Background

The tragic loss of 13 young children in the Throb nightclub disaster fractured the veneer of a stable and organized society. The tragedy attracted widespread attention and evoked sympathy, support and aid for the community. Amongst those who rallied to support of the community was the former President Nelson Mandela. He identified that the community needed more than comfort and short-term aid and proposed the establishment of a Youth Centre. The envisaged centre is to stimulate coordinated activity of the youth, thus closing the door on idle and unsupervised children

Location

Chatsworth is a sprawling suburb located 20km away from the city centre in Durban. The suburb was born out of the Group area act in mid 60's. The eradication of the influx control and pass laws saw the establishment of several informal settlements of African people in and around Chatsworth. For this reason the Center must be multicultural.

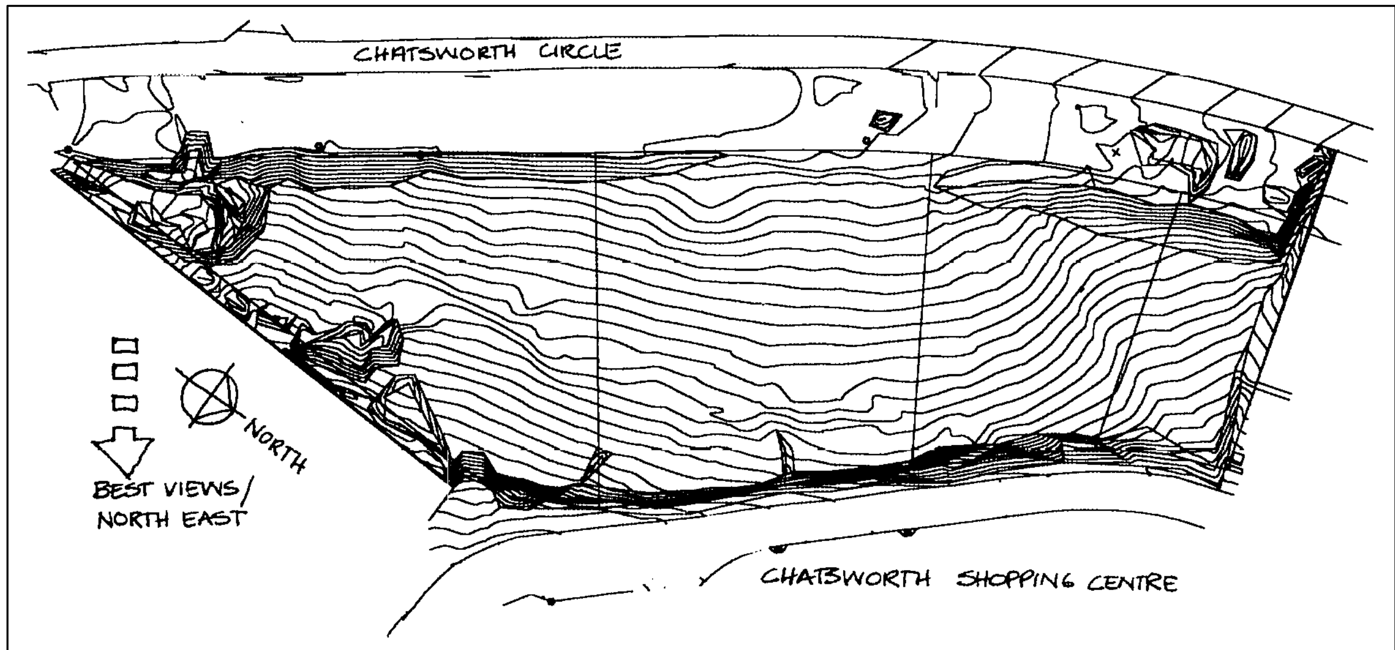
Brief

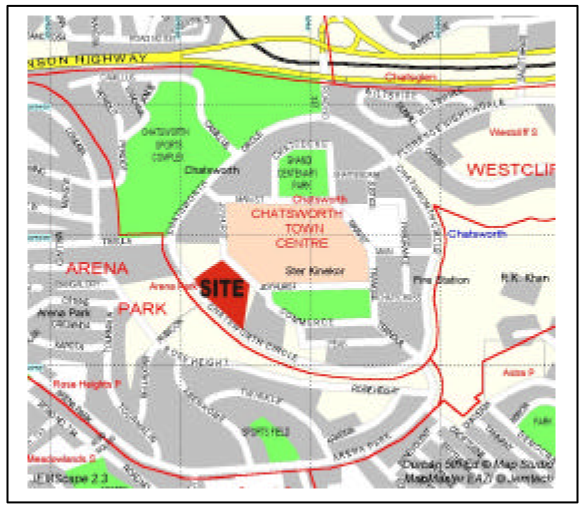
Youth Centre:

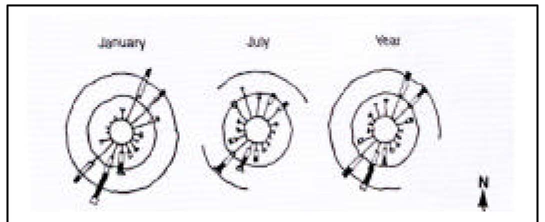
- Entertainment areas (Pool, music, coffee shop, recording studio, in house 'radio station'), Counseling/clinic.
- IT Centre which would be accessible to Youth and office workers alike (generate income for Centre)
- Gym/Aerobics area for Youth
- Outside Sports fields (skate boarding, cricket nets, netball and volleyball).

