

t e c h n i c a l i n v e s t i g a t i o n _

6.1 introduction _

“Gottfried Semper classified the building craft as two fundamental procedures: the stereotomic of the earthwork, the repetitious piling up of massive elements to compose a volume; and the tectonics of the frame, lightweight components composed to define a spatial matrix.”
(FRAMPTON 1996:5)

“Vernacular architecture displays varying roles played by these two forms, influenced by climate, custom and available material. The tectonic or frame component has an affinity to the sky, whereas the stereotomics has an affinity to the earth, dissolving therein.”
(FRAMPTON 1996:7)

Architecture can then be understood as the expression of sky and earth. The same sky and earth to which man’s existence is bound. It can then be argued that architecture can be used to redefine the relationship between man and nature.

The technical discussion will consist of these two elements, and their relation to the human component, with the primary focus on the tectonic as a fleeting and temporal interface.

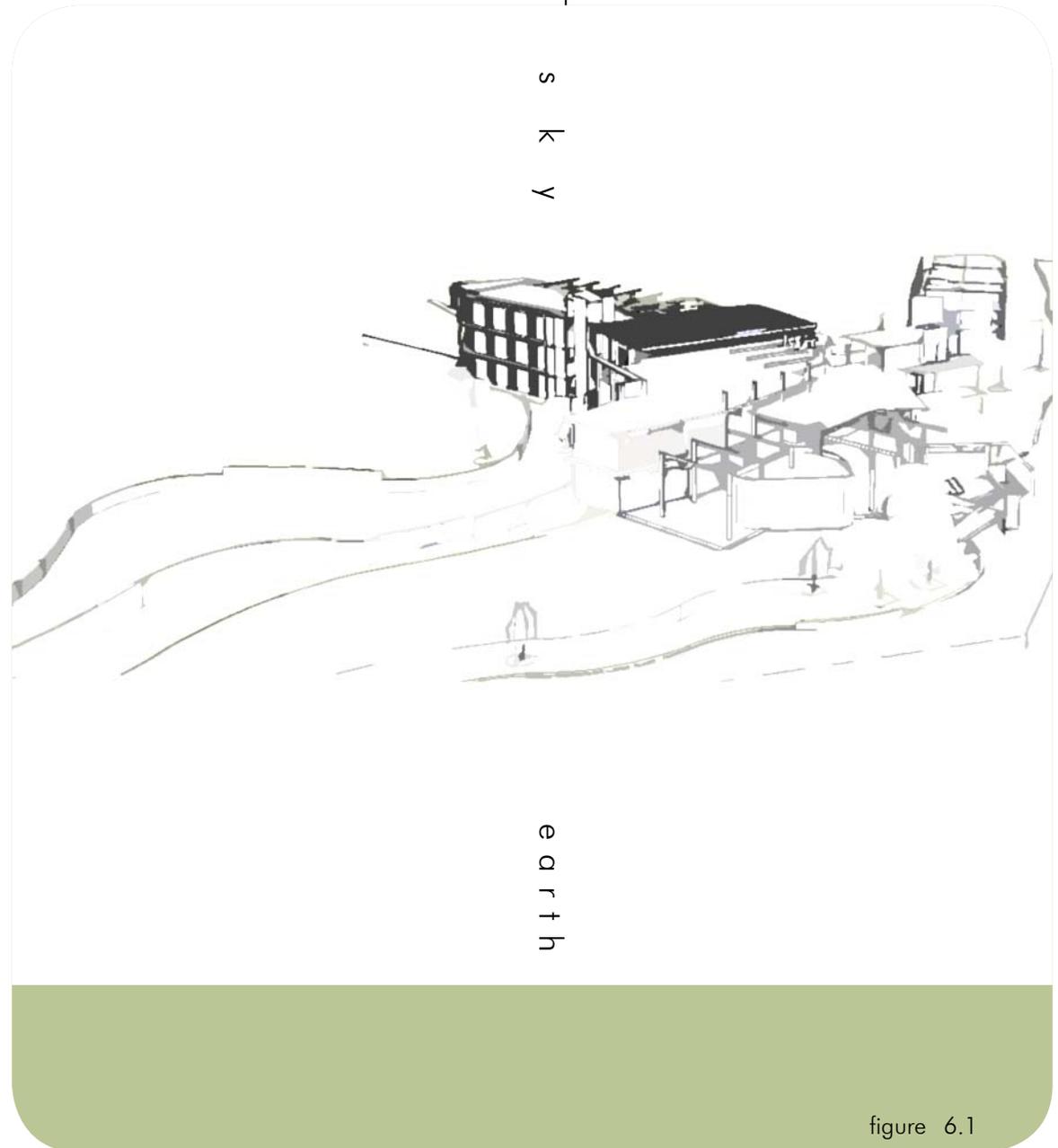


figure 6.1

6.2 stereotomic_

"I understand STEREOTOMIC architecture as that in which the gravitational force is transmitted continuously, in a continuous structural system, in which the constructive continuity is complete. It is a massive, stony, weighty architecture, which settles down on the earth as if it had been born there. It is an architecture that seeks light, that perforates its walls so that light may enter. It is the architecture of the podium, the plinth, the stylobate. It is, in short, the architecture of the CAVE." (CAMPO BAEZA, A. 2006: Approximations to the Terms "Stereotomic" and "Tectonic.")

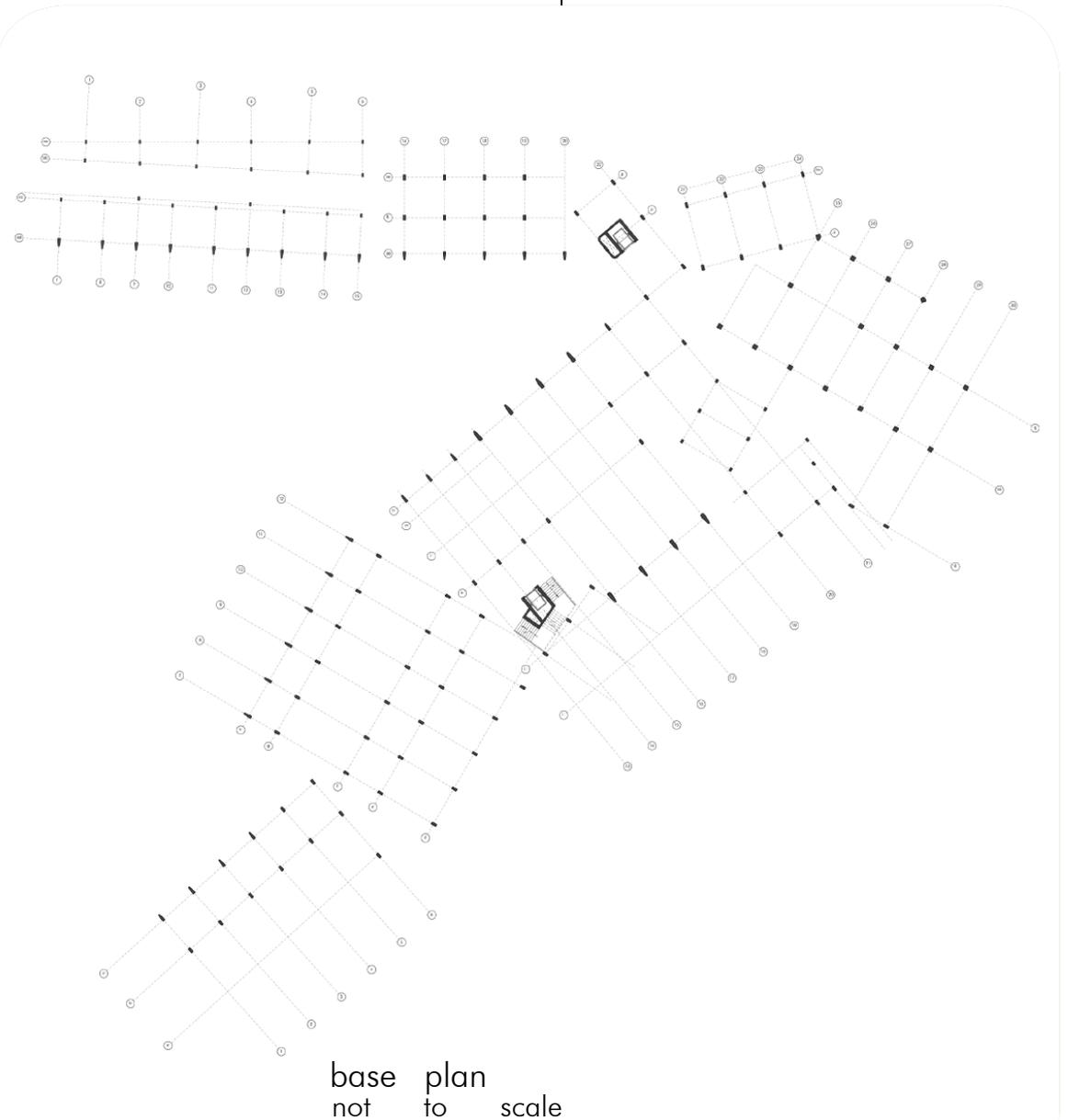
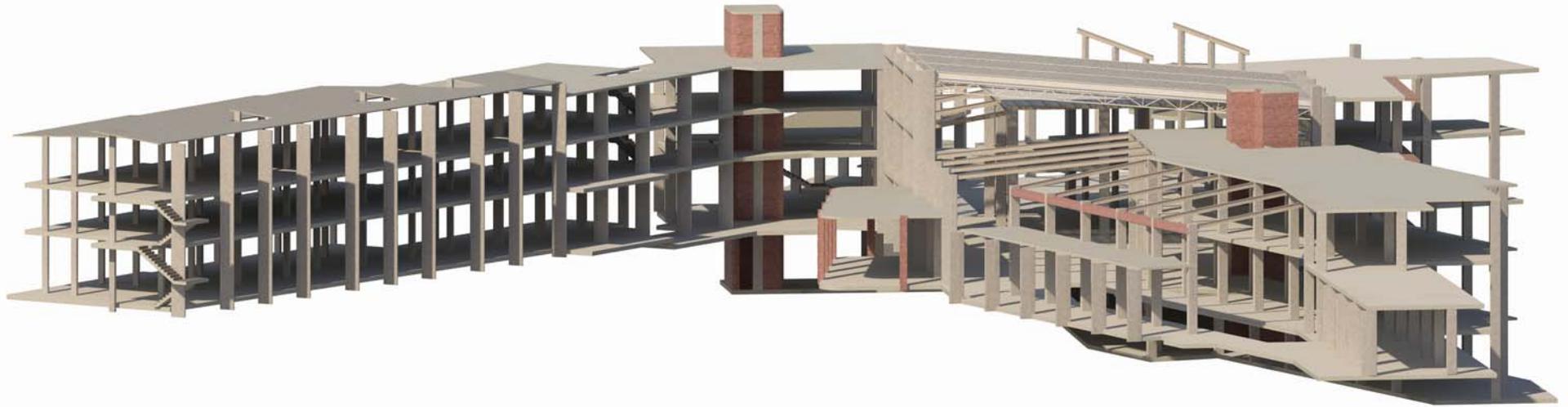


