitation (m), A=area (m^2), and C=run-off coefficient)

Area of Catchment: (Per surface)	Area (m^2)	Run-off Coefficient
Roofing	690.00 m^2	0.9
Paving	2 403.00 m^2	0.8
Veldgrass	28 234.00 m^2	0.4
Lawn	0.00 m^2	0.4
Planting	70.00 m^2	0.3
Gravel	1 671.00 m^2	0.7
Grey water	1 141.50 m^2	1
TOTAL:	**34 209.50 m^2**	0.47

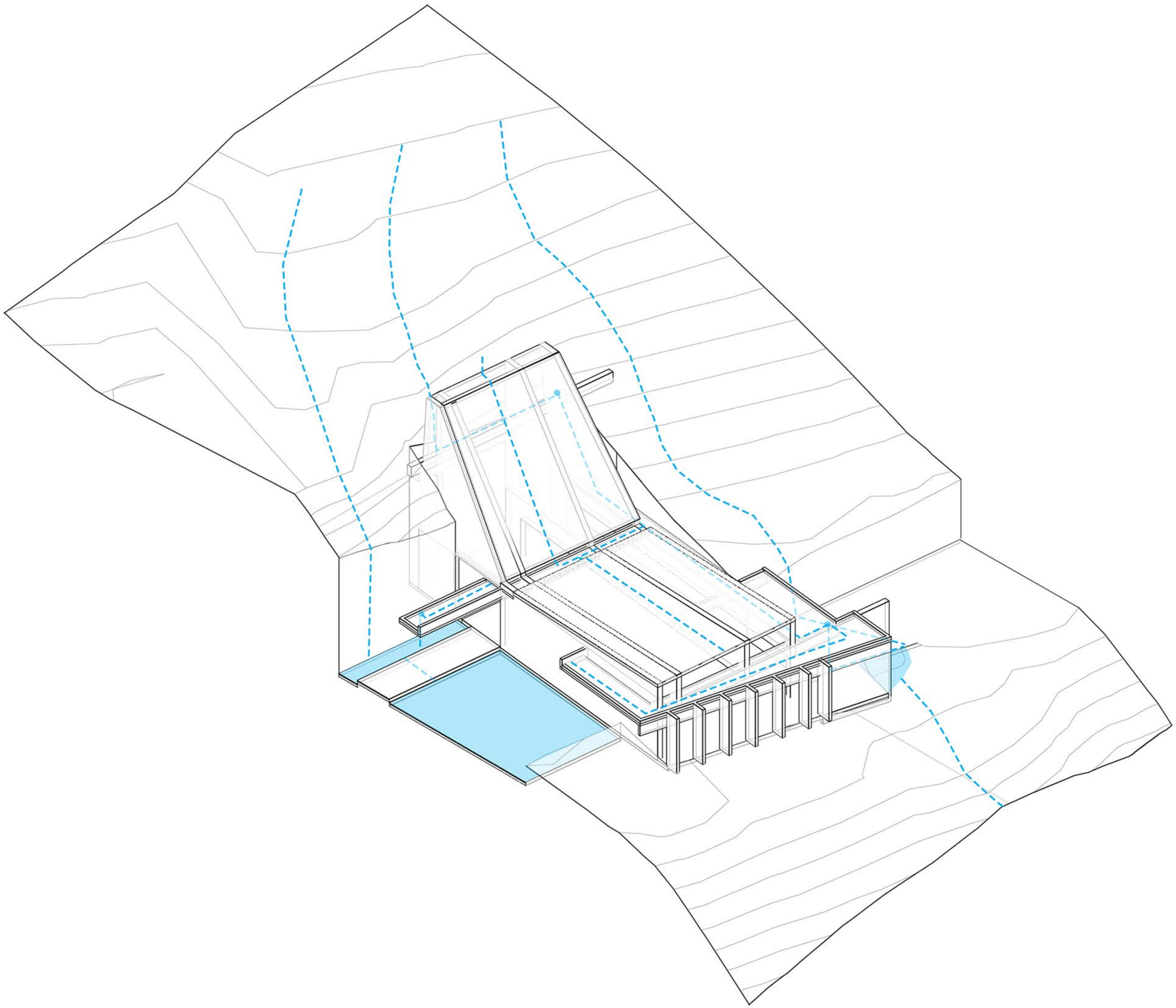
MONTH	Precipitation **Average Monthly (mm)**	Area	Run-off **Coefficient**	Yield **P(m) x A(m^2) x C**
January	105 mm	34 210 m^2	0.47	1 698 m^3
February	121 mm	34 210 m^2	0.47	1 956 m^3
March	96 mm	34 210 m^2	0.47	1 552 m^3
April	39 mm	34 210 m^2	0.47	631 m^3
May	25 mm	34 210 m^2	0.47	404 m^3
June	9 mm	34 210 m^2	0.47	146 m^3
July	3 mm	34 210 m^2	0.47	49 m^3
August	7 mm	34 210 m^2	0.47	113 m^3
September	19 mm	34 210 m^2	0.47	307 m^3
October	78 mm	34 210 m^2	0.47	1 261 m^3
November	85 mm	34 210 m^2	0.47	1 374 m^3
December	109 mm	34 210 m^2	0.47	1 762 m^3
YEAR	696 mm	**34 210 m^2**	0.47	**11 254 m^3**

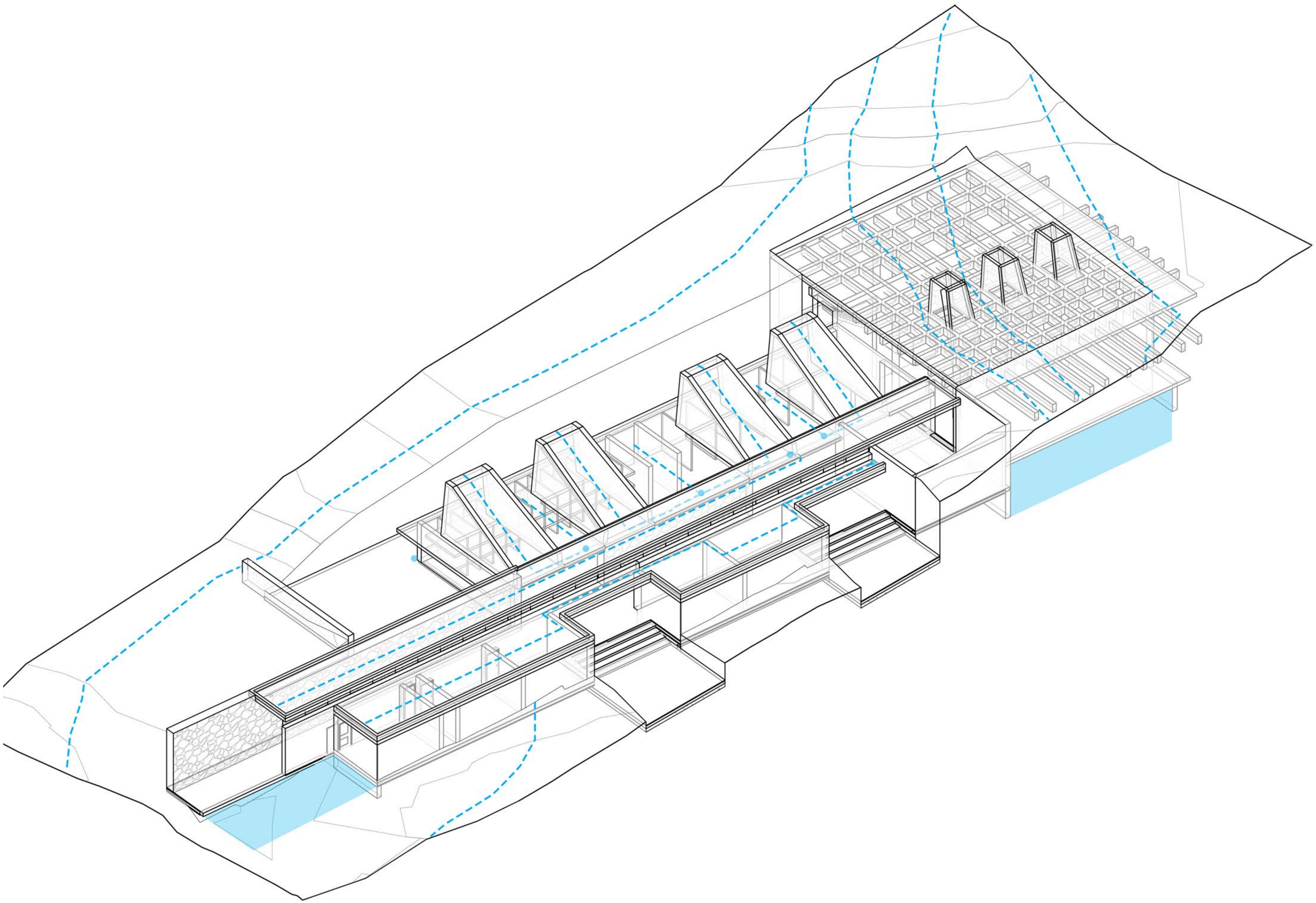
Cremation - Water Budget (m^3)

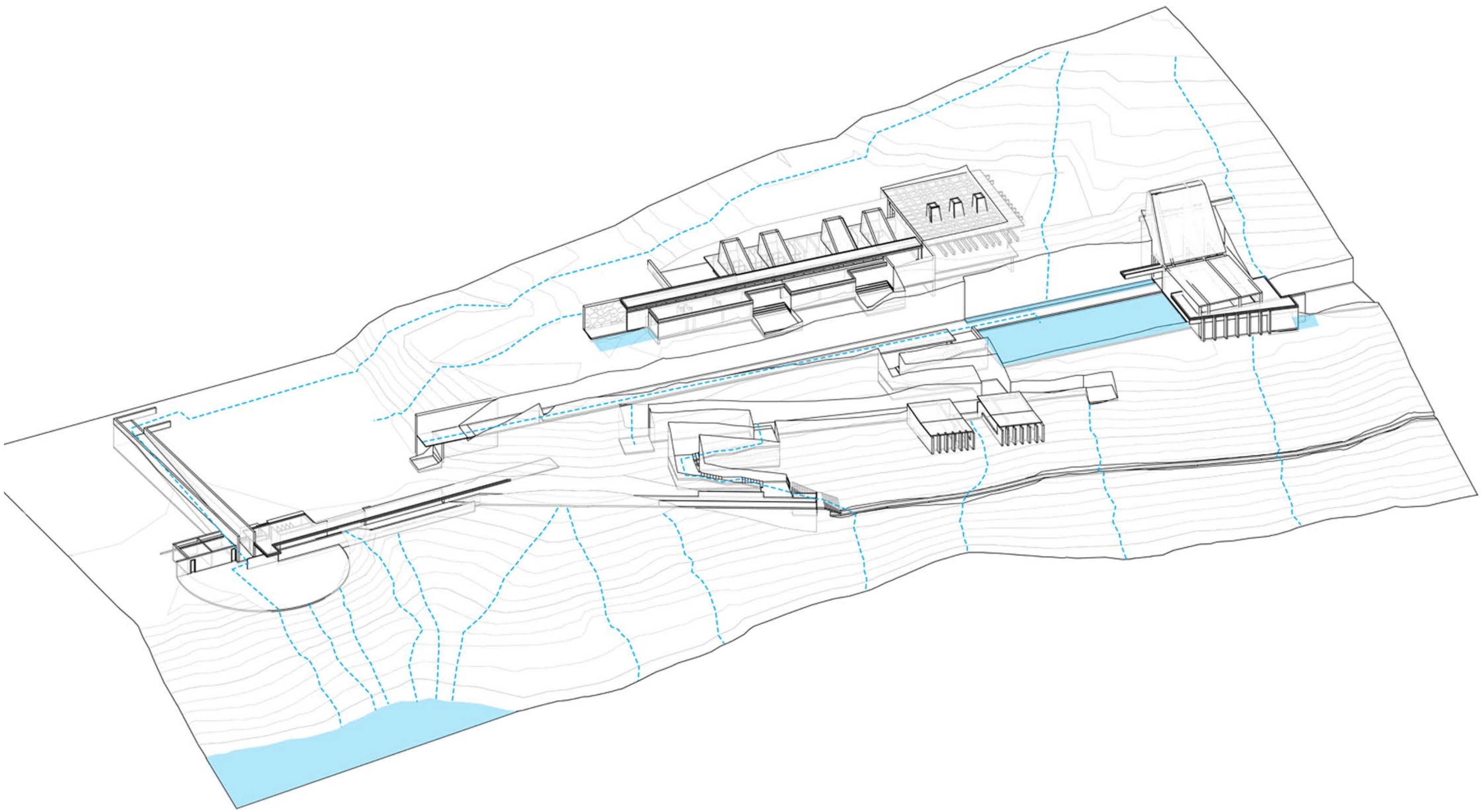
	YIELD from onsite runoff (m^3)	DEMAND total onsite water demand (m^3)	Monthly Balance	Water in Tank/Reservoir (m^3)
January	1 698 m^3	1 017 m^3	681 m^3	**1 817 m^3**
February	1 956 m^3	918 m^3	1 038 m^3	**2 855 m^3**
March	1 552 m^3	1 017 m^3	535 m^3	**3 391 m^3**
April	631 m^3	981 m^3	-3 50 m^3	**3 040 m^3**
May	404 m^3	1 011 m^3	-6 06 m^3	**2 434 m^3**
June	146 m^3	978 m^3	-8 32 m^3	**1 601 m^3**
July	49 m^3	978 m^3	-9 29 m^3	**672 m^3**
August	113 m^3	1 011 m^3	-8 97 m^3	**0 m^3**
September	307 m^3	981 m^3	-6 74 m^3	**0 m^3**
October	1 261 m^3	1 017 m^3	244 m^3	0 m^3
November	1 374 m^3	984 m^3	390 m^3	**390 m^3**
December	1 762 m^3	1 017 m^3	746 m^3	**1 136 m^3**
YEAR	**23 163 m^3 (Total)**	**11 909 m^3 (TOTAL)**		
Greatest volume of water in tank/reservoir at any time is the minimum capacity of the tank				**3 391 m^3**
Safety Factor:	1	**Final Tank/Reservoir Size:**		**3 391 m^3**