Offices

- The office area would be for N.G.O's, welfare organizations e.g. Child welfare, lifeline etc. These offices would generate income to support the Youth Centre.
- Councilors for youth (Aids, Rape etc.)

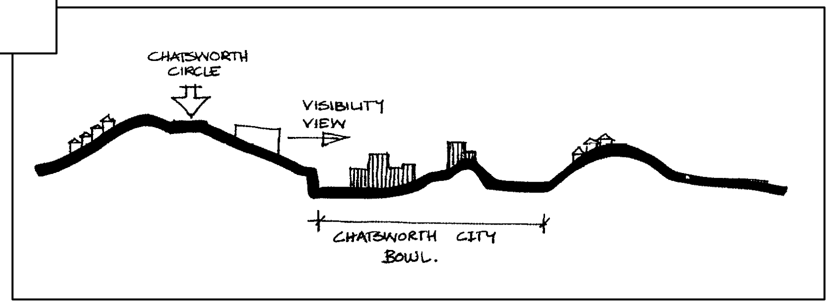




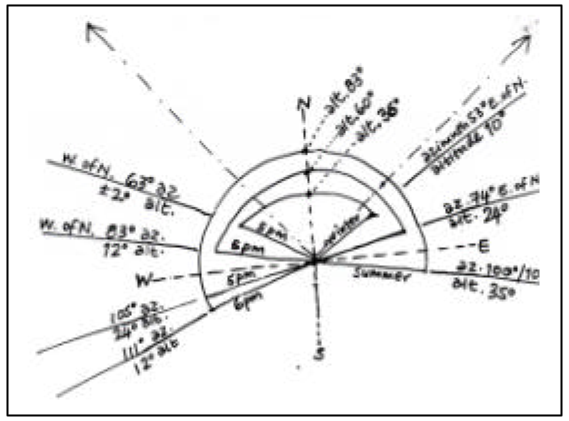


Climate

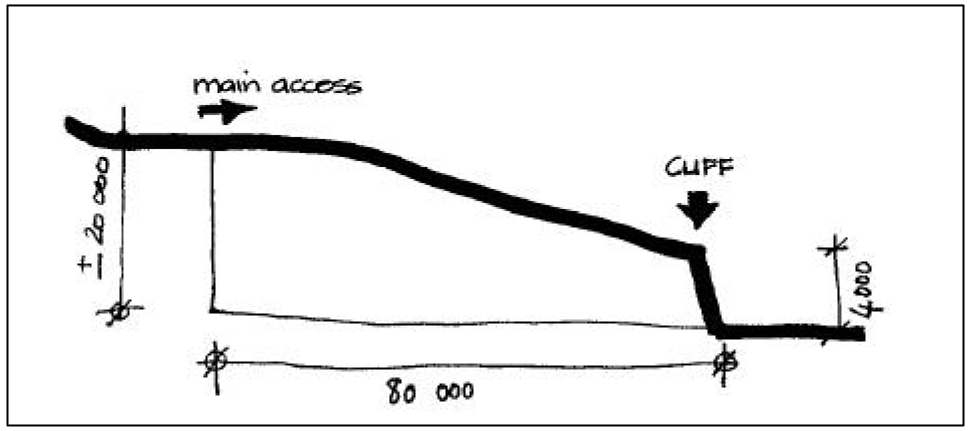
- 29 degrees south
- Humid coastal climate
- Predominantly South east and North West



Wind Roses
(Dieter Holm)



Sun Angles



Site Section (metres)

Site

The site is situated on the Chatsworth Circle Road, which defines the Commercial Center of Chatsworth. It is a stone's throw from the original Throb Nightclub, which is ideal. The area is very hilly and the Chatsworth centre is in a bowl with the site on the edge looking down over the shopping centers, hospital, municipal buildings etc. It is on a very steep site but is visible all over Chatsworth.

There is also a 4m cliff at the bottom of the site separating the site from the shopping centre, which acts as a natural barrier instead of a fence. Pedestrian access from the bottom is possible. Main vehicular access is from the top of the site

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Precedent: Building Response to Climate

Traditional buildings provide clues to appropriate responses to local climate, in this case tropical to sub-tropical. Relevant examples include traditional Japanese architecture and vernacular buildings in tropical areas. These structures are typified by

- lightweight structure
- large roof overhangs
- stilts providing elevation off the ground
- use of various types of adjustable screens for control of sun and light penetration, and ventilation
- maximum allowance for natural ventilation

Social / Economic

- Low/medium technology
- "Cool" building to attract kids
- High Visibility (choice of site and image of building)
- Brief to ensure financial sustainability: Income producing activities, spaces to subsidize the Youth Centre

Materials

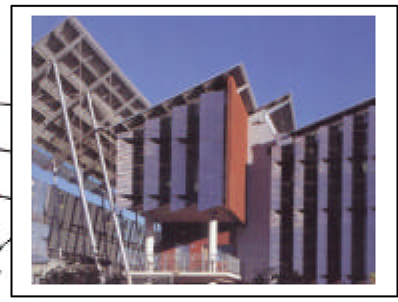
- "Kit of parts" galvanized steel structure, bolted together on site (no welding – high corrosion area)
- Lightweight (Low thermal mass, infill panels (timber, gypsum, etc.)
- Recycled components e.g. steel fittings, insulations e.g. greenhouses from Holland (www.knijenburg.nl)
- Light reflective colours