figure 6.2



structural model

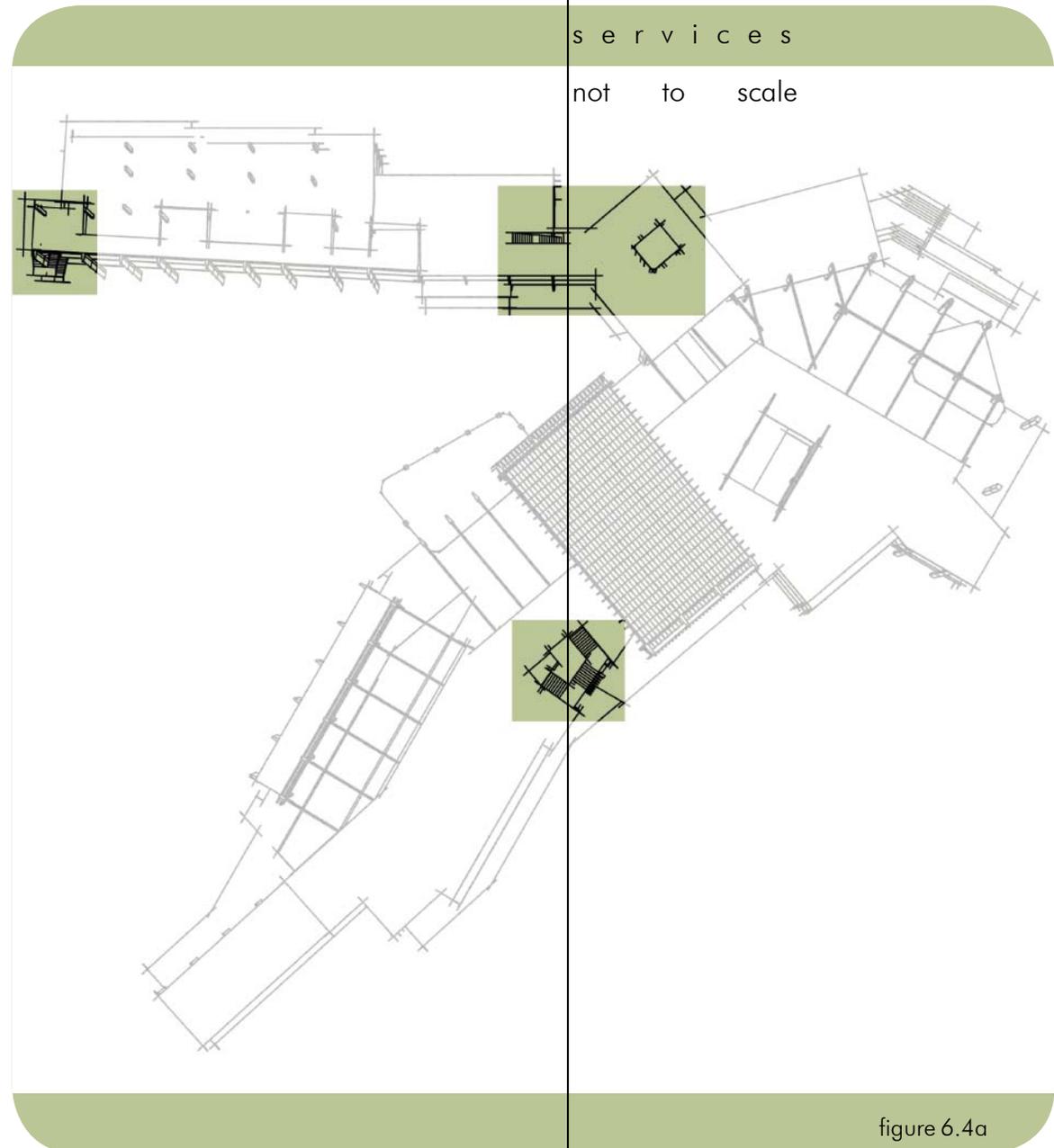
figure 6.3

2.1_structure

“Inspired by Brazil Builds, many civic and institutional buildings built after the 1940’s display elements such as Brise Soleil, roof gardens and fluid concrete form work.” (FISCHER 1998. 123)

Two different factors determined the choice of concrete as a structural system. The one is the search for a more contextual and regional architectural design solution, and the other based upon material requirements. The inherent mass of concrete makes it favourable for more temperate internal environments.

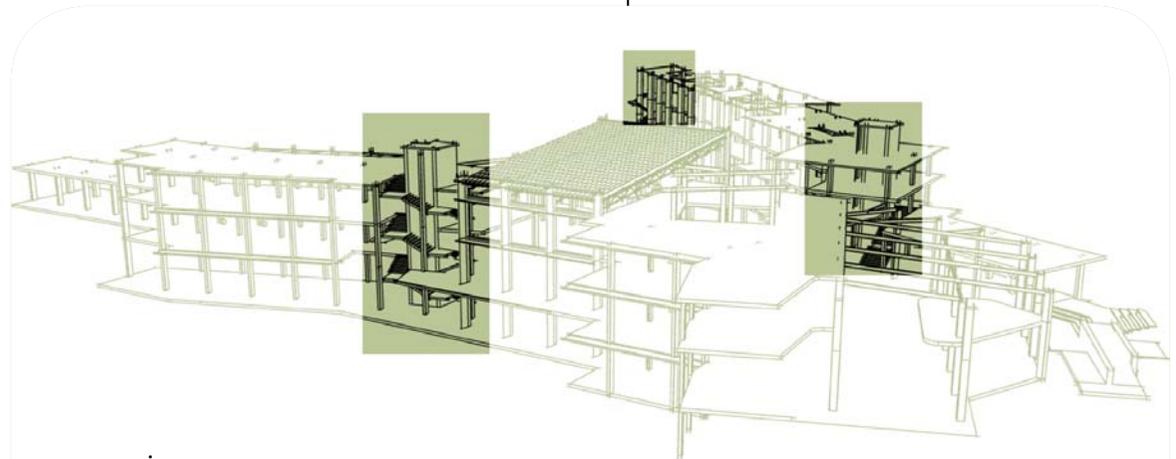
The structural grid is based upon the spatial design of the building. Several separate grids are integrated to make up the proposed structural grid, and originates from the site’s inherent landscape form. The grid can be further understood as an expression of the buildings activities. Off-shutter concrete columns are then used to extend the structural grid into the proposed spaces. Different column sizes indicate the spatial hierarchy and also depict the height of freestanding columns. The shape of the column is used to partially protect the interior spaces from direct sunlight. Columns are tapered toward the exterior which enhances the experience of movement in and out of the building. These structures function as frames to the interior and the exterior spaces.