User - Water Budget (m^3)

	YIELD from onsite runoff (m^3)	DEMAND total onsite water demand (m^3)	Monthly Balance	Water in Tank/Reservoir (m^3)
January	1 698 m^3	258 m^3	1 440 m^3	**4 069 m^3**
February	1 956 m^3	233 m^3	1 724 m^3	**5 793 m^3**
March	1 552 m^3	258 m^3	1 294 m^3	**7 087 m^3**
April	631 m^3	247 m^3	384 m^3	**7 471 m^3**
May	404 m^3	252 m^3	153 m^3	**7 623 m^3**
June	146 m^3	244 m^3	- 98 m^3	**7 525 m^3**
July	49 m^3	244 m^3	-1 95 m^3	**7 330 m^3**
August	113 m^3	252 m^3	-1 39 m^3	**7 192 m^3**
September	307 m^3	247 m^3	61 m^3	**7 252 m^3**
October	1 261 m^3	258 m^3	1 003 m^3	0 m^3
November	1 374 m^3	250 m^3	1 125 m^3	**1 125 m^3**
December	1 762 m^3	258 m^3	1 505 m^3	**2 629 m^3**
YEAR	**14 252 m^3 (Total)**	**2 998 m^3 (TOTAL)**		
Greatest volume of water in tank/reservoir at any time is the minimum capacity of the tank				**7 623 m^3**
Safety Factor:	1	**Final Tank/Reservoir Size:**		**7 623 m^3**

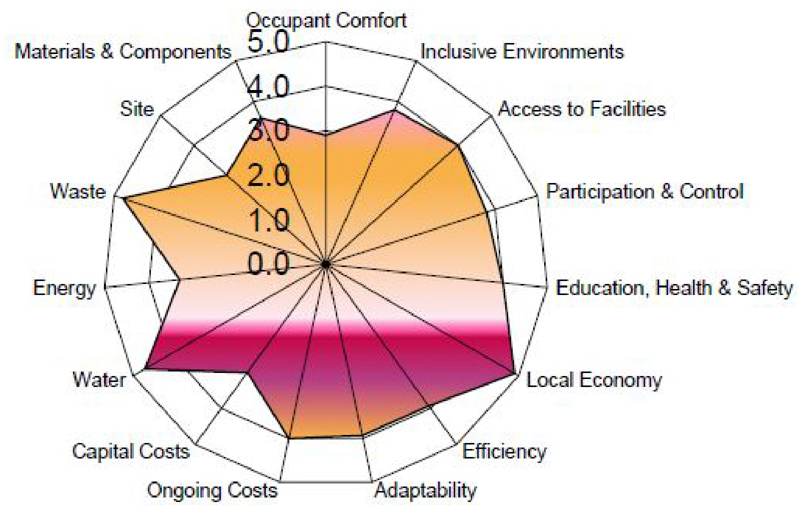






Sustainable Building Assessment Tool (SBAT- P)

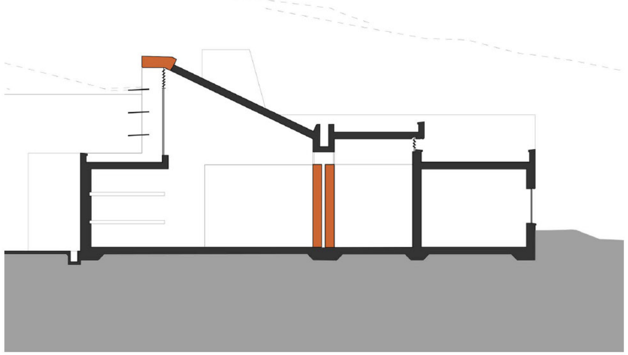
PROJECT		ASSESSMENT	
Project title:	Death of the Cemetery	Date:	10/8/2013
Location:	Johannesburg, Obersevatory Ridge	Undertaken by:	Erwin Struwig
Building type:	Crematorium, Cemetery, Park	Company / organisation:	UP Boukundie
Internal area (m2):	2672	Telephone:	Fax:
Number of users:	110	Email:	



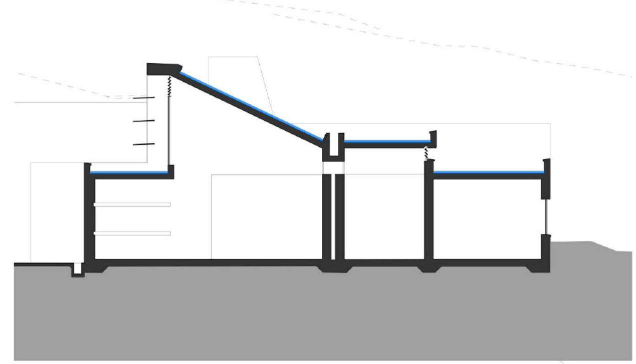
Social	3.7	Economic	4.0	Environmental	3.9
Overall	3.8	Classification			

Mortuary environmetal Diagram

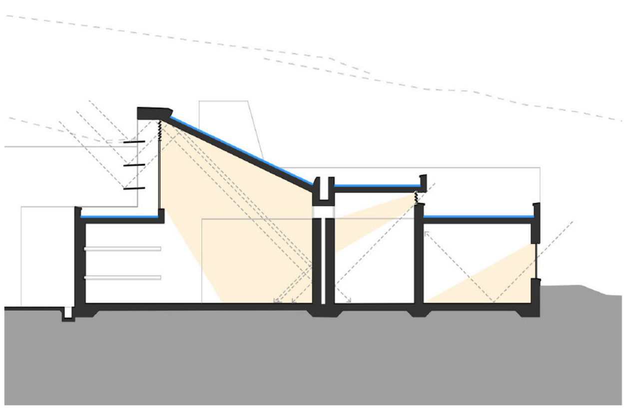
MORTUARY MASSING



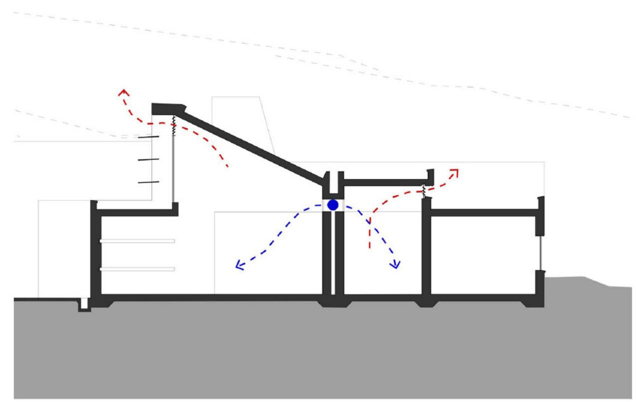
MORTUARY INSULATION



MORTUARY LIGHT

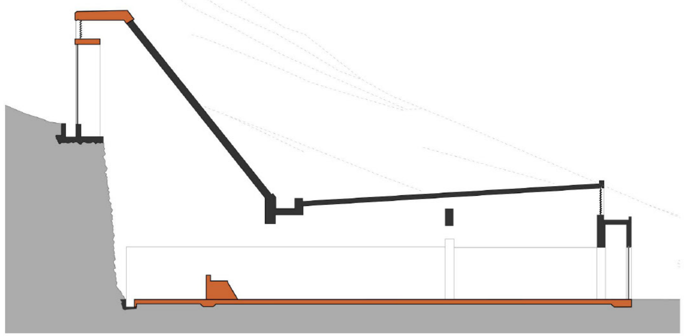


MORTUARY VENTILATION

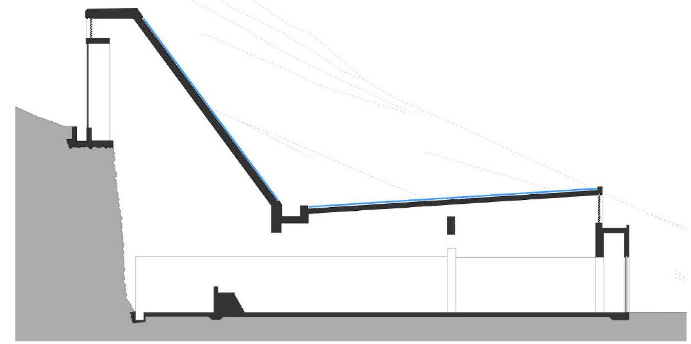


Chapel environmetal Diagram

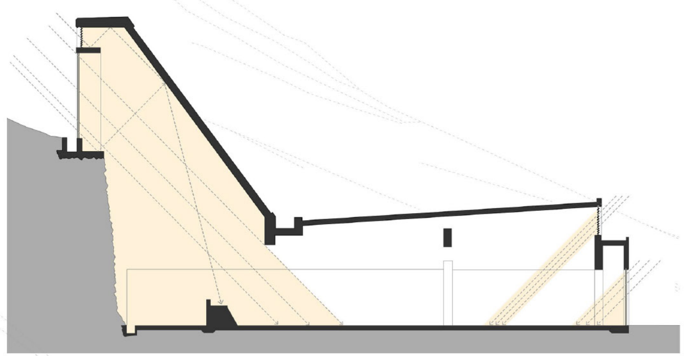
CHAPEL MASSING



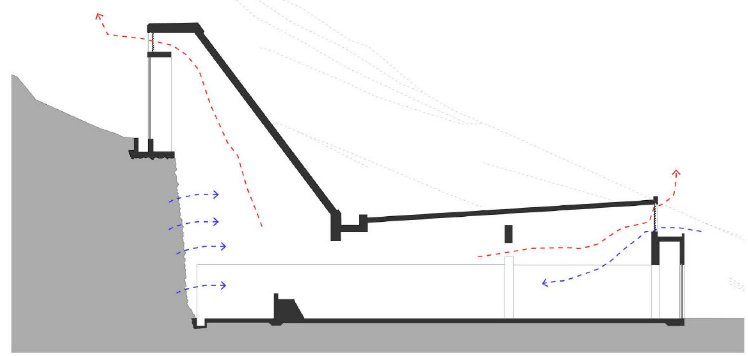
MORTUARY INSULATION



CHAPEL LIGHT



CHAPEL VENTILATION



System Design Focus – Water

The following section deals with the technical process of the design. It illustrates a series of development sketches. The process is an ongoing one, therefore none of the following diagrams or drawings are final and should be seen as iterations working toward a final set of drawings that will be presented in the examination.

These drawings also aid in creating a clearer understanding of the route towards the final drawings.

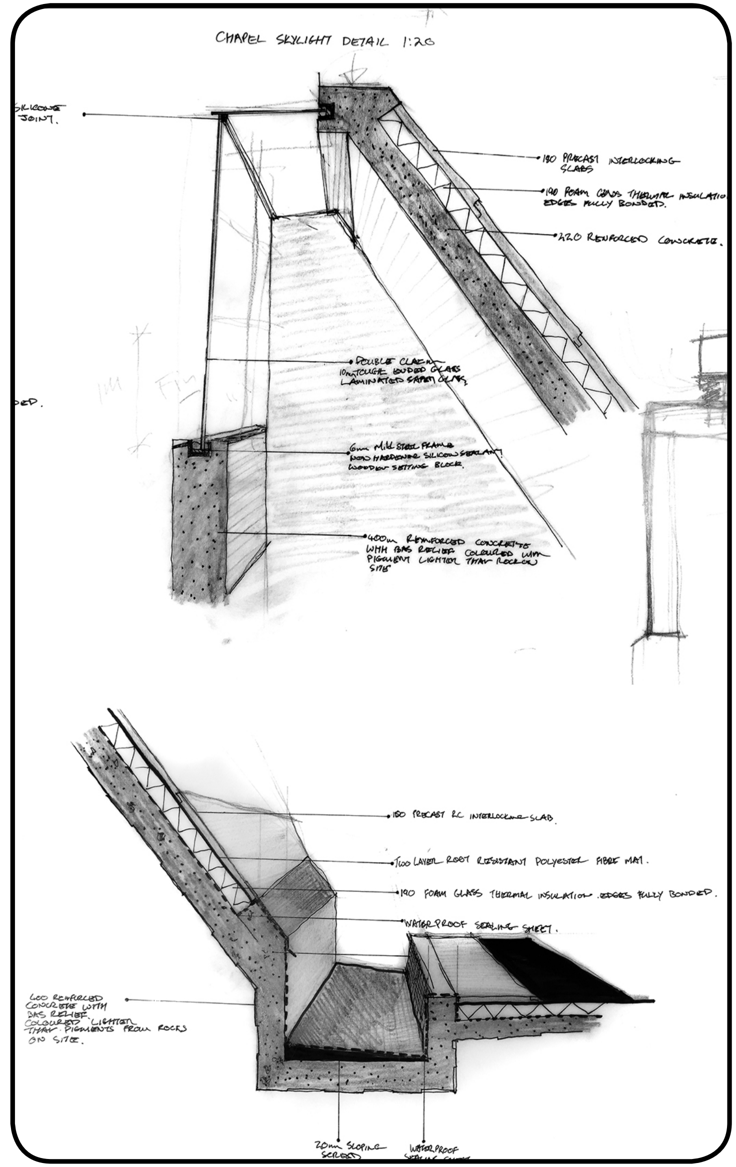


fig 11.4. Sketches illustrating detail iteration of chapel skylight and gutter system NTS. (by Author, 2015)