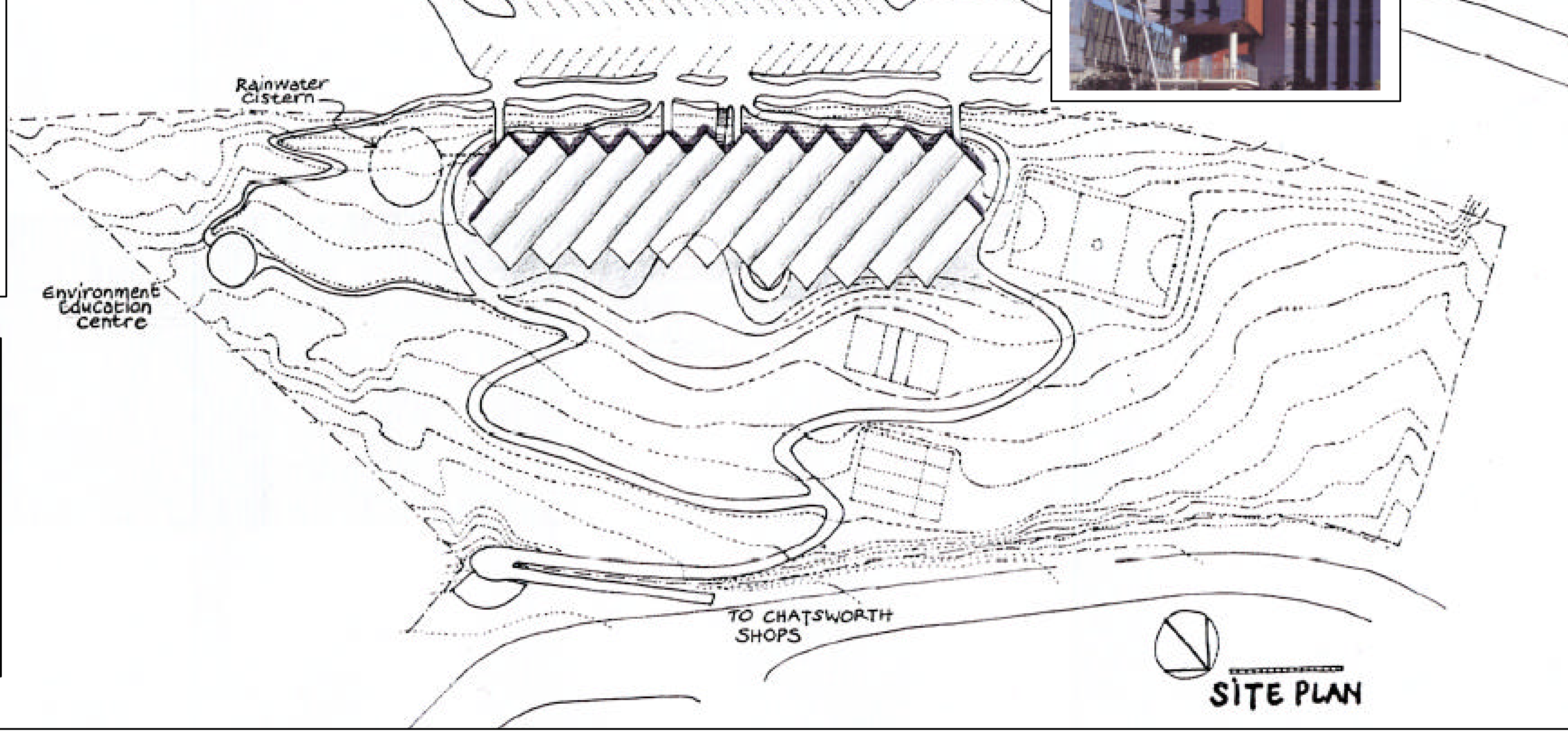
Design for Deconstruction

Design for deconstruction essentially refers to the design of a building with intent to manage its end of life more efficiently. The biggest problem with recycling and reusing is the way buildings are constructed and demolished. Too much is damaged or destroyed. The way buildings are designed is a factor.

Saving useful components has to be made worthwhile to demolition contractors to improve availability.

Thanks to Dennis Macozuma at Boutek, CSIR





Services

- Rainwater collection for showers an irrigation
- Greywater for irrigation
- Low water use sanitary fittings

Design Decisions

- Steep slope - place a long narrow building along the contours.
- This positioning results in NE / NW orientation.
- Optimise N orientation for windows and solar collectors by placing the structural grid at an angle.
- Facades are staggered with N-facing openings and E- or W-facing elements, treated in different ways to optimise control of climate.
- Aligned with the dominant wind directions to aid natural ventilation.
- Broken up roof structure allows a series of north facing slopes for optimal placing of solar collectors, with south lights to improve daylighting.
- The solar collectors act like an umbrella to shade the inner roof, which is insulated.
- Lift structure off the ground plane to take advantage of diurnal wind changes along the slope, allowing air flow all around the building.
- Maximise the use of natural daylight and ventilation, thereby reducing its energy demand.
- Where required indoor comfort levels cannot be achieved at all times in this way, installations that utilise renewable energy are used.
- Ground works are limited to providing a level area for the base of the building, with sculpted terraces to integrate other functions.
- The ground plane and retaining walls behind the building to be planted with low level planting to provide a cooling effect around the building, avoid dense vegetation which will obstruct air flow.