2.2_services

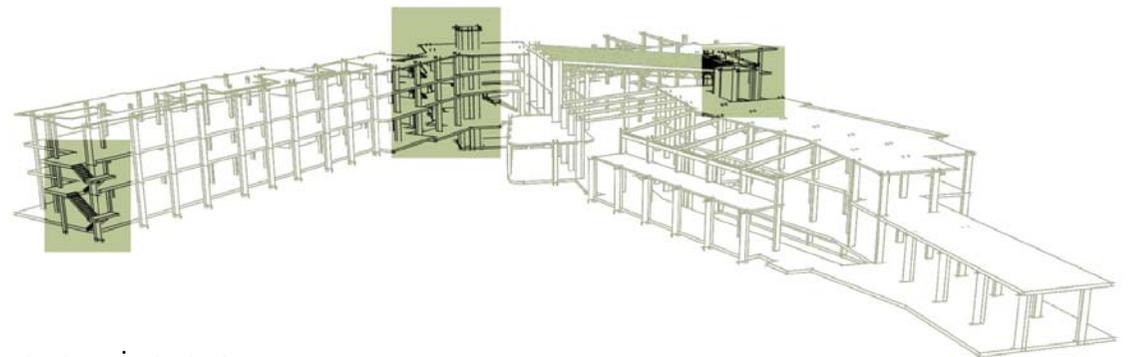
Horizontal services in the building are connected vertically by means of two primary cores. These cores accommodate the lifts, staircases, and the smaller service shafts. Regulations and design principles depicted the placing of these cores. A secondary service shaft is placed at the end of the living as a fire regulation. Most of the services will be accommodated in the basement with the indoor pool services. The reason for this is the integration of the pool heating system and the cooling system of the building. This system will also benefit from a rock bed storage system which will sub-track cooler air from the surrounding environment. Such a system will utilise the existing natural climatic conditions in optimising its functionality. These integrated heating and cooling systems are more efficient within this particular type of building, and precedent studies based on these scenarios also validated this. The only problem arose with the calculations which indicated that during the winter months there will be a loss in the system due to higher heat demand.

The building temperature will be regulated in three different zones. Uncontrolled external spaces will solely depend on the natural ventilation of the site. Semi-controlled internal service spaces will be mechanically ventilated but there will be no direct cooling of these spaces. The heat released by the pool will be used as part of this



s e r v i c e s

figure 6.4b



s e r v i c e s

figure 6.4c



figure 6.5a

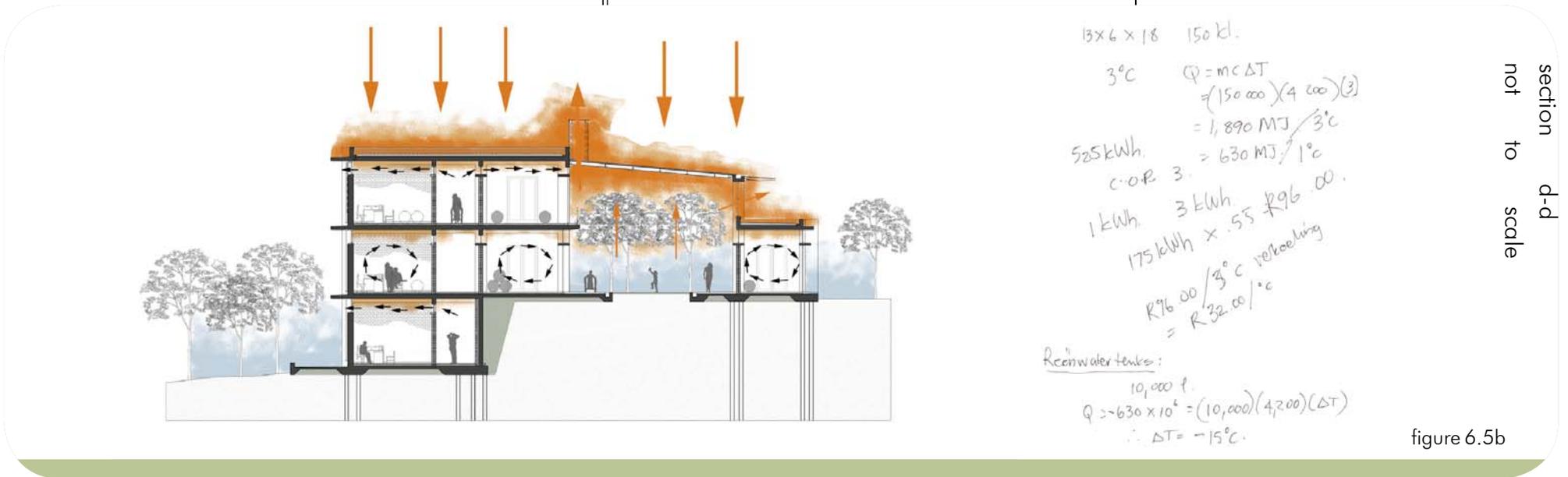


figure 6.5b

aforementioned system. Cooling and heating will only be implemented in the controlled spaces of the building which will include the offices and studios. In optimising the systems efficiency each space will maintain its own temperature based upon demand.

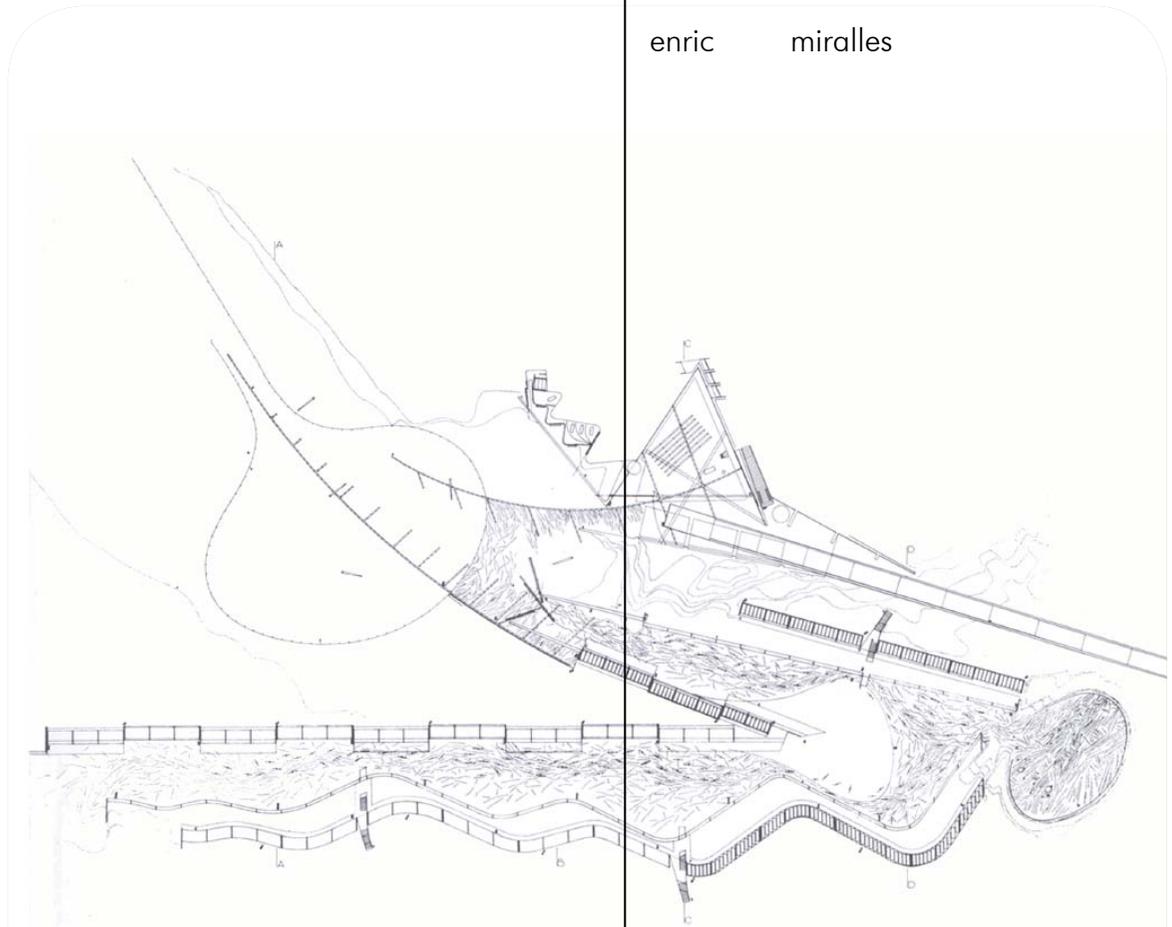
Heating of the pool will be passively assisted using solar water heaters installed on the roof of the building. A small percentage of rain water will be stored in the rock bed which will assist the ventilation system. The building orientation and material choices result in the semi-controlled areas ventilating passively.