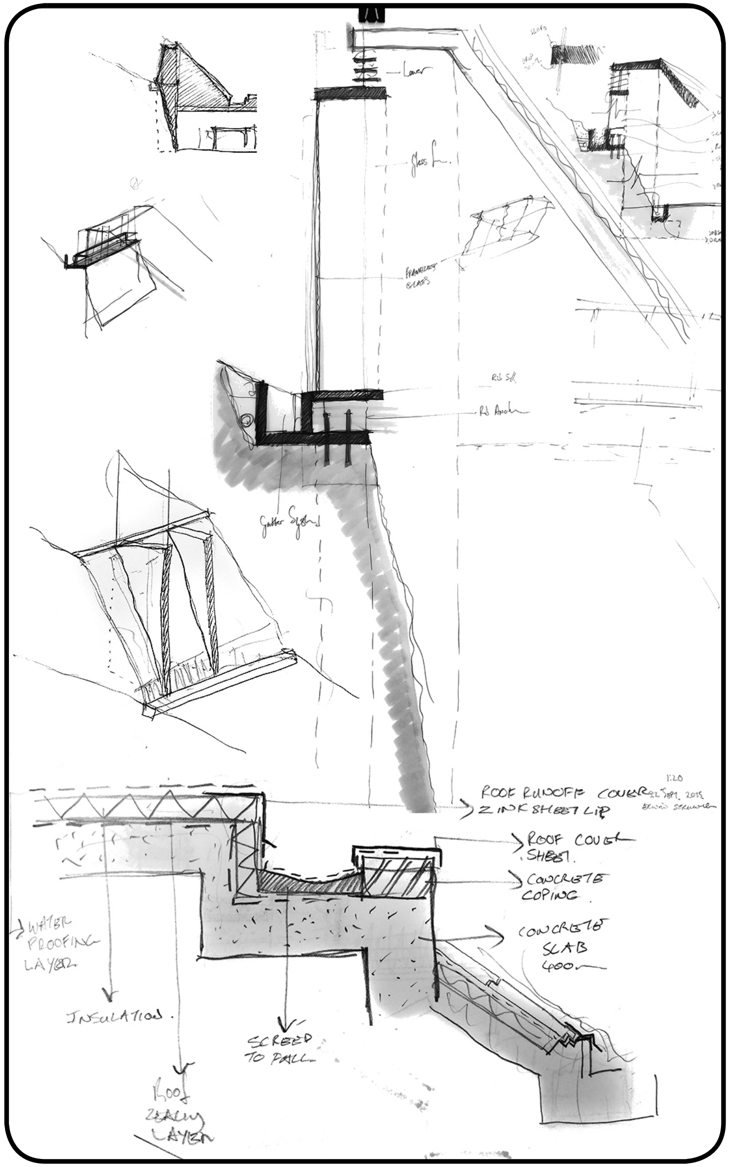


fig 11.5. Sketches illustrating detail iteration of chapel skylight and gutter system NTS. (by Author, 2015)

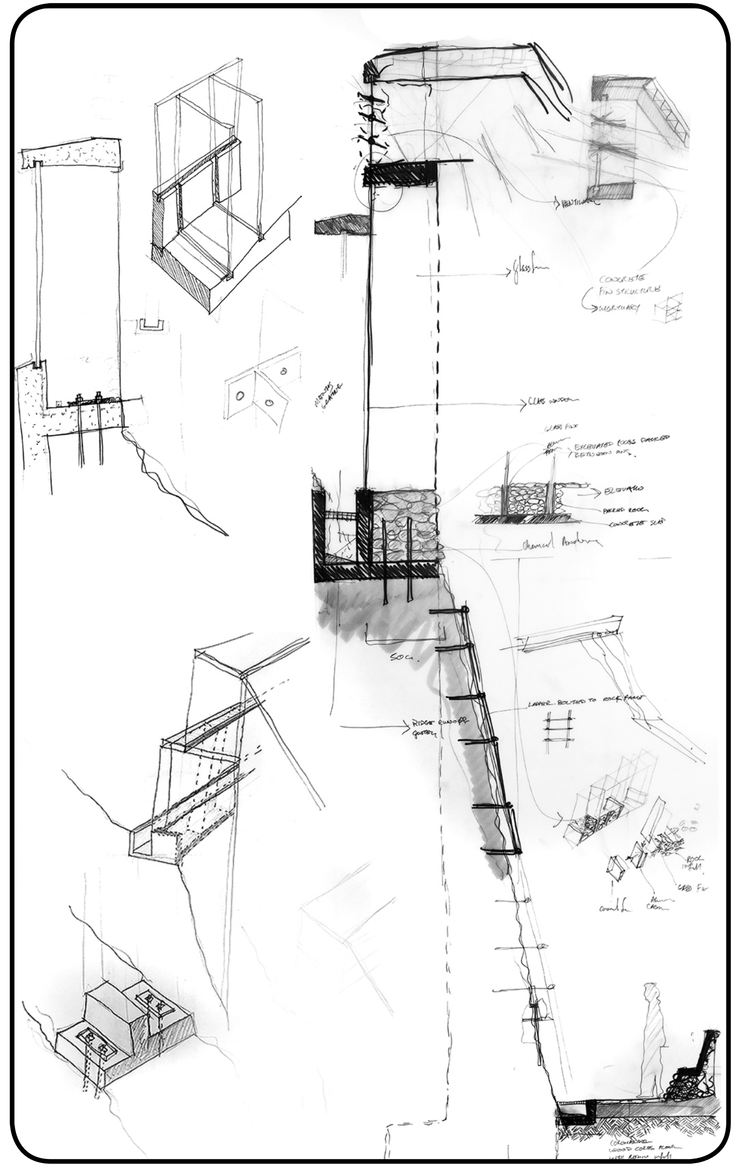
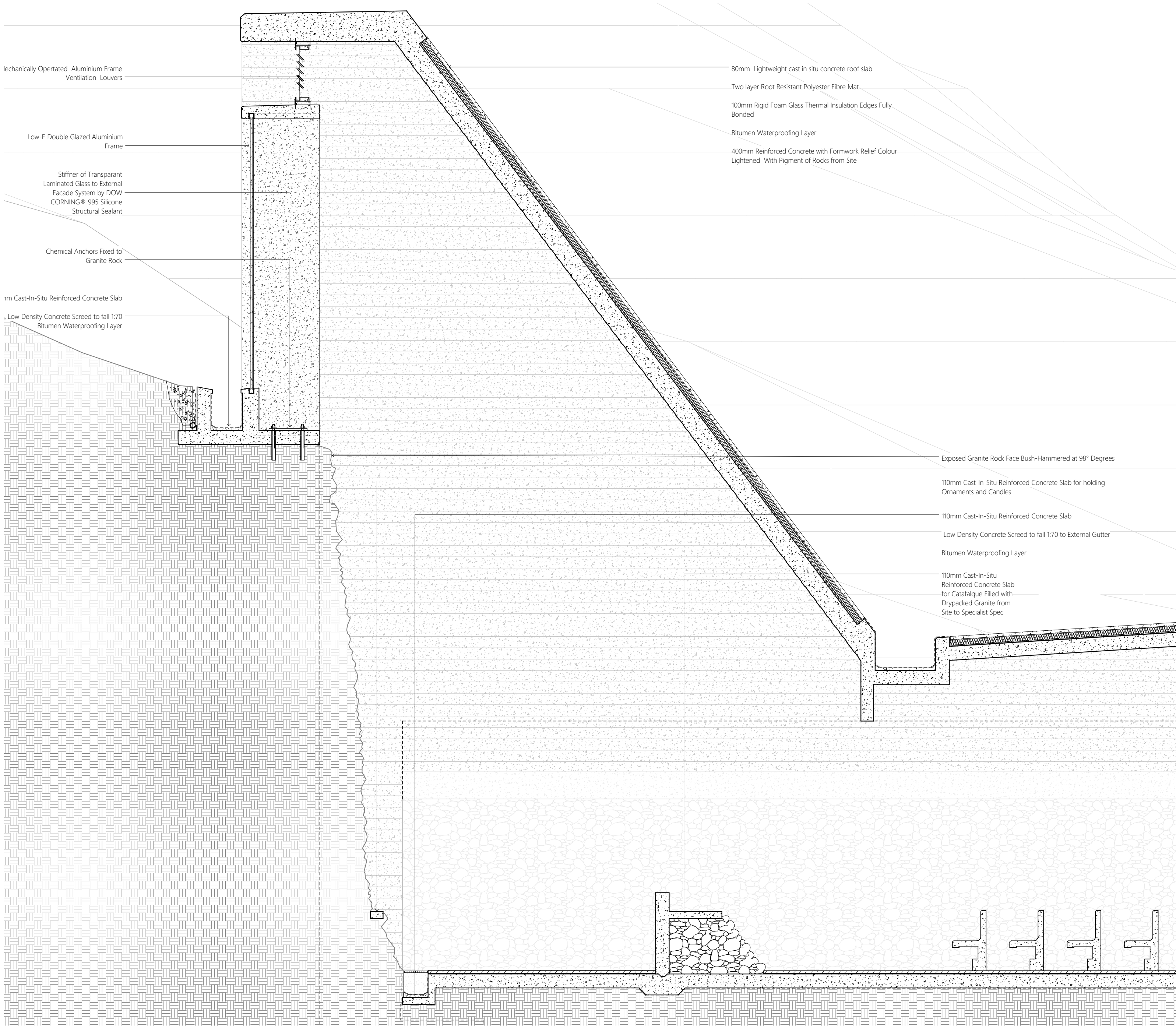
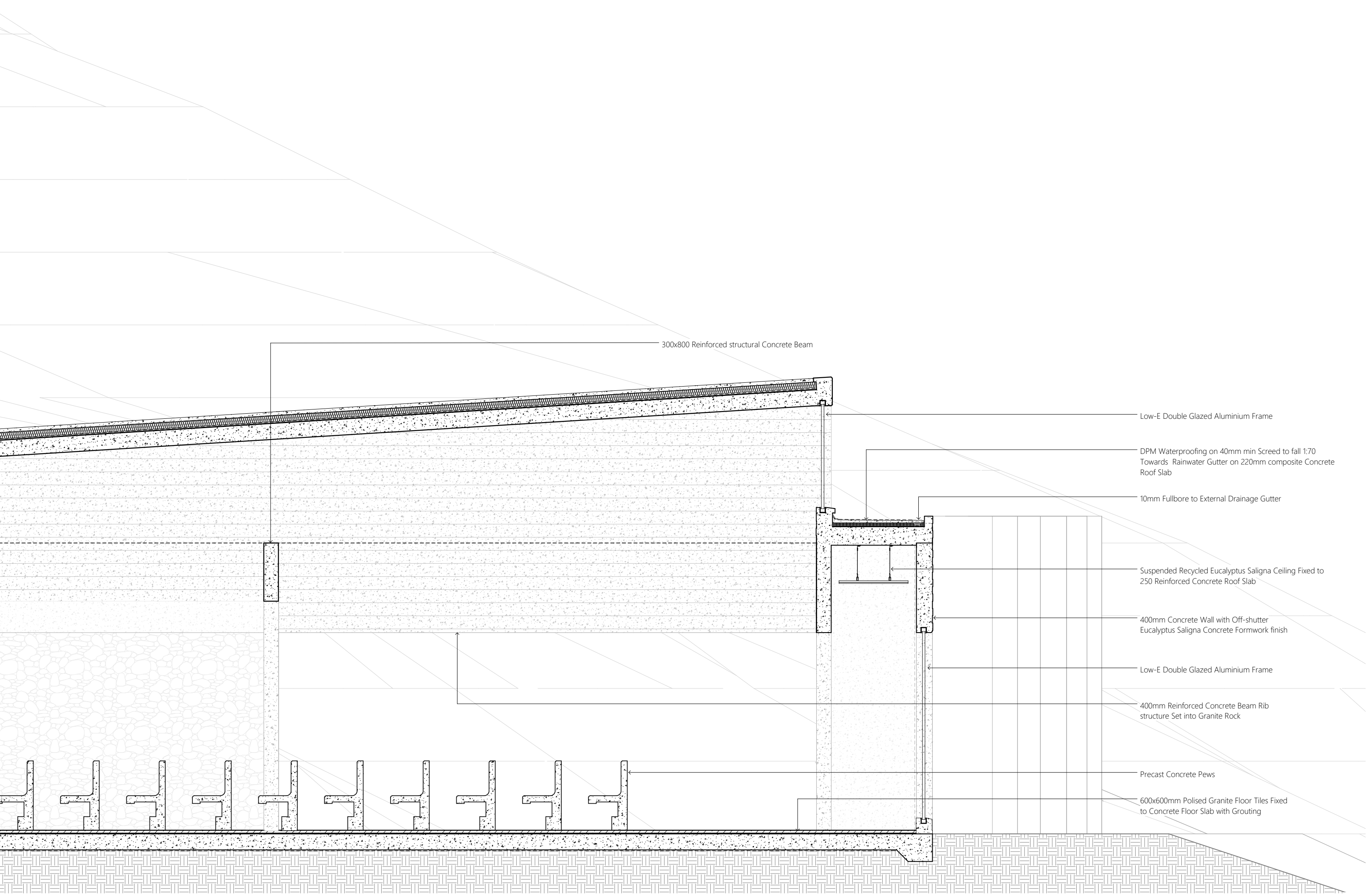


fig 11.6. Sketches illustrating detail iteration of chapel skylight, fixing to rock, and structural glazing method NTS. (by Author, 2015)