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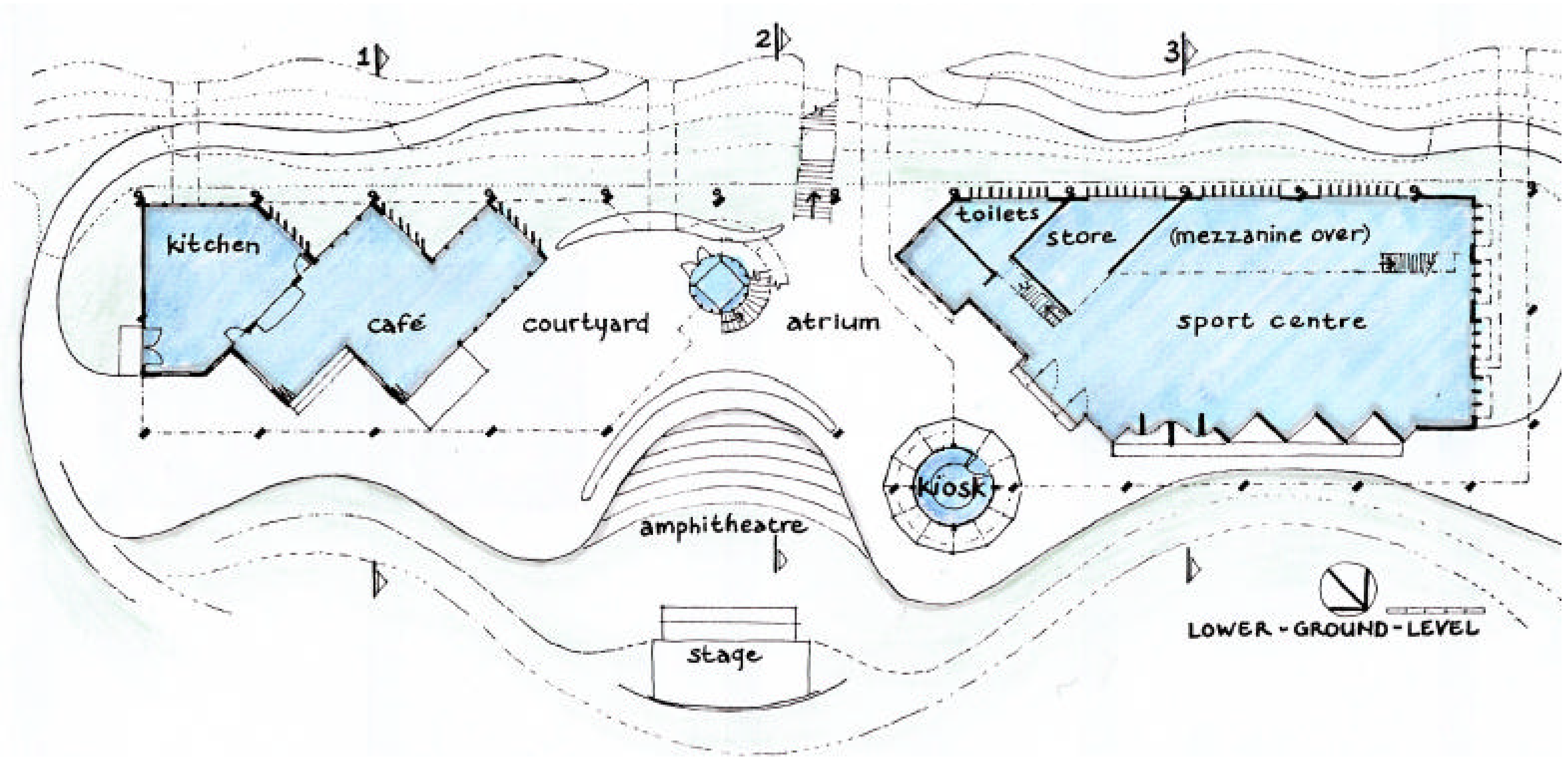