2.3_landscaping

A landscape is the representation of the earth itself. And it communicates the inherent history of the site. The preamble of the landscaping was the creation of a relation between the existing campus, the new facility and the environment. By doing this the design could create spaces for disabled users in which they can freely move.

The architectural works of Enric Miralles was used to define a method of response for the site. He uses contours as design elements and expresses it as simple lines and more complex structures. Using tectonic elements and textures he redefines the landscapes he works in.

Based on these works the landscaping was

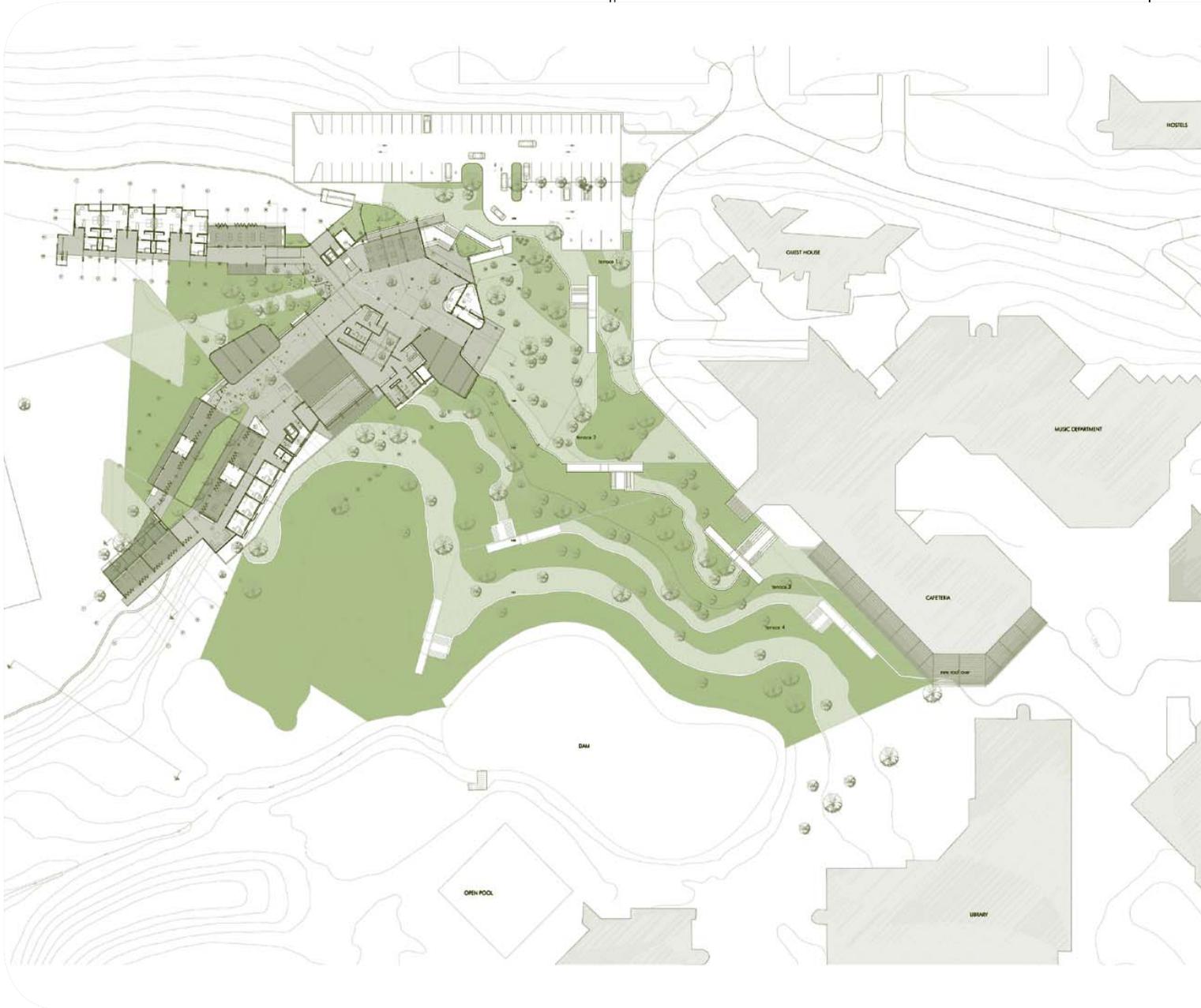


enric miralles

parc dels colors (spain)

igualada cemetery (spain) figure 6.6





landscaping
not to scale

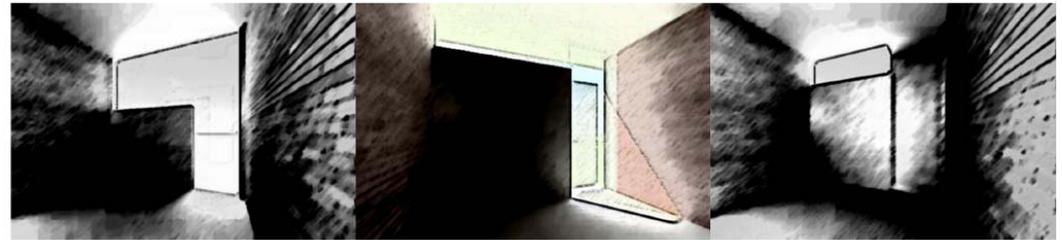
figure 6.7

designed to integrate the new building and the existing landscape. Terraces were designed to accommodate disabled users and allow for new ways of experiencing the same space. These terraces were based upon the contours and became the roots of the design. The landscape runs from the existing campus through the new design and into the open rehabilitated landscape.

6.3 tectonics_

"I understand TECTONIC architecture as that in which the gravitational force is transmitted in a syncopated manner, in a structural system of knots and joints in which the construction is articulated. It is a bone, wood and light architecture, which sets itself on the earth as if raised on tiptoe. It is an architecture that defends itself from the light, that has to look after and veil its open spaces to be able to control the light that pours into it. It is the architecture of the shell, of the abacus. It is, in short, the architecture of the HUT." (CAMPO BAEZA, A. 2006: Approximations to the Terms "Stereotomic" and "Tectonic.")

i n t e r i o r



1

2 3

figure 6.8a

e x t e r i o r

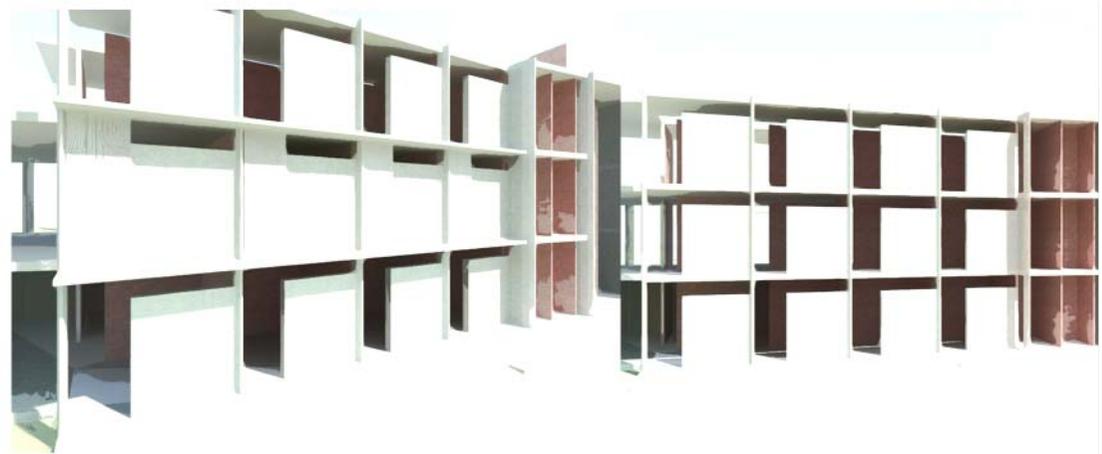


figure 6.8b

3.1_openings

“The generic window is obviously the most delicate point at which these two natural forces impinge upon the outer membrane of the building, fenestration having an innate capacity to inscribe architecture with the character of a region and hence to express the place in which the work is situated.” (HAWKES & ASSOCIATES 2002: 20)

The function of openings in the buildings is to create intricate meetings between man and the natural forces. Placed within these openings are the simple yet fundamental elements of windows and doors. They function as thresholds between the indoor and outdoor spaces with the window as the most frangible point of the building facade. For this reason the doors and windows will not act as boundaries but rather as convening spaces and the extension of space. By opening and closing these elements movement, light and ventilation could spontaneously occur.