Chapel Section - Development




300x800 Reinforced structural Concrete Beam
Low-E Double Glazed Aluminium Frame
DPM Waterproofing on 40mm min Screed to fall 1:70 Towards Rainwater Gutter on 220mm composite Concrete Roof Slab
10mm Fullbore to External Drainage Gutter
Suspended Recycled Eucalyptus Saligna Ceiling Fixed to 250 Reinforced Concrete Roof Slab
400mm Concrete Wall with Off-shutter Eucalyptus Saligna Concrete Formwork finish
Low-E Double Glazed Aluminium Frame
400mm Reinforced Concrete Beam Rib structure Set into Granite Rock
Precast Concrete Pews
600x600mm Polised Granite Floor Tiles Fixed to Concrete Floor Slab with Grouting

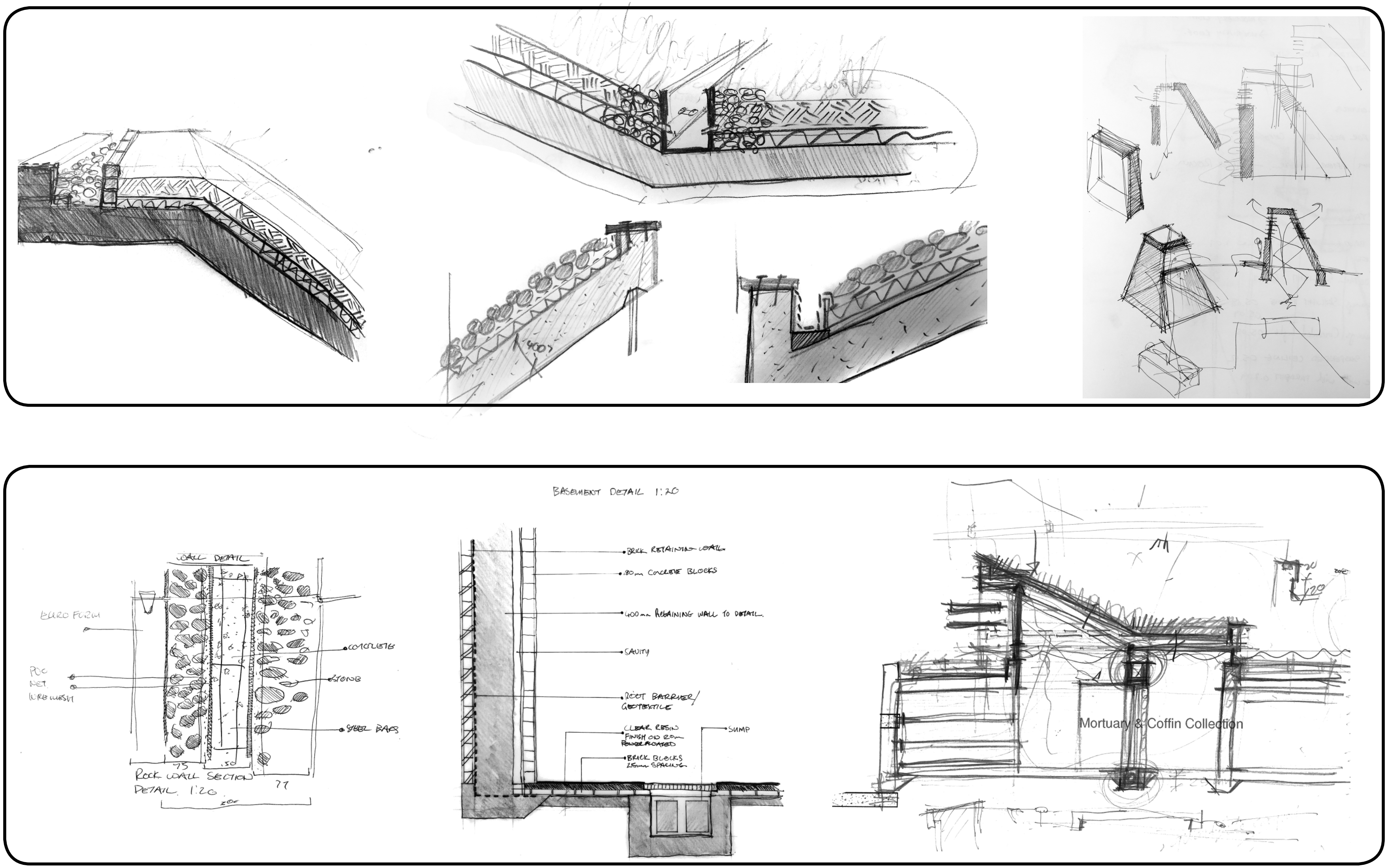
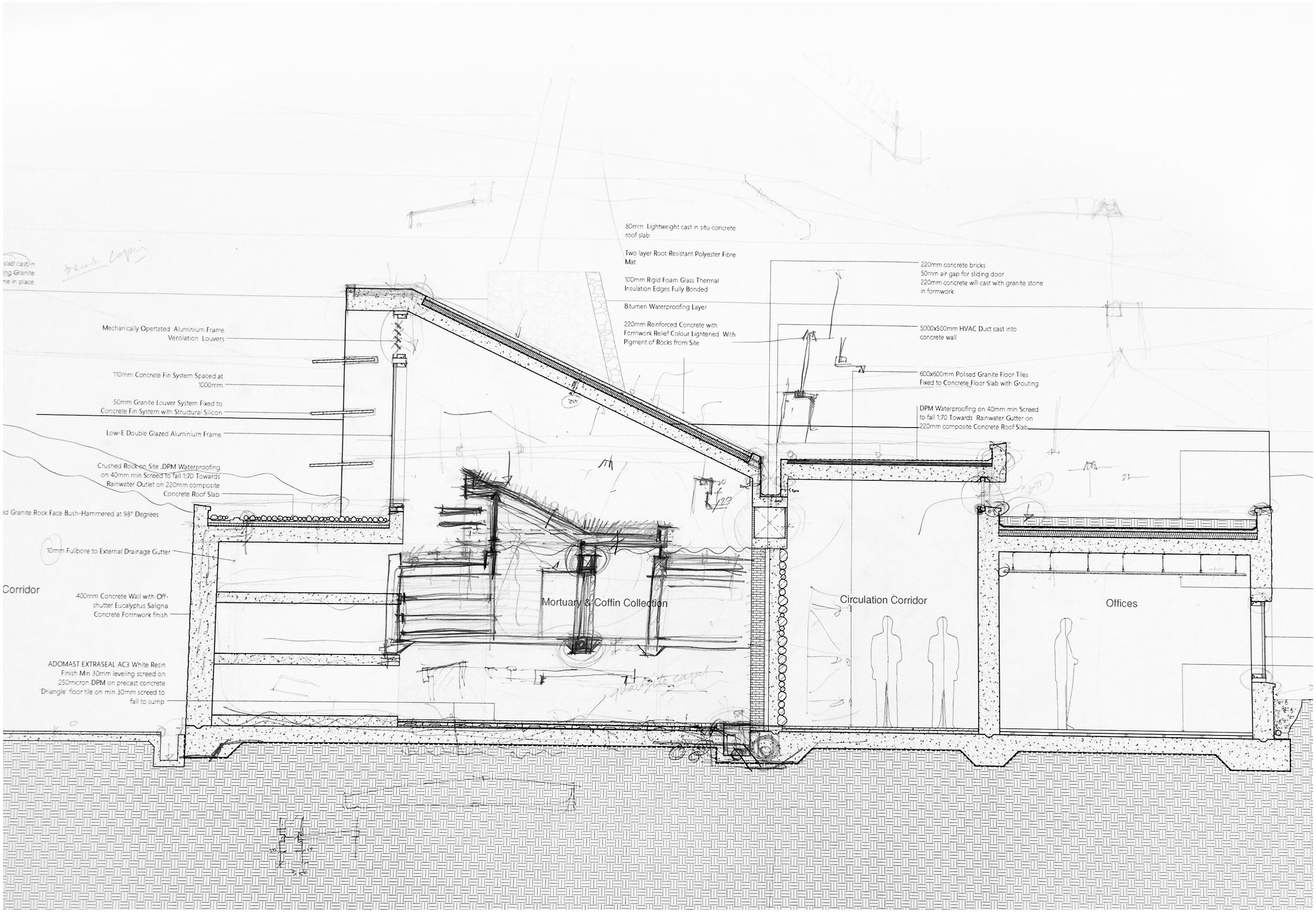
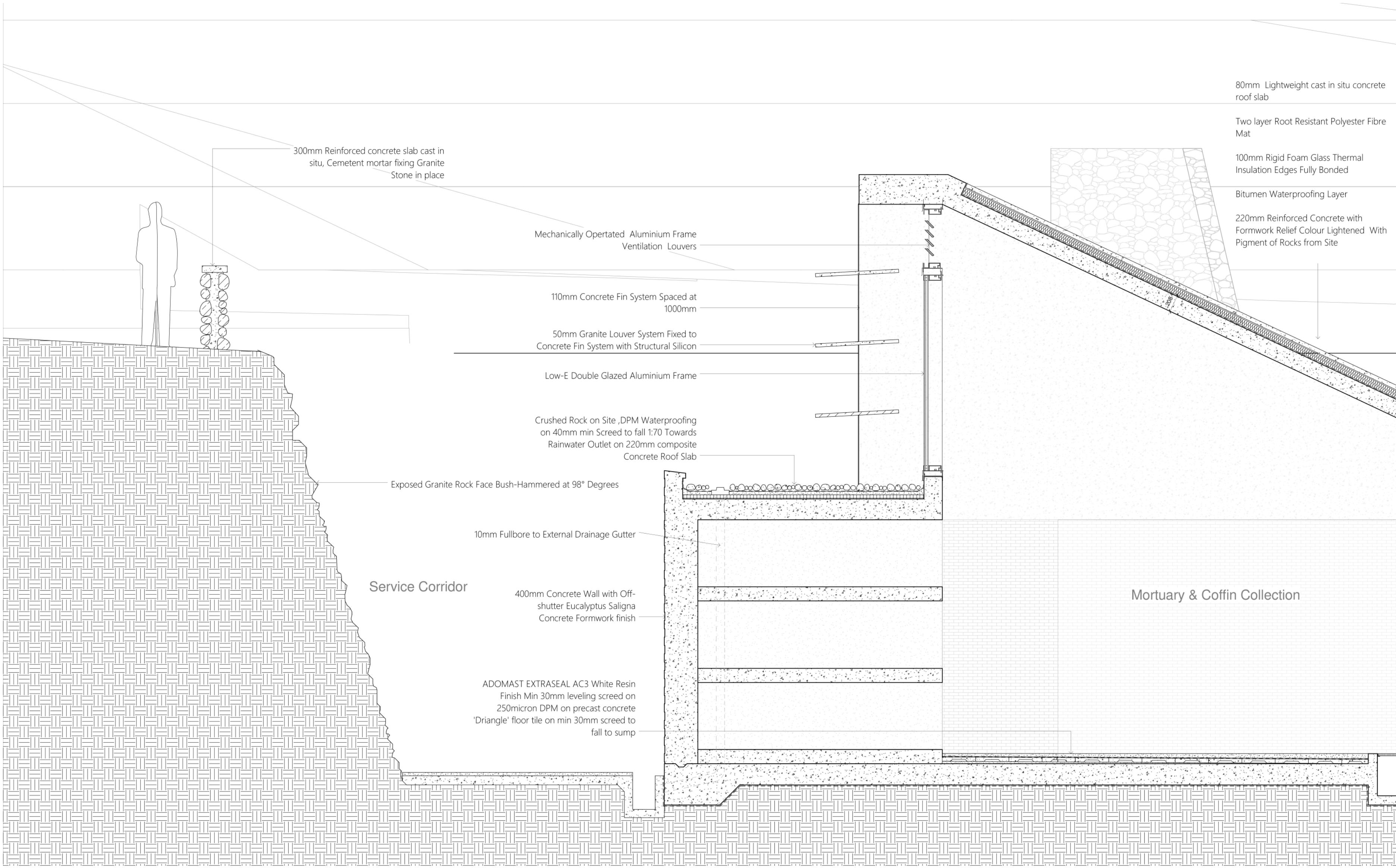
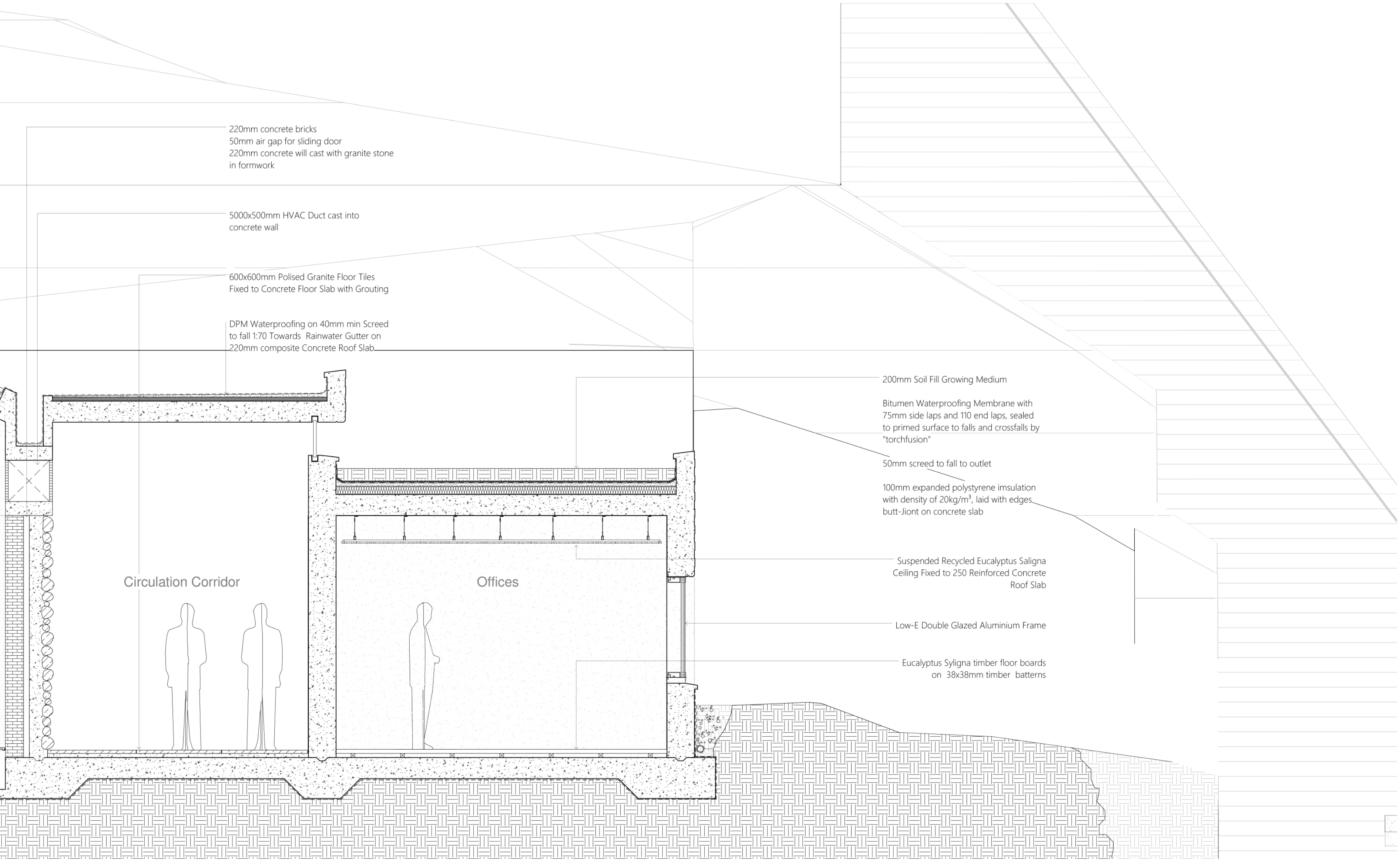