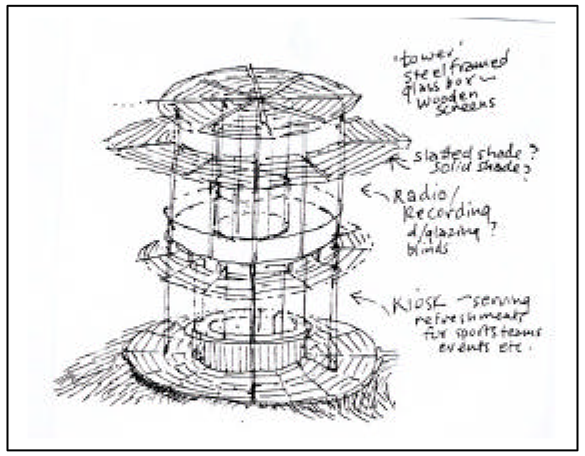

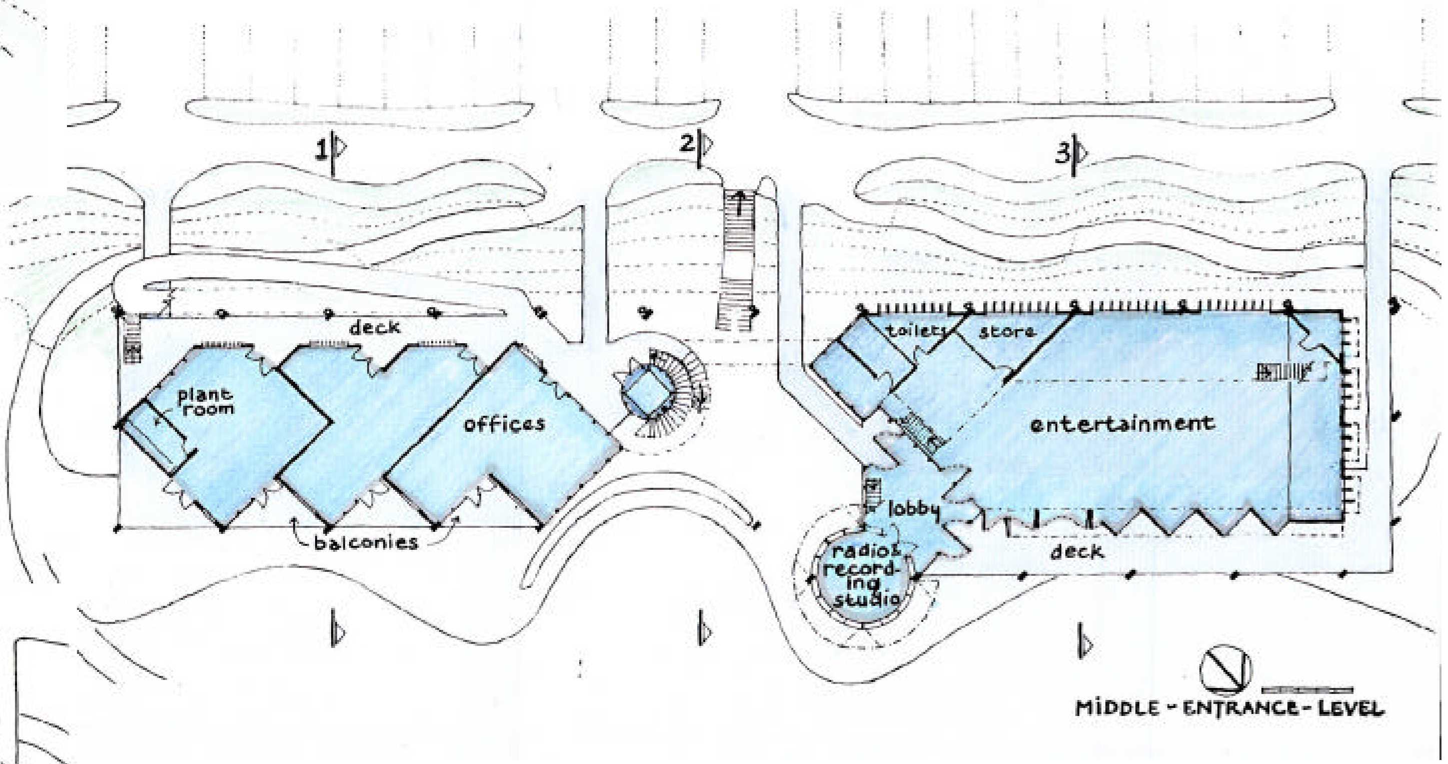

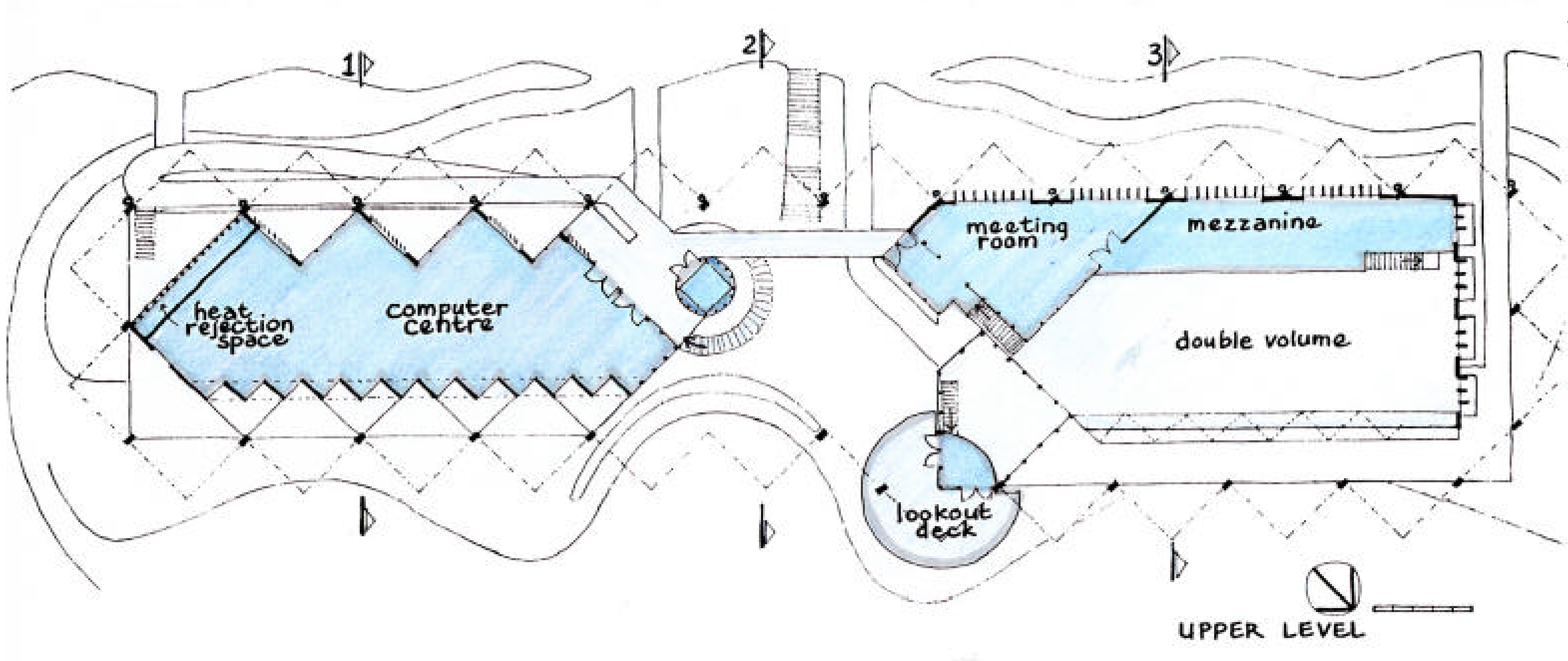