The design resolution required the exploration of mechanical and manual mechanisms for the opening of windows and doors. Materials for these elements were explored and the options were wood, steel and aluminium. The conclusion was that aluminium frames were the more economical option on the scale of the building due to the fact that wood would require too much maintenance and steel would be too heavy. Door openings are designed to permit fluent slower and faster movement through them. This allows the service

i n t e r i o r

open - closed



figure 6.8c

e x t e r i o r



flexible openings



figure 6.8d

space to function as an extension of the training areas. Window openings are primarily designed to protect the user from the natural forces and emit substantial light into spaces. Small openings are used on the eastern facade where the western facade has larger openings but the latter windows function as an extension of the outdoor space and will have shading elements.

These openings are an important element in framing the landscape and creating a stage of events for the users. Ventilation will be allowed based on the allocated ventilation zone of the building. And the higher openings will consist of much smaller opening sections for practical reasons.

3.2_shading devices

Various elements were explored in this regard based upon practical, economical and aesthetical principles. One of the concerns was the amount of expected light in relation to the permissible amount based on heat gains. Wood was the first choice but maintenance on these elements proved to be uneconomical. Profiled Galvalume sheets were then chosen for its economical and aesthetical qualities. The selected material has a curved profile and is perforated and coloured. These sheets are then placed in a frame which will either be fixed on a sliding track or fixed directly to the structure.



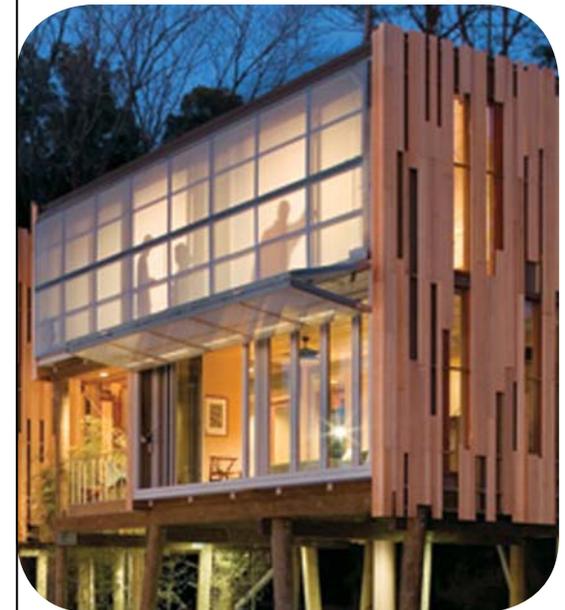
figure 6.9b

m a t e r i a l s

figure 6.9a



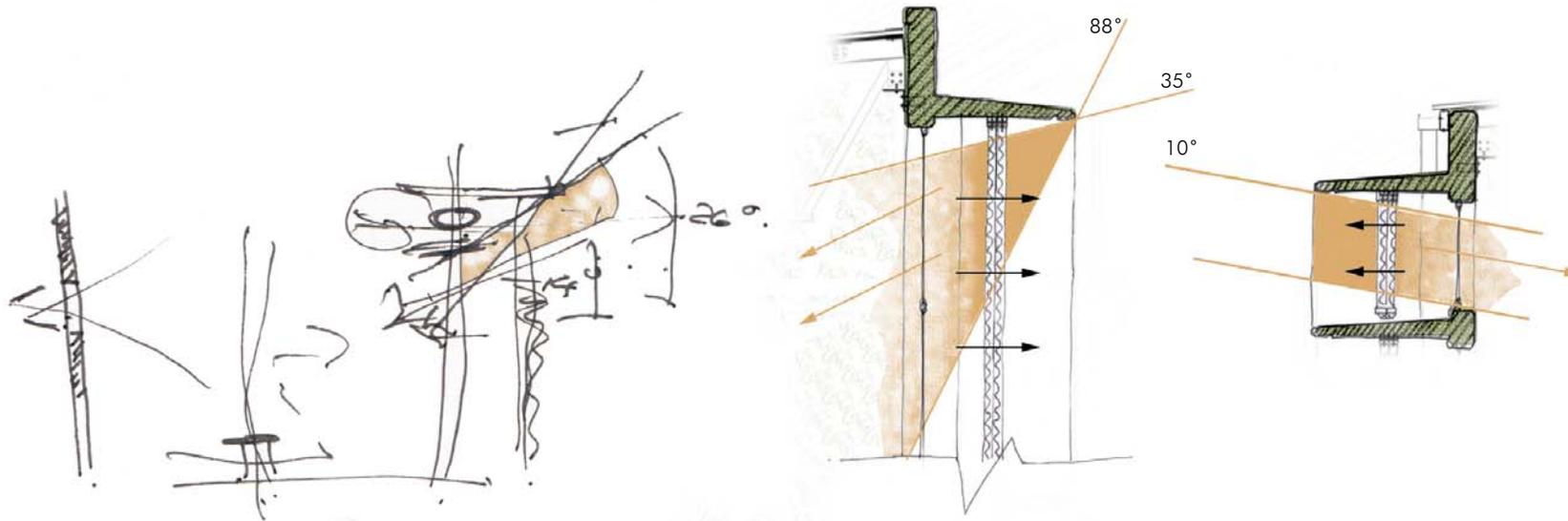
figure 6.9c





section
not to scale
c-c

figure 6.10a

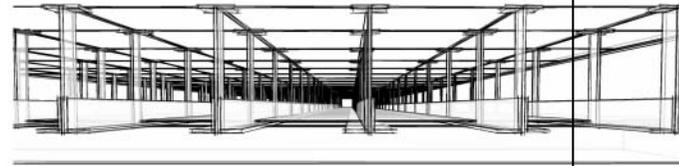


details
not to scale
1&4

figure 6.10b

renzo piano

figure 6.11



beyeler foundation (switzerland)



Vertical shading devices were allocated to the eastern and western facade to protect it from early morning sun. These elements had to function as a second membrane of the building in the same fashion as the hair on the skin of the body. This will protect the glazing from direct sun exposure and prevent heat build up inside the building.