fig 11.7. Sketches illustrating the iterative process of Mortuary section development. (by Author, 2015)

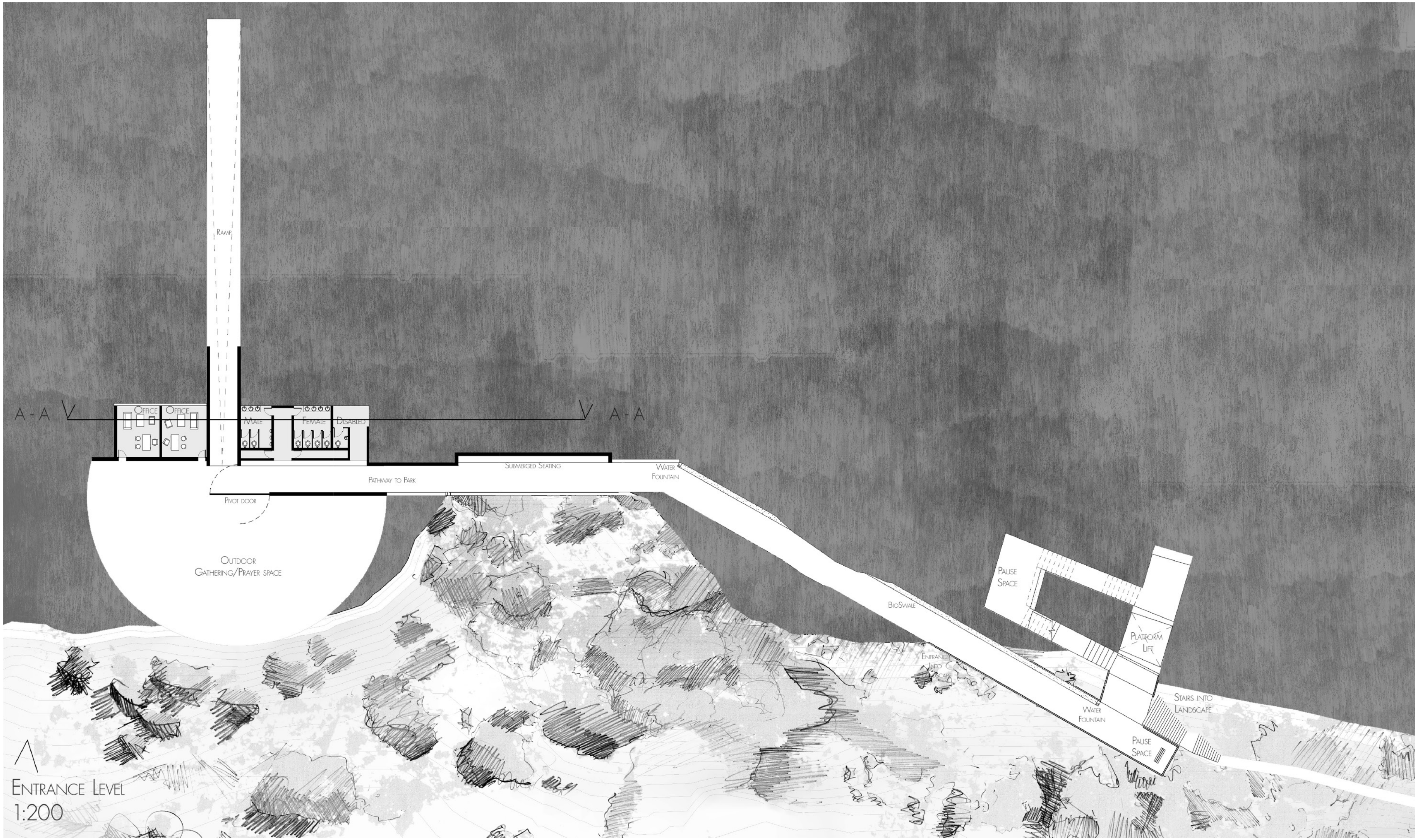

80mm Lightweight cast in situ concrete roof slab
Two layer Root Resistant Polyester Fibre Mat
100mm Rigid Foam Glass Thermal Insulation Edges Fully Bonded
Bitumen Waterproofing Layer
220mm Reinforced Concrete with Formwork Relief Colour Lightened With Pigment of Rocks from Site
220mm concrete bricks
50mm air gap for sliding door
220mm concrete will cast with granite stone in formwork
5000x500mm HVAC Duct cast into concrete wall
600x600mm Polised Granite Floor Tiles Fixed to Concrete Floor Slab with Grouting
DPM Waterproofing on 40mm min Screed to fall 1:70 Towards Rainwater Gutter on 220mm composite Concrete Roof Slab
Mechanically Opertated Aluminium Frame Ventilation Louvers
110mm Concrete Fin System Spaced at 1000mm
50mm Granite Louver System Fixed to Concrete Fin System with Structural Silicon
Low-E Double Glazed Aluminium Frame
Crushed Rock on Site ,DPM Waterproofing on 40mm min Screed to fall 1:70 Towards Rainwater Outlet on 220mm composite Concrete Roof Slab
Granite Rock Face Bush-Hammered at 98° Degrees
10mm Fullbore to External Drainage Gutter
Corridor
400mm Concrete Wall with Off-shutter Eucalyptus Saligna Concrete Formwork finish
ADOMAST EXTRASEAL AC3 White Resin Finish Min 30mm leveling screed on 250micron DPM on precast concrete 'Driangle' floor tile on min 30mm screed to fall to sump
Mortuary & Coffin Collection
Circulation Corridor
Offices

Mortuary Section - Development

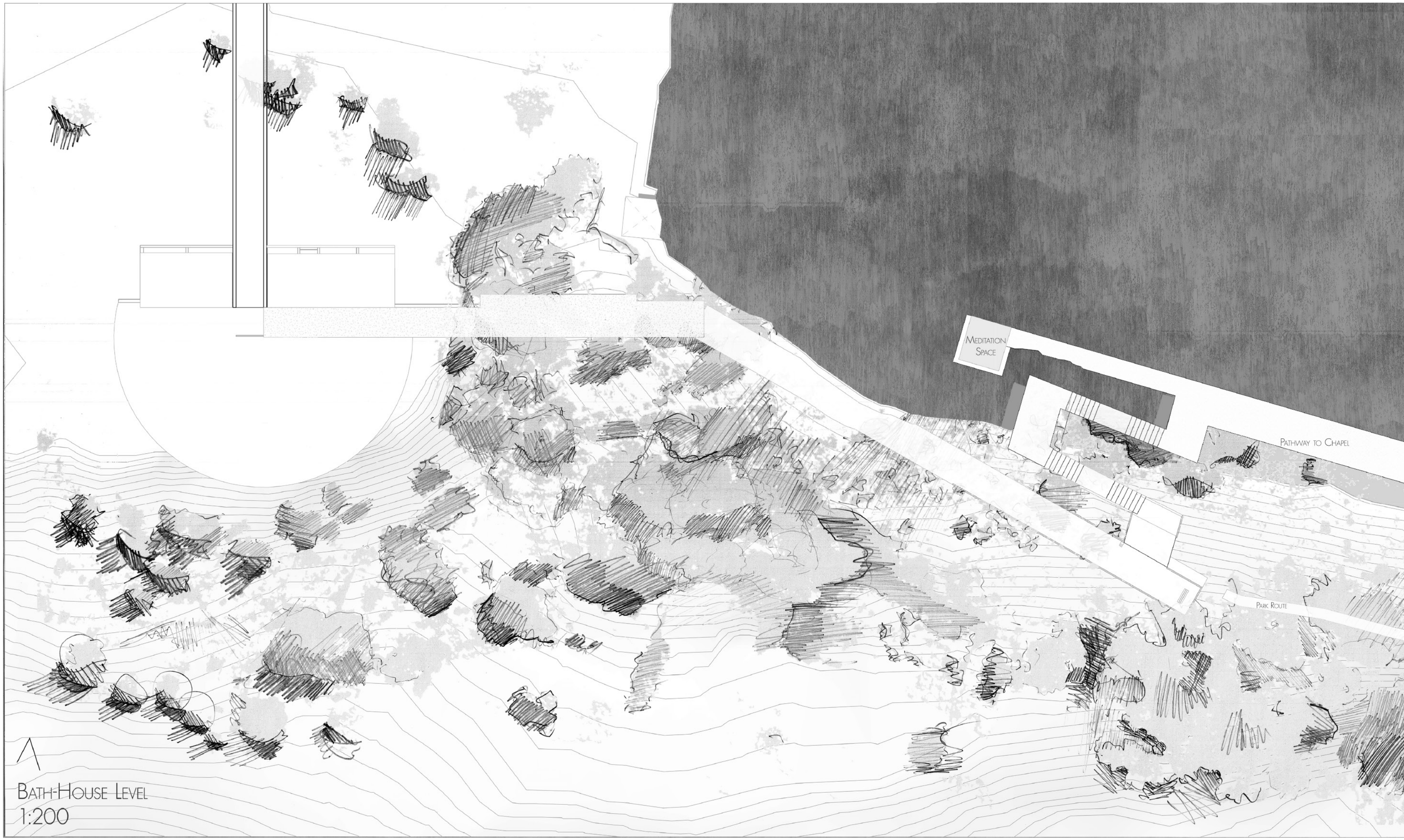



220mm concrete bricks
50mm air gap for sliding door
220mm concrete will cast with granite stone
in formwork
5000x500mm HVAC Duct cast into
concrete wall
600x600mm Polised Granite Floor Tiles
Fixed to Concrete Floor Slab with Grouting
DPM Waterproofing on 40mm min Screed
to fall 1:70 Towards Rainwater Gutter on
220mm composite Concrete Roof Slab
200mm Soil Fill Growing Medium
Bitumen Waterproofing Membrane with
75mm side laps and 110 end laps, sealed
to primed surface to falls and crossfalls by
"torchfusion"
50mm screed to fall to outlet
100mm expanded polystyrene insulation
with density of 20kg/m³, laid with edges
butt-Jiont on concrete slab
Suspended Recycled Eucalyptus Saligna
Ceiling Fixed to 250 Reinforced Concrete
Roof Slab
Low-E Double Glazed Aluminium Frame
Eucalyptus Syligna timber floor boards
on 38x38mm timber batterns
Circulation Corridor
Offices