Plans

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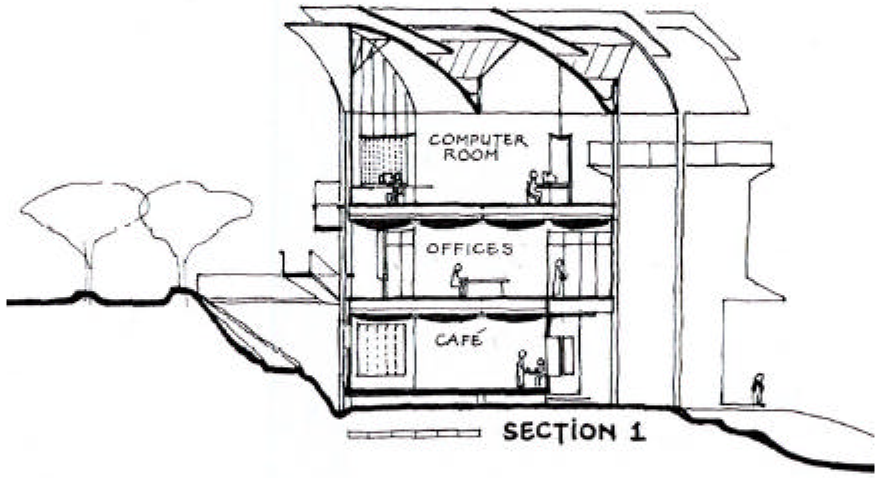