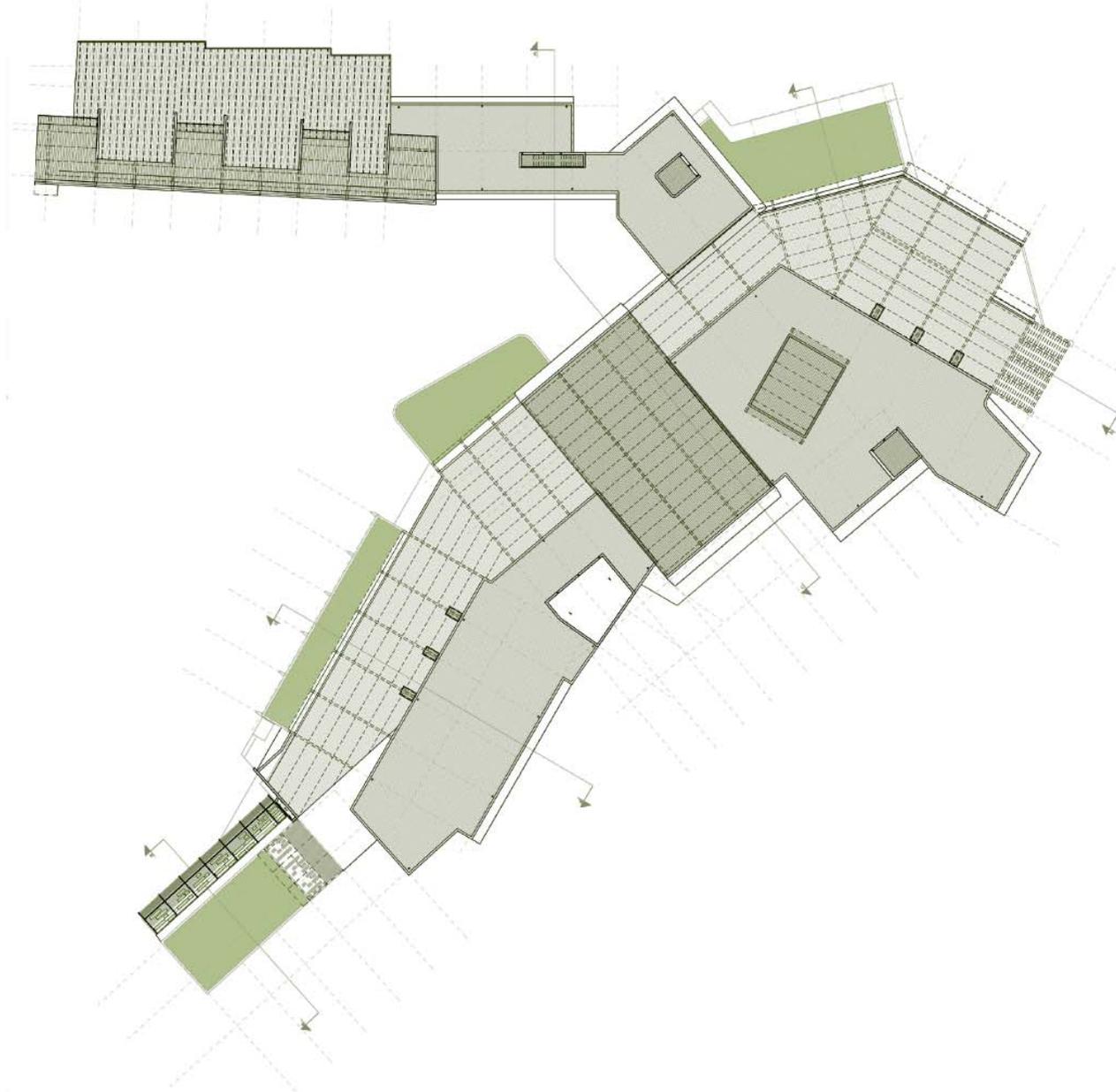
Horizontal shading is provided with the appropriate roof overhangs, and the size of the overhangs are based upon sun studies done for the building. The extension of the roof structure doubles up as shading device for the eastern, western and northern facade. Concrete roof overhangs are tapered for aesthetical reasons and are provided with a drip for construction purposes.

3.2_roof structure

The tree exists with its shadow, with the densest part existing close to the centre. As one moves out of the tree shadow it decreases in density until it opens to the sky. The detail of the branches and leaves decorate the shadows and leave the constant presence of time. The roof functions as the intricate horizontal layer between the sky and earth. It in the given context of the South-African climate it protects us from harsh natural forces.

Various precedents were used in formulating the appropriate roof structure. Renzo Piano's Beyeler Foundation building in Basel, Switzerland was



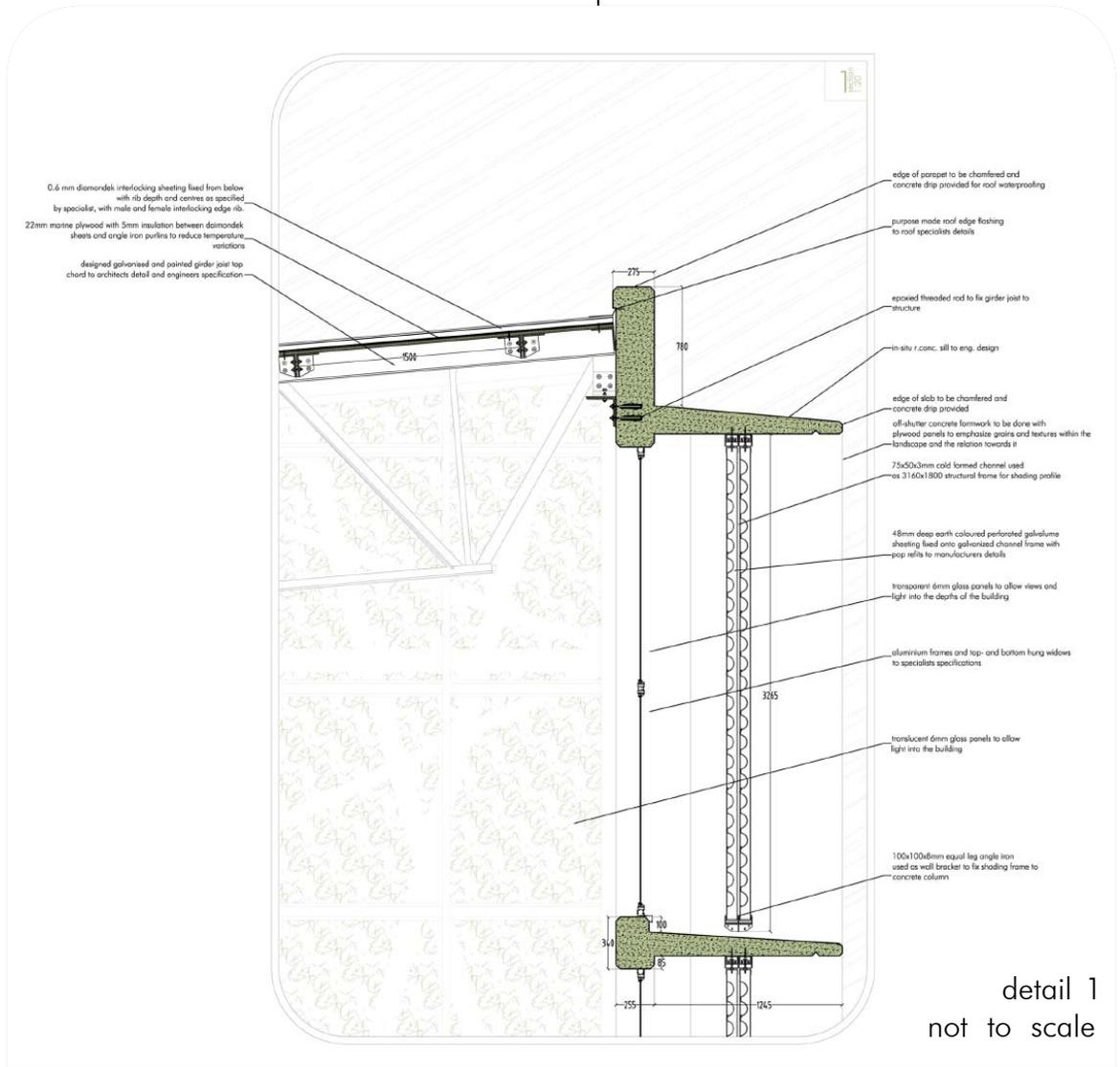


roof plan
not to scale

figure 6.12

used for its light structure and translucent qualities. But vast climate differences made the structure insufficient here. Further studies were made in the local context and included various Virgin Active gyms and also Brooklyn Mall. These facilities proved to be valuable in defining the design principles for the roof structure. For none had the perfect roof structure solution, however by analysing them all, the essential concerns could be identified and possible solutions could be determined.