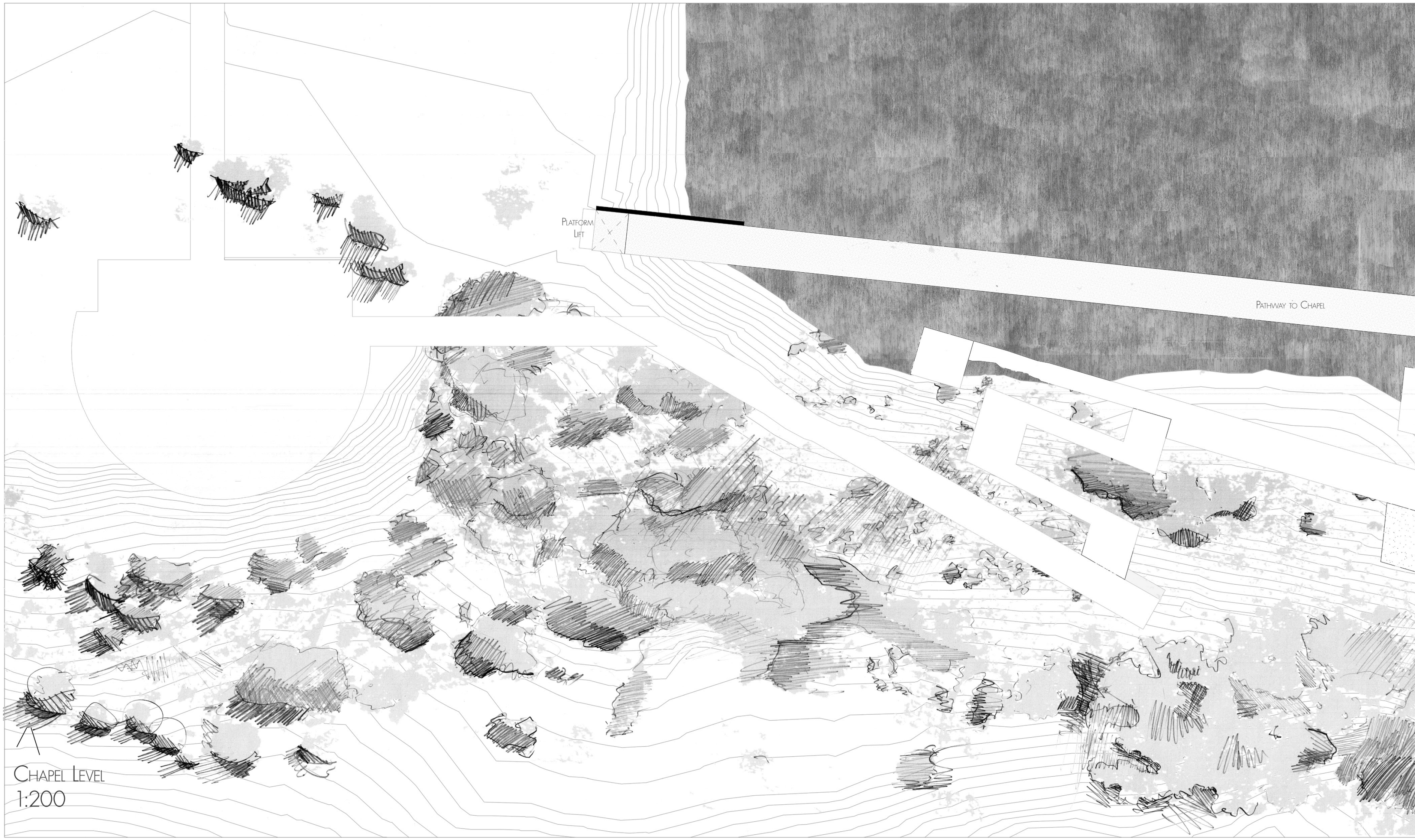
Final Technical Drawings

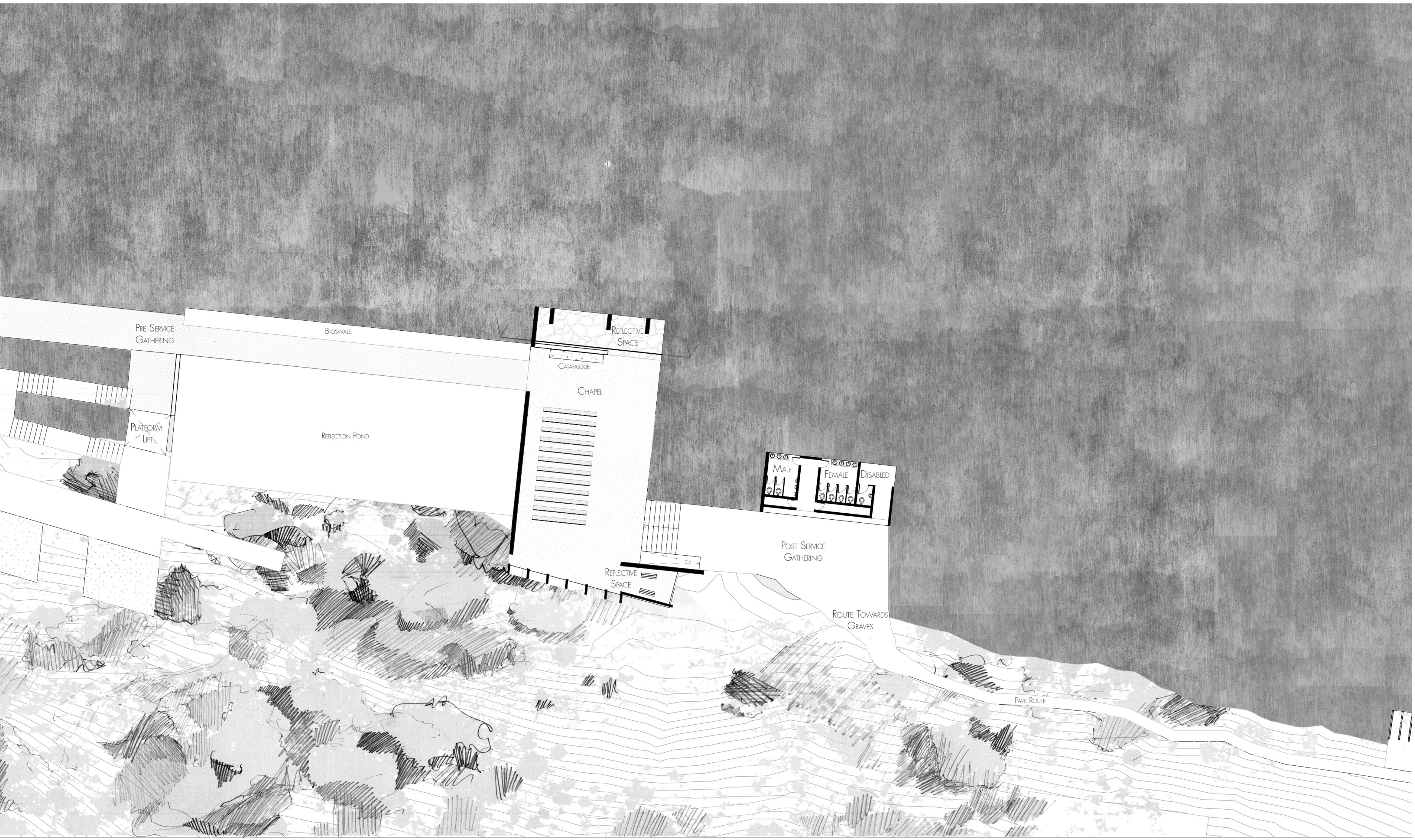


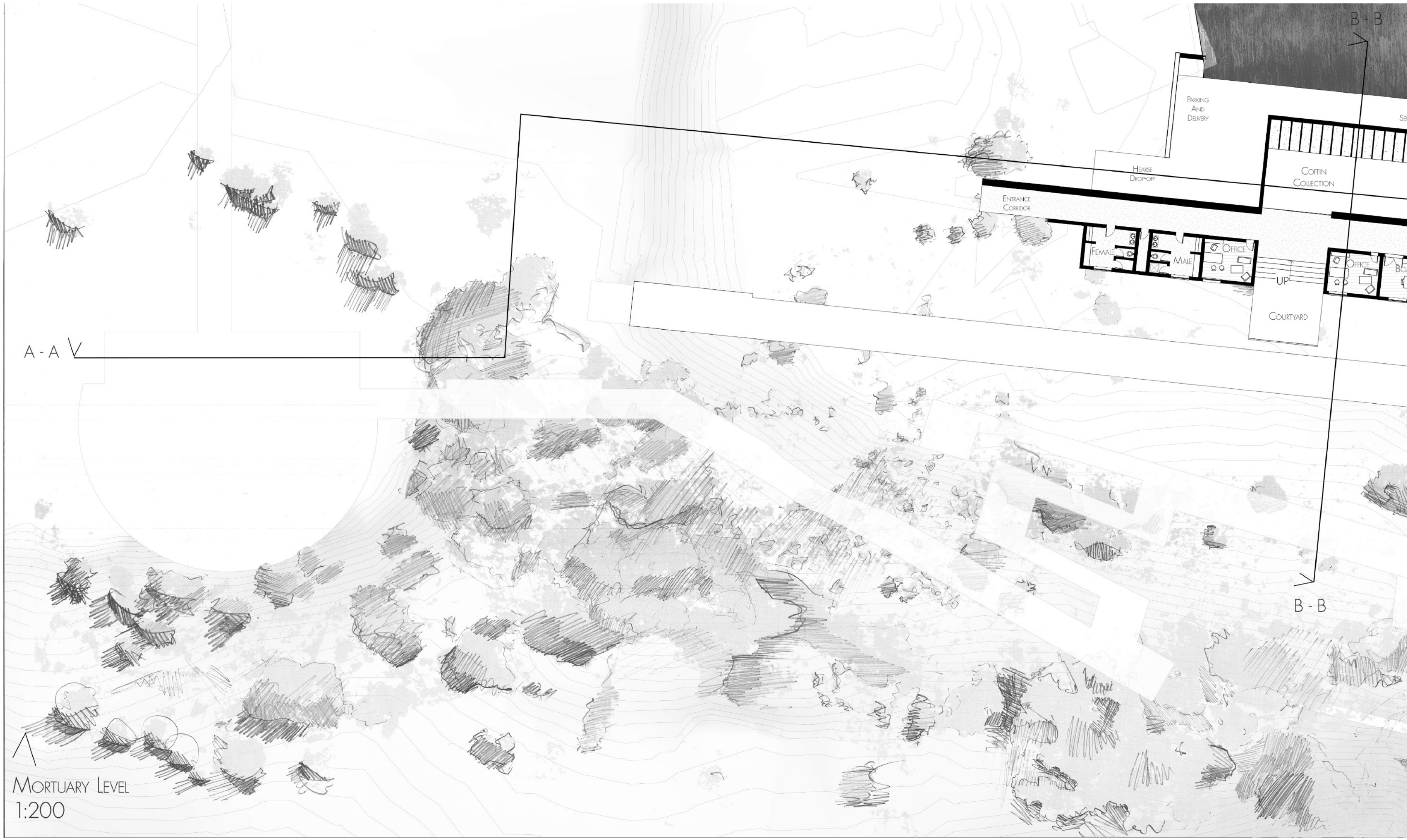

Park Route


Meditation Space
Pathway to Chapel
Park Route
Bath-House Level
1:200


Catafalque
Mortuary
Bathhouse
Catafalque
Mortuary
Bathhouse
Meditation
Space


Platform Lift
Pathway to Chapel
Chapel Level
1:200

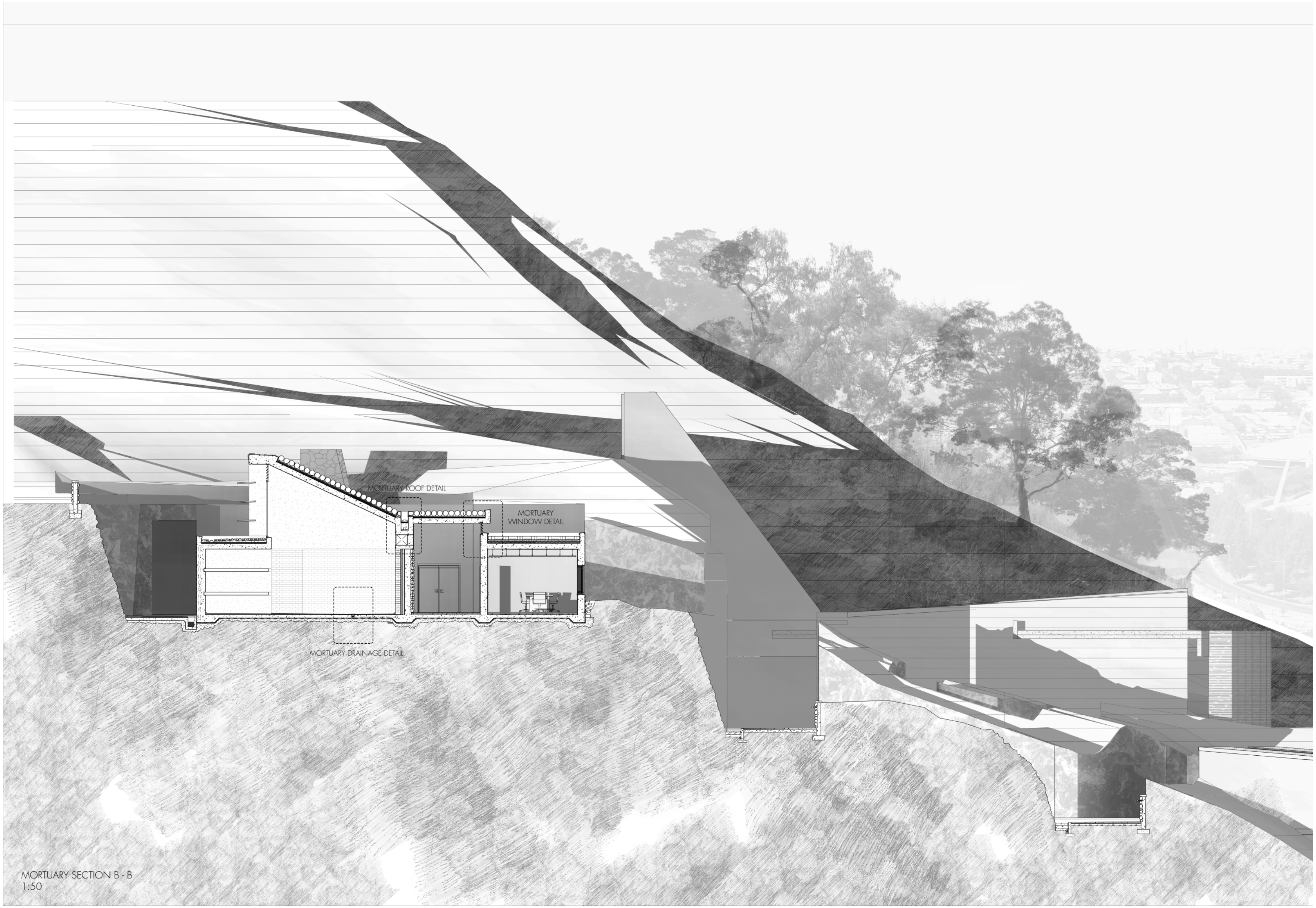

Pre Service
Gathering
Bioswale
Reflective
Space
Catafaique
Chapel
Platform
Lift
Reflection Pond
Male
Female
Disabled
Post Service
Gathering
Reflective
Space
Route Towards
Graves
Park Route