Three roof elements make up the final roof structure. The first roof is the hard concrete roof over the core of the building and reflects the formal character of the design. These roofs are thermally insulated against unwanted heat build up on the roof. Solar water heaters will be located on these flat surfaces. Furthermore a separate Diamondek roof structure is used to highlight the importance of the movement space. The Diamondek interlocking sheets are used with bubblefoil and plywood for insulation purposes. Hierarchy is created in the building by elevating and lowering the roof structure according to the design requirements. Finally the use of sod roofs will be applied to the single storey elements within the design. These roofs will function as a physical and visual relation to the landscape. They will be visible from within the building and will allow for easier maintenance.



detail 1
not to scale

figure 6.13a

detail . 1
not to scale

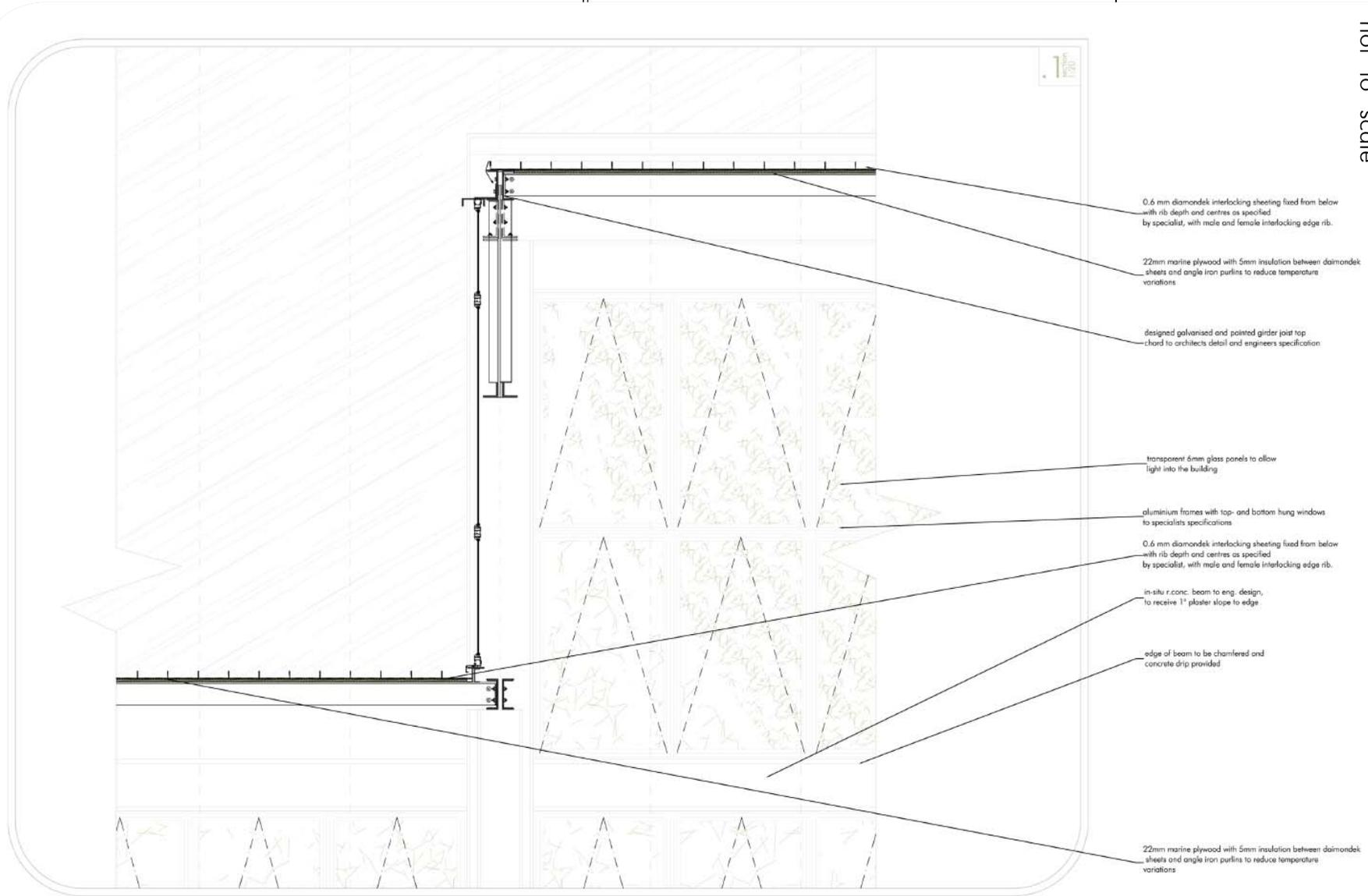


figure 6.13b

6.4 materials_

“The use of a given material should never happen by choice of calculation, but only through intuition and desire. For the young architect each material is measurement of strength. To apply the material to its ultimate capacity is natural for youth. The expression of this inherent force compliments a natural vitality. The material’s sensation carries its conviction and the energy of youth attains structural perfection. With time, certain architects will accept age as a tiredness which has a beauty of its own, allowing raw material a dimension of life and wisdom. The acquiescence of age is a recognition of maturity, a sign of personal growth. It is a generosity transcended through simplicity.”
(FRAMPTON 1996:358-359)

“Scientific investigations into man’s interaction with the environment have shown that there are upper and lower limits to the rate of input of environmental stimuli for the healthy functioning of the human organism. And if the input is too low, the human being will automatically try to increase it by either moving faster through an impoverished environment or by creating additional stimuli (mental activity) from within to substitute for the outer deprivation. Other studies have indicated that human discomfort or stress can be generated by either



figure 6.14



figure 6.15

too much or too little external stimulation, that is, by sensory overload or deprivation.” (NITSCKE, 1993: 45)

“The confrontation with nature and the concrete actuality of materials are intended to provoke reflection.” (NESBIT 1996:456)

4.1 _site textures

Rich earth colours make up the palette for the site’s textures. These colours and textures are used in the design to express the contextual properties. Floor surface patterns express the indoor and outdoor connections as the users move through the building. This will be achieved by using tile insets of the existing site’s textures placed in custom made resin tiles. These tiles are used in the service spaces and reflect movement through the building. The use of small wood insets is used in the building to emphasize joints and spatial qualities.

4.2 _concrete

The concrete structure is to be made of off-shutter concrete cast-in-place. A smooth grained texture is achieved by using oiled shutter-plywood shuttering to function as a non-absorbent formwork. Swelling of the wood prior to the concrete pouring, will water tight the formworks joints. The formwork is placed orderly and in a symmetrical manner with the minimum seems. Surface defects and tie holes will be patched and made good according to approved methods. Grains symbolize the contextual textures



figure 6.16

m a t e r i a l s



figure 6.17

and sculptural landforms. The intricate concrete details require custom made formwork and the use of concrete specialists in execution.

4.3_masonry

The historical value of the site determined the use of red SA-stock bricks as an infill material. Sand used for mortar must closely resemble the colour properties of the site's soil colour. Wall and detail finishes are flush jointed and washed representing a structural honesty of the material. The use of various bonds relinquishes the material properties and these textures enhance the spatial experience of the site and building. Detail in the building is added by using brick patterns and then conveying these details into the surrounding landscape. These brick details help obtain more human scaled spaces even if the spatial volumes are of a much larger scale.

4.4_steel

The detail of the building as it transcends into the landscape required a finer detail to which steel properties adhered. It is primarily used in the roof structure and smaller detail such as railings and shading devices. Joints are accentuated and celebrate the intricate composition of the surrounding environment. The detail of the members evolves toward the edges where nature and architecture meet. These details are then further expressed in the skin of the building. Aluminium doors and windows are used in the building



figure 6.18



figure 6.19

based on their economy and their light material properties. Anodising is used on the aluminium for its harder and more abrasive surface finish.

6.4 precedents studies_

The in-depth study of similar facilities and systems was done to establish an understanding of the required measures. The associated problems could be identified and accordingly resolved in the proposed design based on these studies.

Brooklyn Mall, Brooklyn, Pretoria, Gauteng_

2008/09/26 10:00_

2008/09/26 14:00_

The thermal and light impact was studied at the given times, and temperature differences were noticed and measured at various skylights. Temperatures were higher on the upper levels and even higher temperatures were found under the larger skylight situated over the escalators and lift areas. Even though these skylights were higher than the other skylights, they had insufficient heat extraction. As a result, the warm air accumulates quickly in these areas and cause discomfort, largely



figure 6.20a

b r o o k l y n

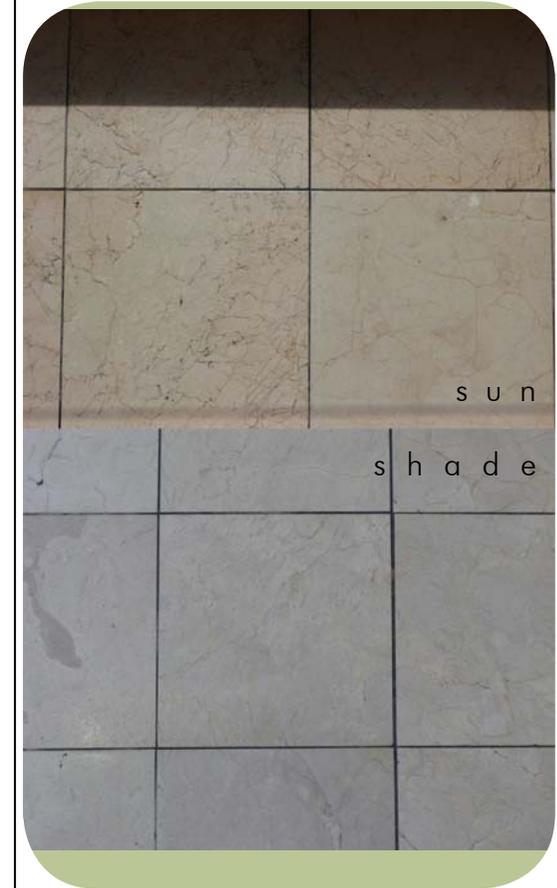


figure 6.20b

due to the height and volume._

Glazing for these skylights is used with a metal mesh, allowing diffused light to filter into large parts of the building. The photographs taken of the tiles under the skylights, and then directly out of the sun indicated a slight discomfort. This conclusion applies only for the larger skylights due to the vast volumes of light being conveyed in these areas.