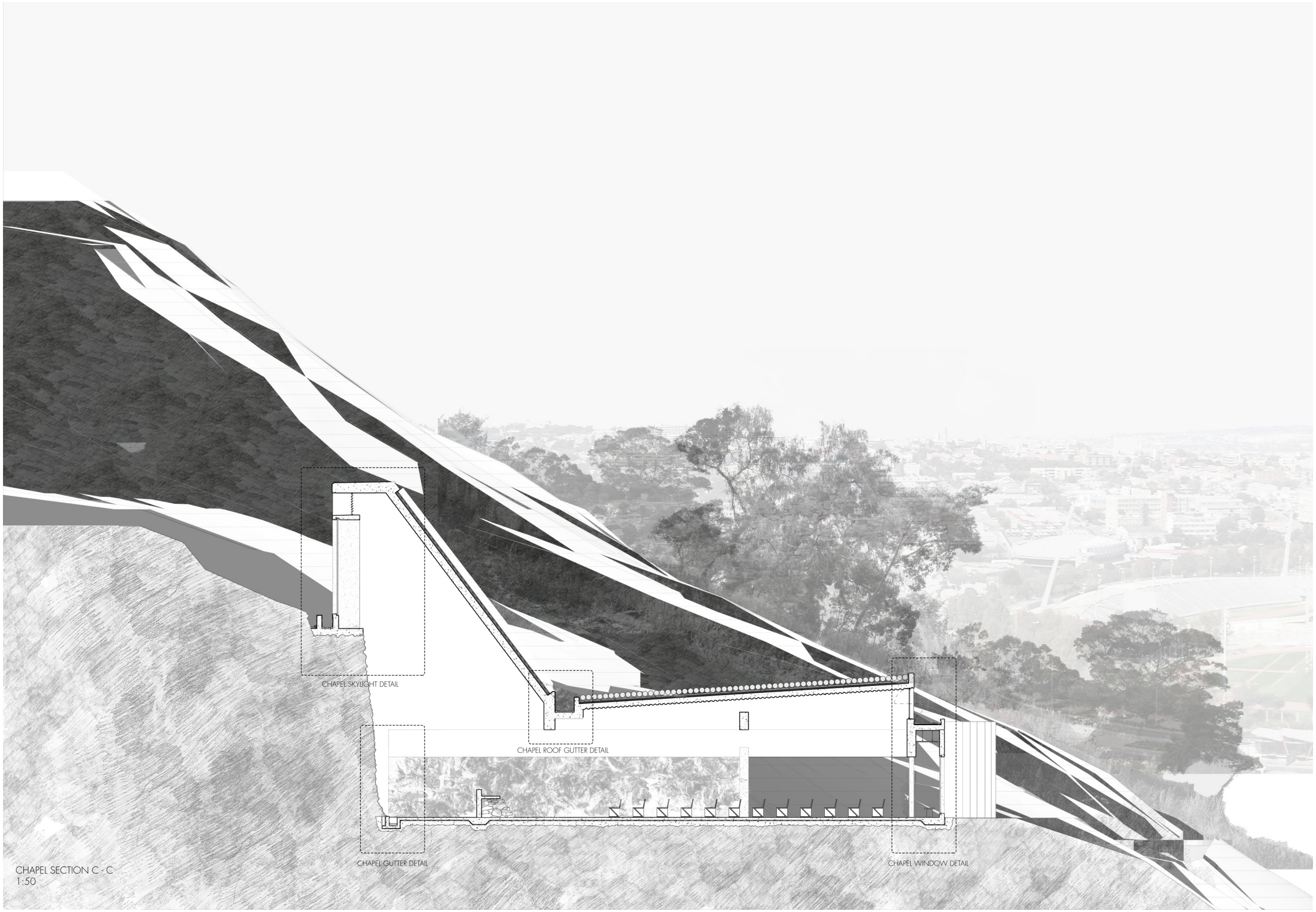

B - B
Parking And Delivery
Hearse Drop-off
Coffin Collection
Entrance Corridor
Female
Male
Office
UP
Office
Courtyard
A - A
B - B
Mortuary Level
1:200


Post Cremation
Effluence Tanks
Water and Chemical
Storage
Service
Room
Mortuary
BioCremators
Catafalque
Waiting Area
Viewing Area
Courtyard
A-A

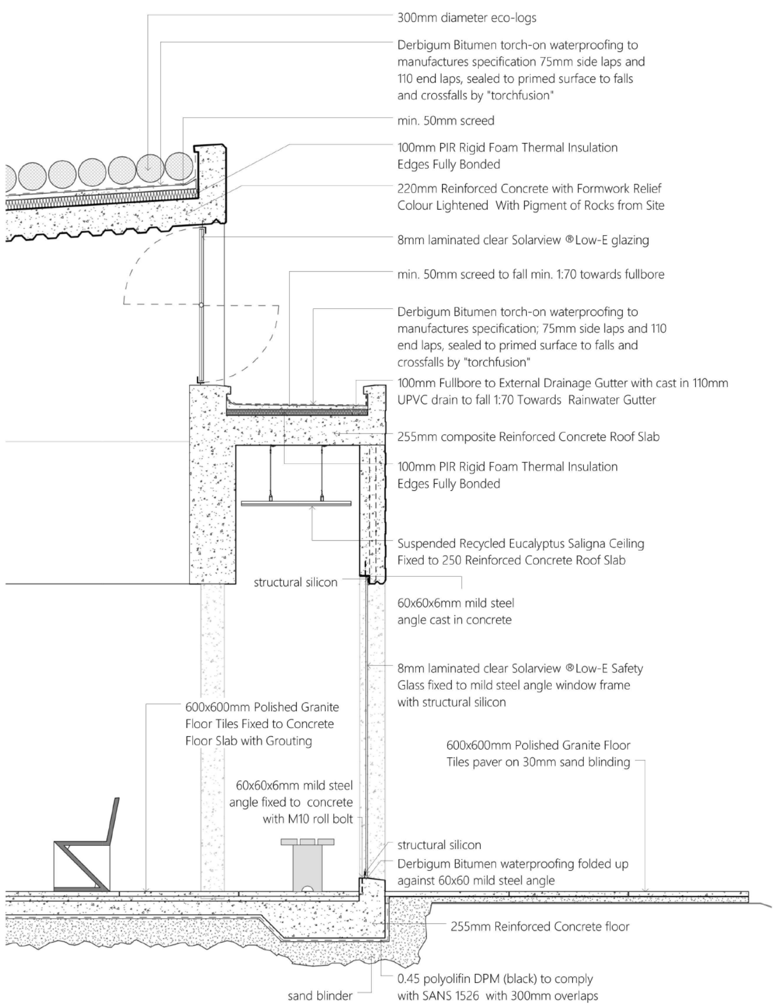

OFFICE
OFFICE
WALKWAY
MALE
FEMALE
DISABLED

VENTILTORS
&
LIGHT SHAFTS
ROOF GARDEN
HEARSE DROP-OFF
COFFIN COLLECTION
PREPERATION
MORTUARY
STORAGE
BIO CREMATORS
CREMATORIUM DETAIL
CHEMICAL STORAGE
&
WATER TREATMENT
REFLECTIVE SPACE
CATAFALQUE

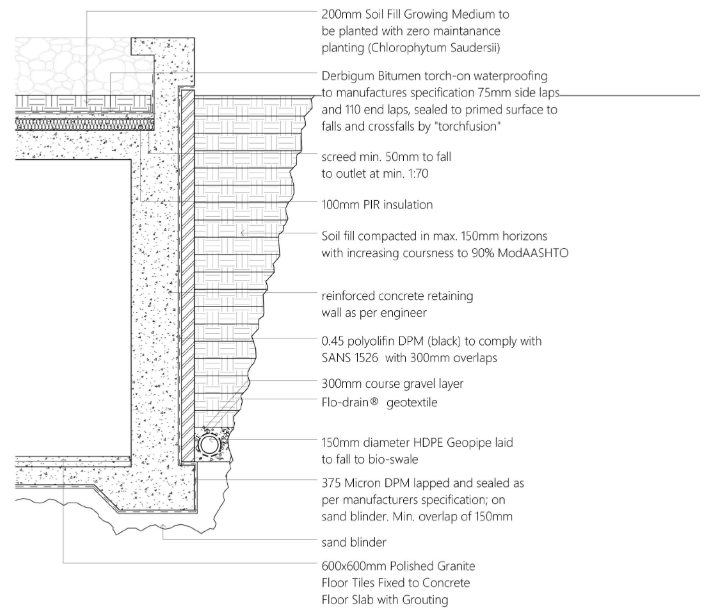

MORTUARY ROOF DETAIL
MORTUARY WINDOW DETAIL
MORTUARY DRAINAGE DETAIL
MORTUARY SECTION B - B
1:50


CHAPEL SKYLIGHT DETAIL
CHAPEL ROOF GUTTER DETAIL
CHAPEL GUTTER DETAIL
CHAPEL WINDOW DETAIL
CHAPEL SECTION C - C
1:50

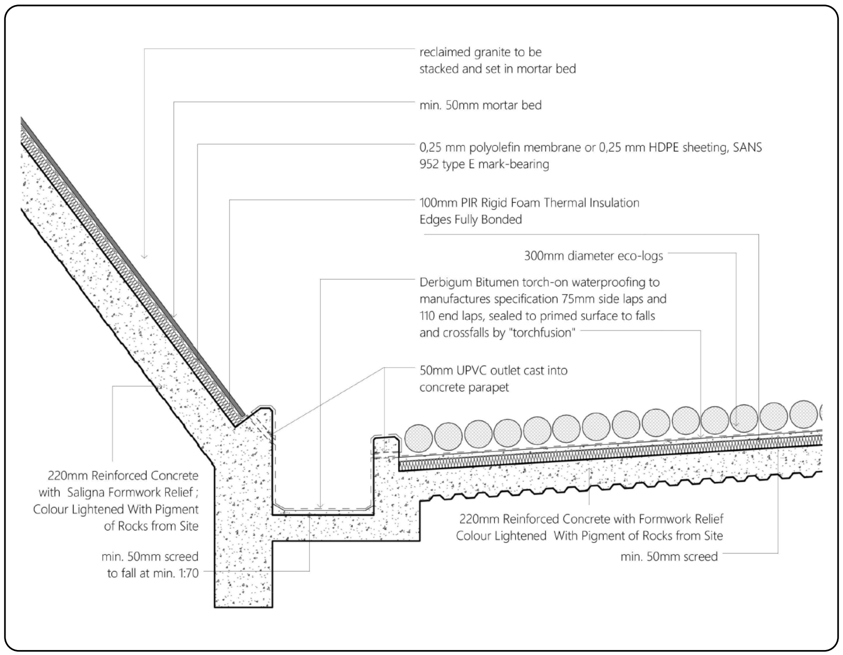
CHAPEL FACADE DETAIL
1:20



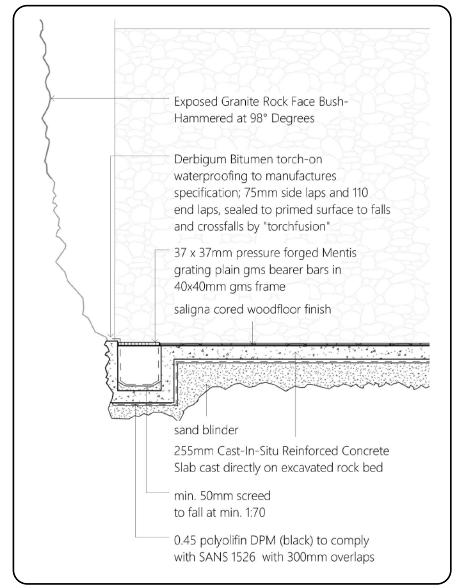
ENTRANCE BASEMENT DETAIL
1:20



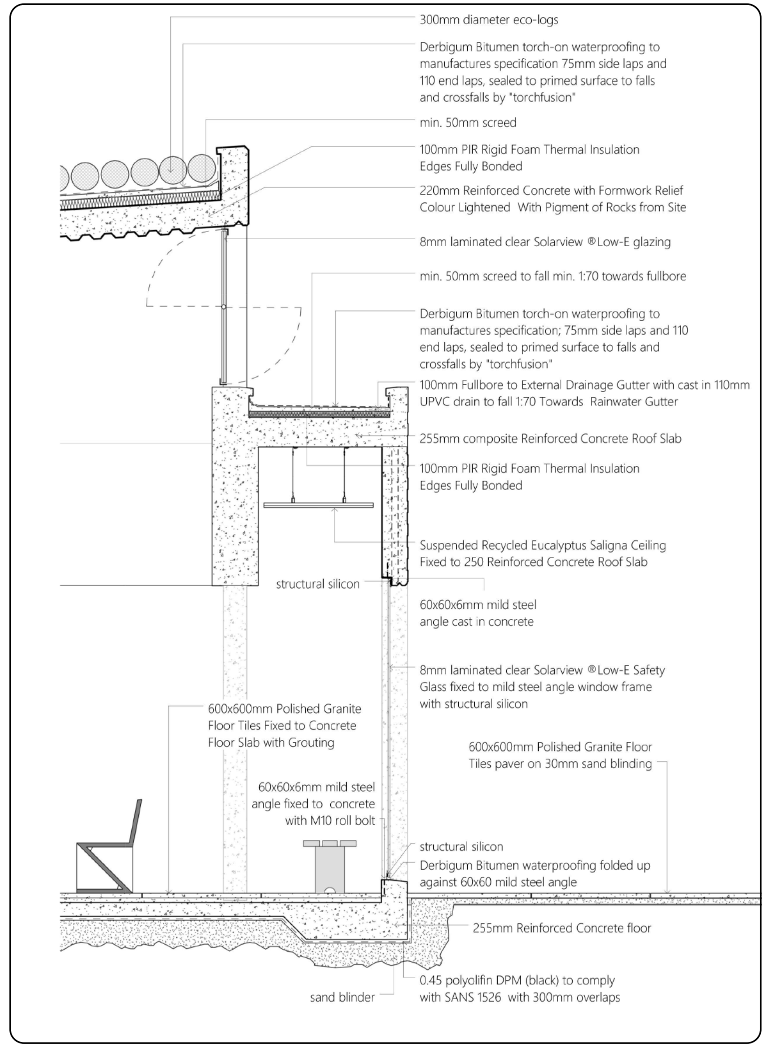
CHAPEL ROOF GUTTER DETAIL
1:20



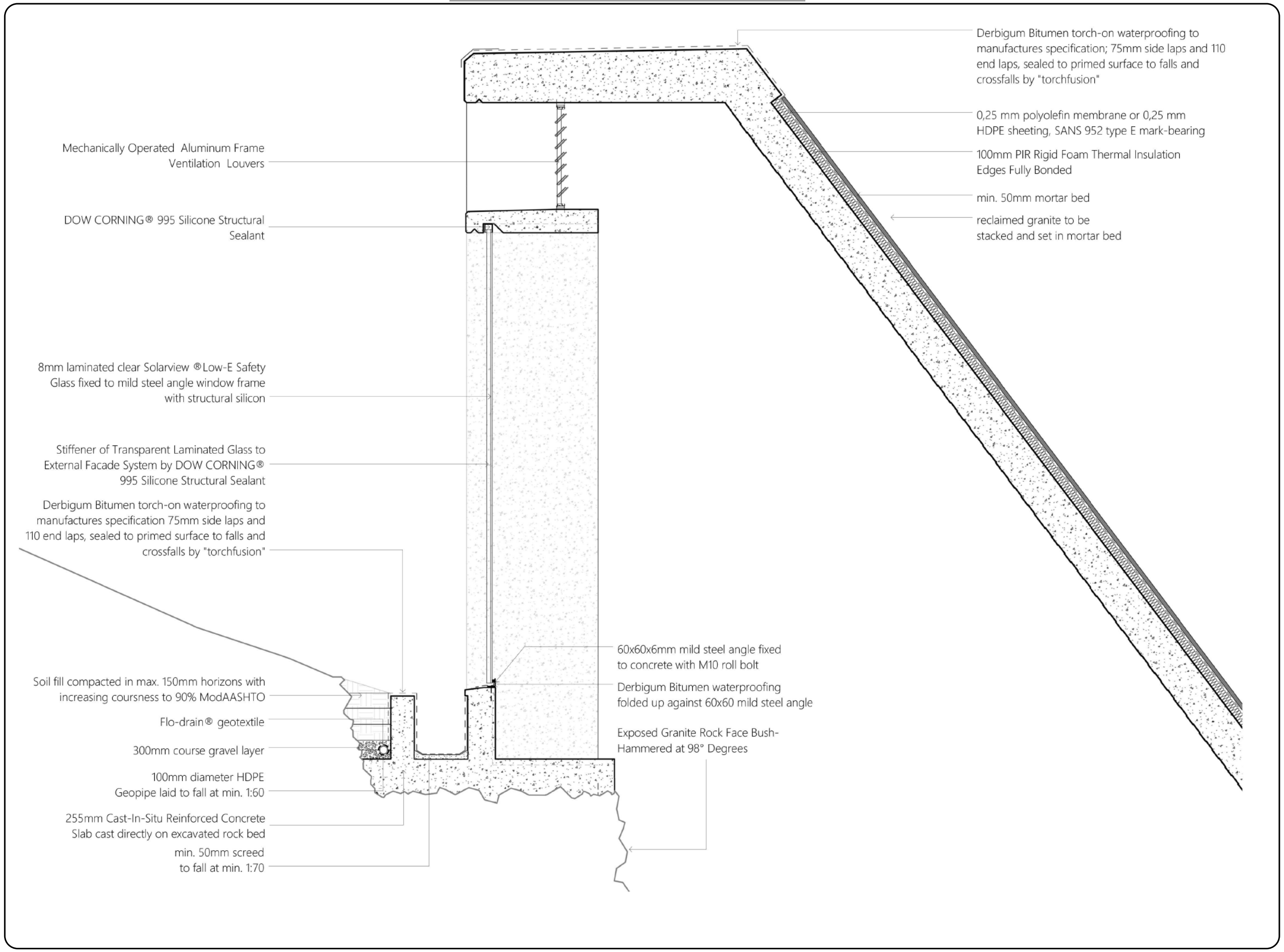
CHAPEL INTERNAL GUTTER DETAIL
1:20



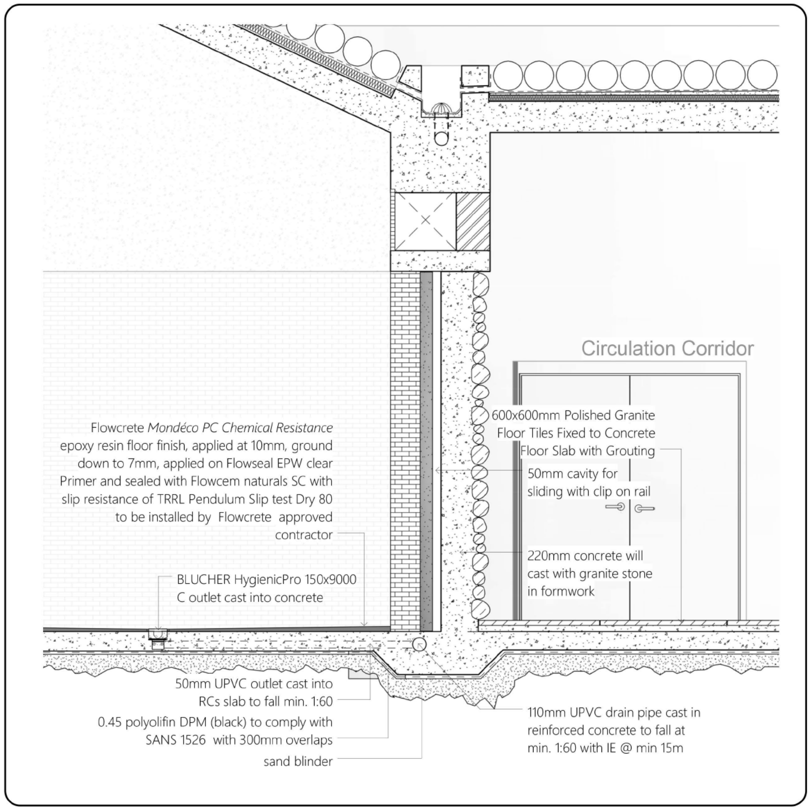
CHAPEL WINDOW DETAIL
1:20



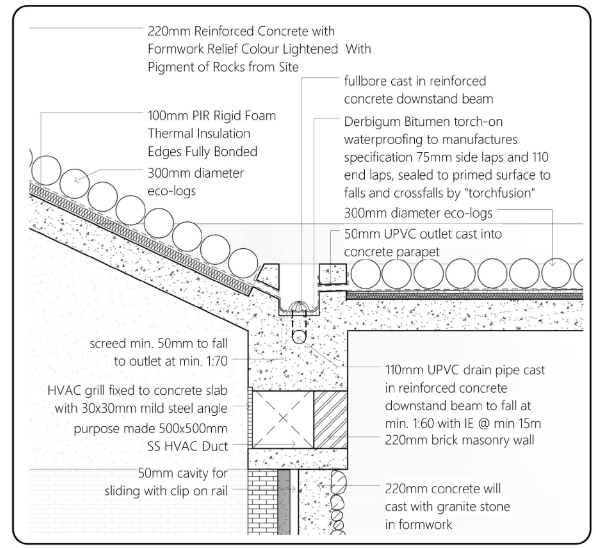
CHAPEL SKYLIGHT DETAIL
1:20



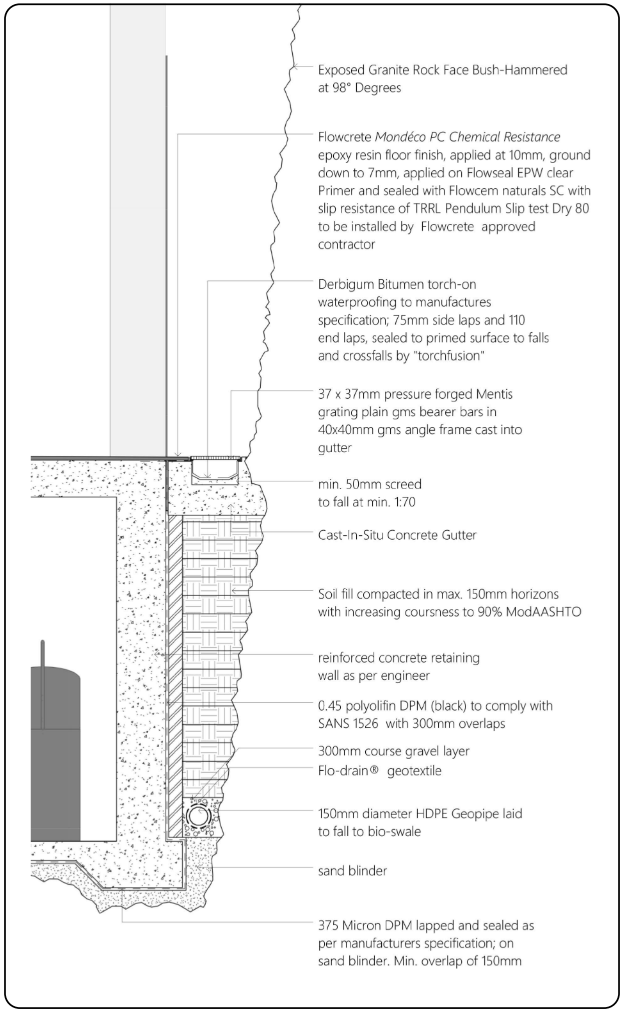
MORTUARY DETAIL
1:20



MORTUARY GUTTER DETAIL
1:20



MORTUARY INTERNAL GUTTER DETAIL
1:20



MORTUARY LOUVER DETAIL
1:20