Virgin Active, Gauteng, South-Africa_

2008/10/05 08:00-17:00_

Virgin Active (Three different gyms were documented for the study but for privacy reasons they will be mentioned in this document only as Virgin Active South Africa.)

The study included current ventilation systems within their gyms specifically related to heated pools within the building. Temperature control within the building is based on varying activities. Implications of condensation due to higher moisture and temperature differences on roof and glass surfaces were studied, as well as material uses due to the higher moisture content in the air. Open and concealed ventilation and cooling systems were used and only one used height difference over

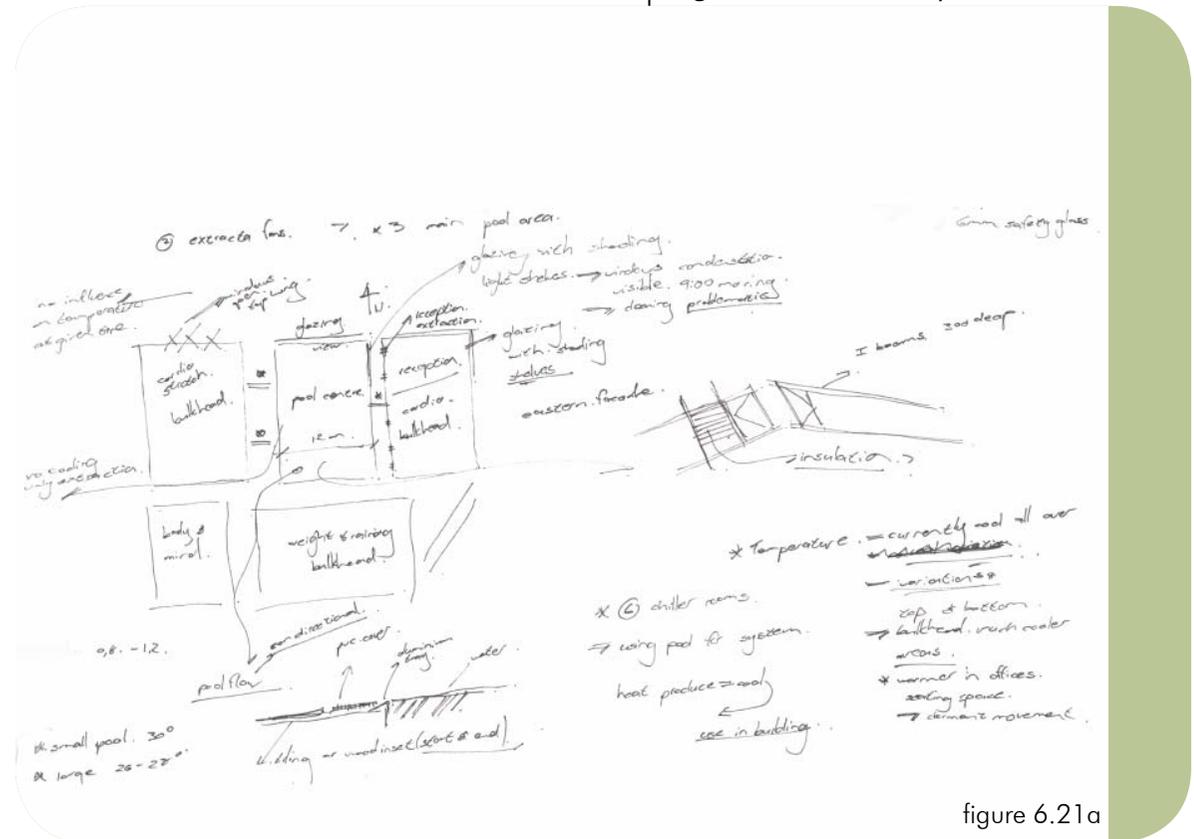


figure 6.21a

pool to compensate for additional heat gain. Structurally the buildings could be classified as warehouse type with steel roof structure and metal sheeting on the exterior. The interior roof surface consisted either of Iso-board, bulkheads or some sort of PVC sheeting. Pool temperatures varied from 26-30 degrees depending on the use of the pool. Flow-rims are used for their hygienic qualities, but they are not the best for professional swimmers due to their visual deceptive characteristics.

Cooling within the building is based on regions and the use of various cooling systems, and offices had warmer temperatures than the studios as a result. The reason for this would be to accommodate low and high levels of activities.

The use of an integrated system helps to maximise output and input creating greater efficiency. Over the pool areas the only interventions are the extraction of hot air.

Exposed glazed facades are shaded externally with horizontal metal shelves which function as shading. External shading devices were not sufficient and alternative roll-up shading devices are used in all these cases internally.

Basic cleaning of the facilities happens on a daily basis but with an industrial scaled cleaning and maintenance activity every quarter.

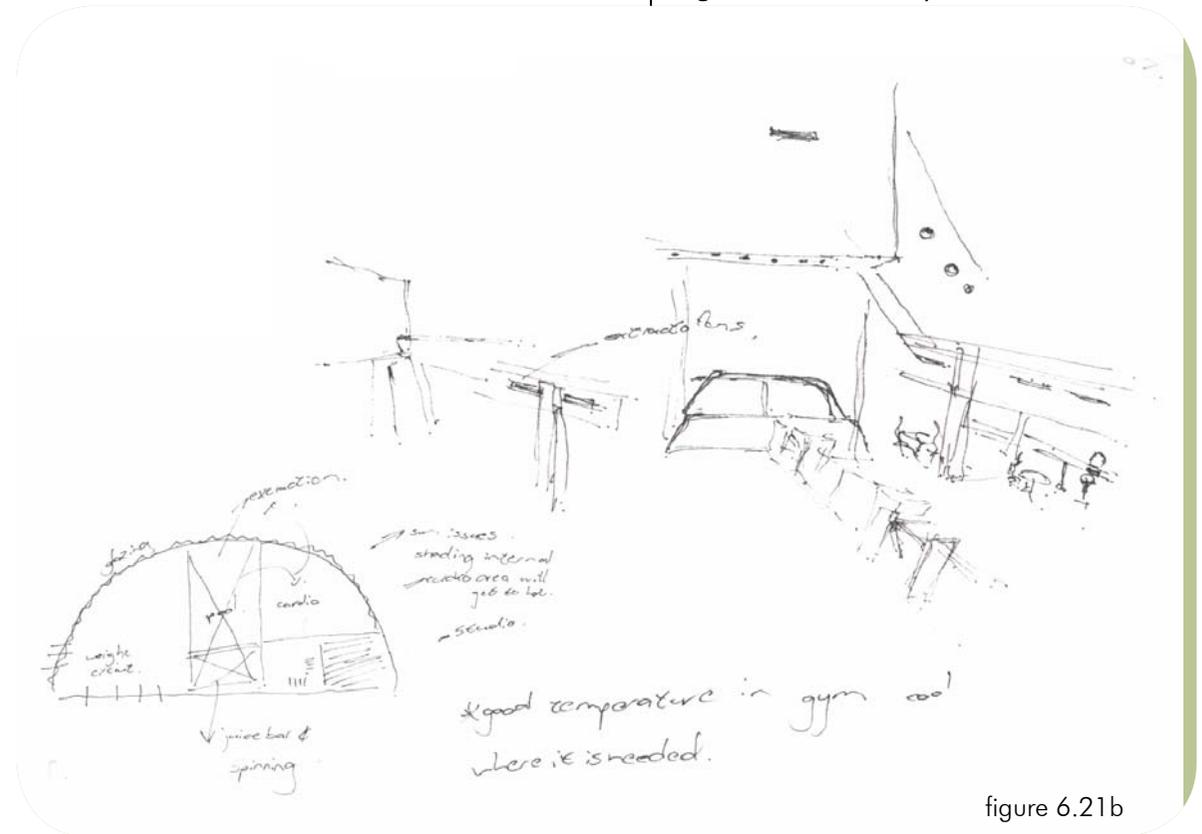


figure 6.21b