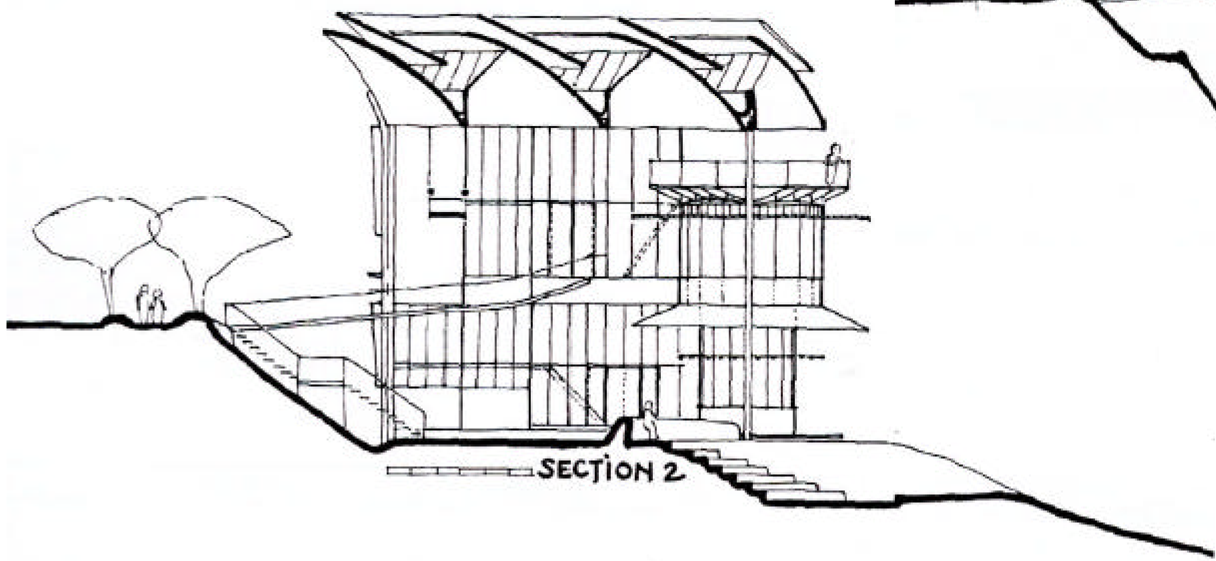

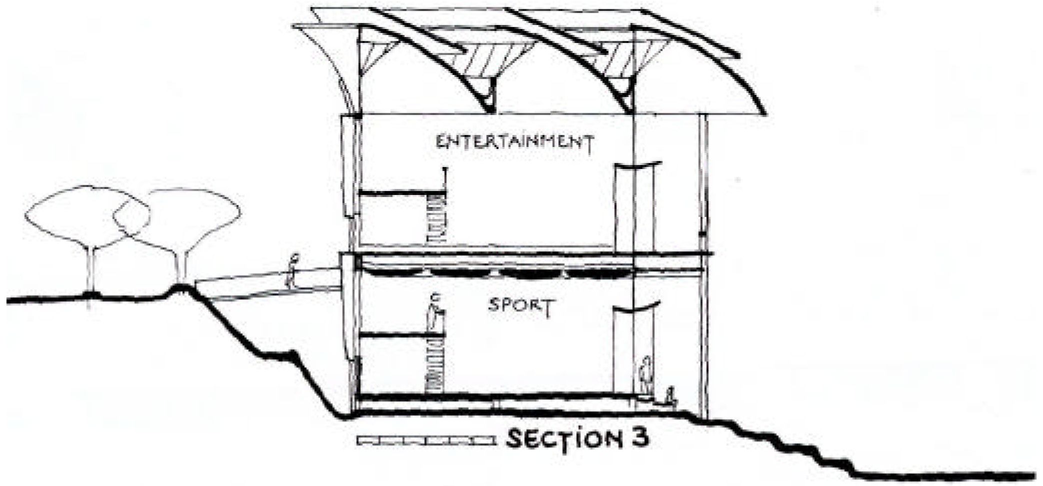

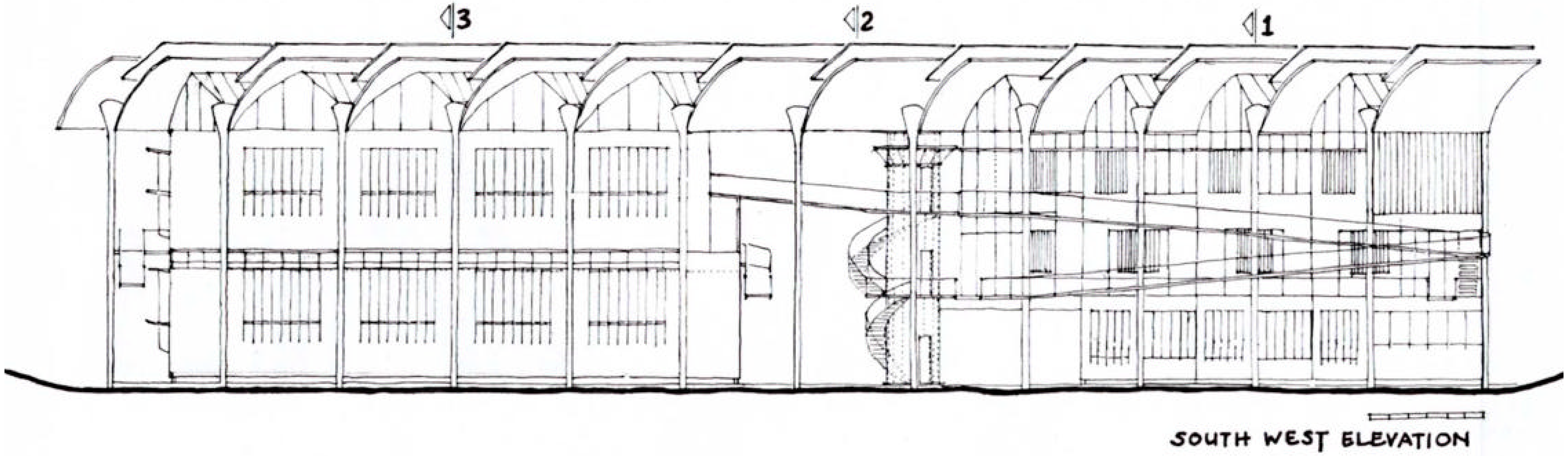

Sections & Elevations

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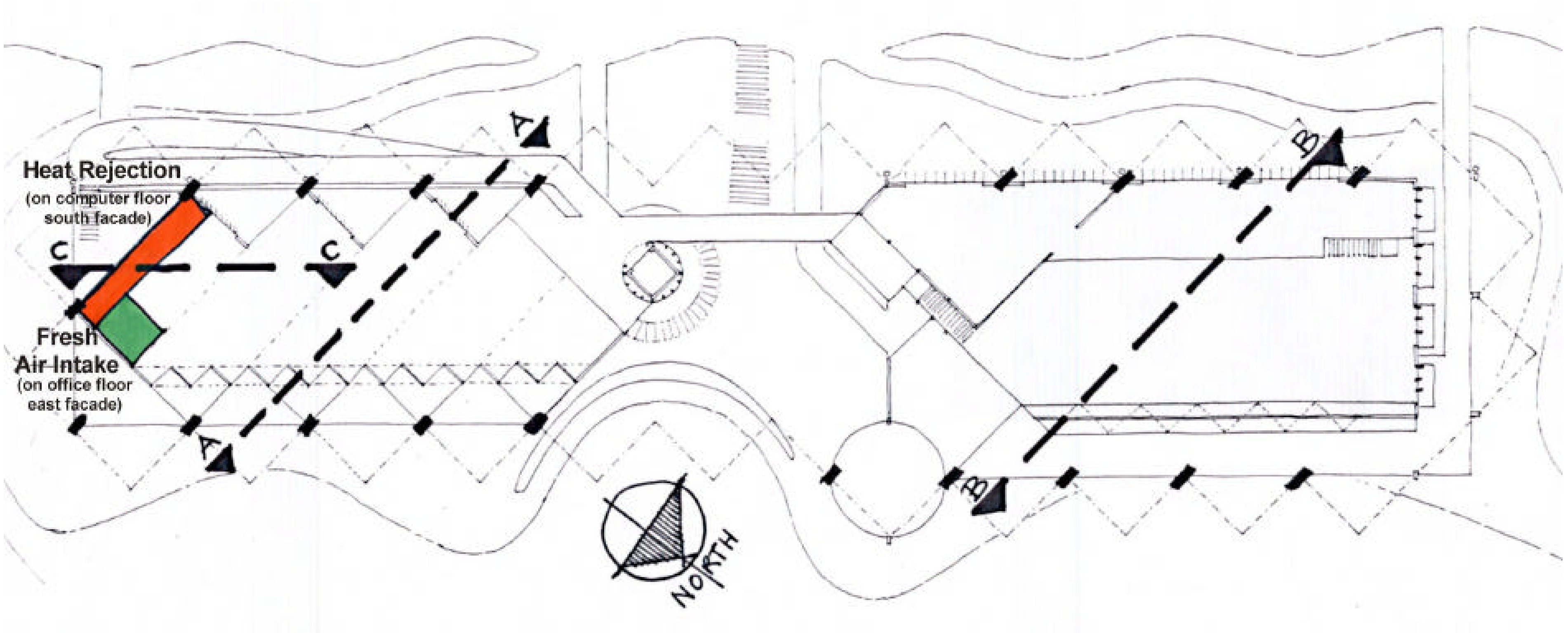
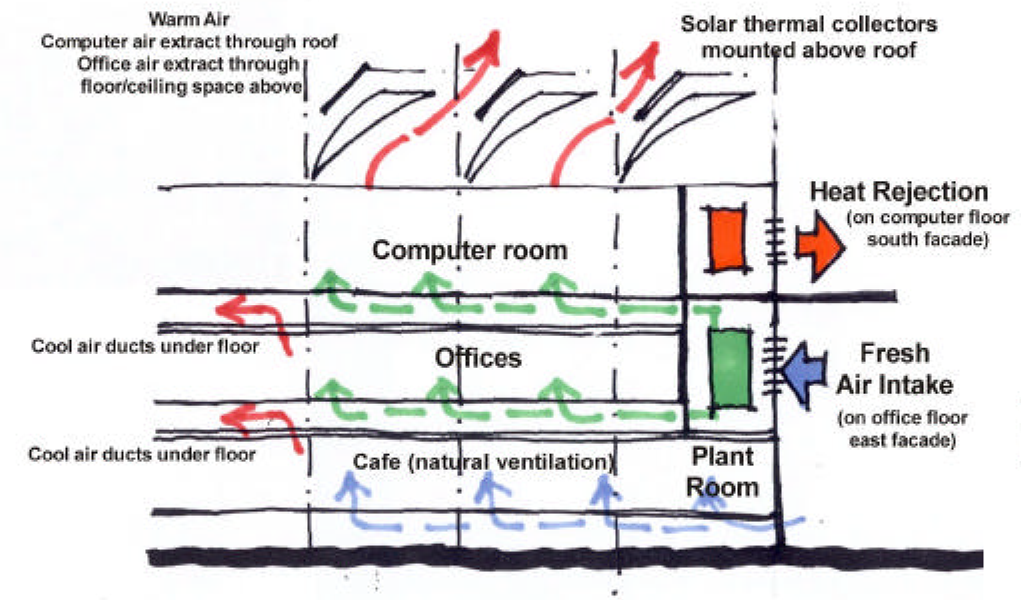


Natural ventilation and cooling

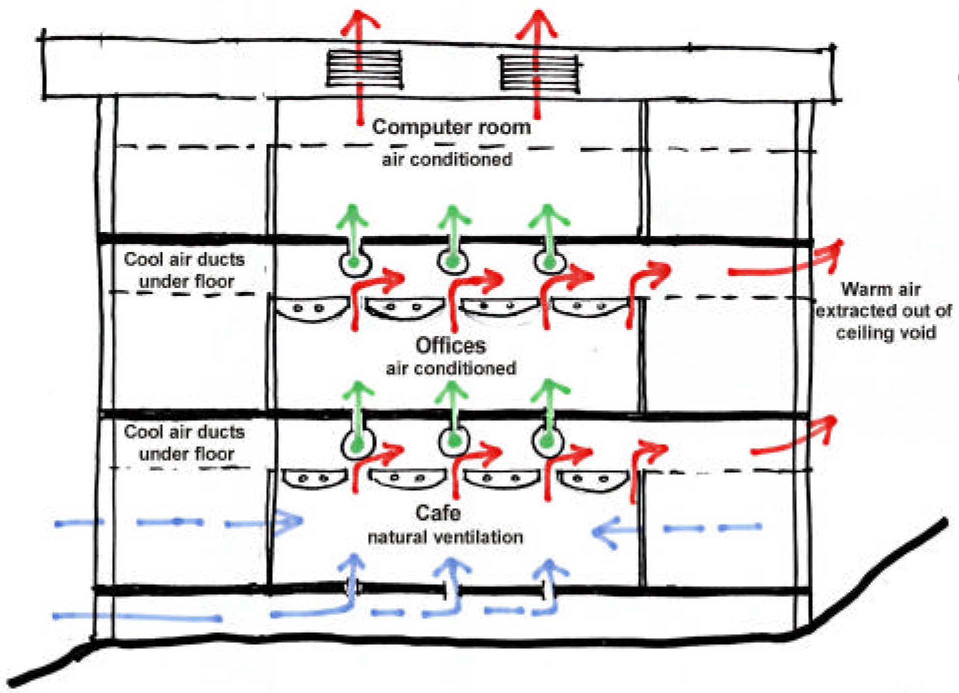
- To all areas other than computer room and offices
- The predominant winds in Durban are South East and South East, in line with the off set grid.
- A space between floors, in line with the lattice girders, is provided for airflow. This space is divided into two; Fresh air intake (upper) and warm air extract (lower)
- The fresh air intake space opens to the prevailing wind (wind operated flaps). The extract space would then be automatically closed on the prevailing wind side in order that the warm air is not recirculated into the fresh air intake.
- When the wind changes the flaps reverse.
- The wind is pulled up though the floor through vents between lamella perpendicular to the wind direction
- Cross ventilation through windows, louvers, etc.



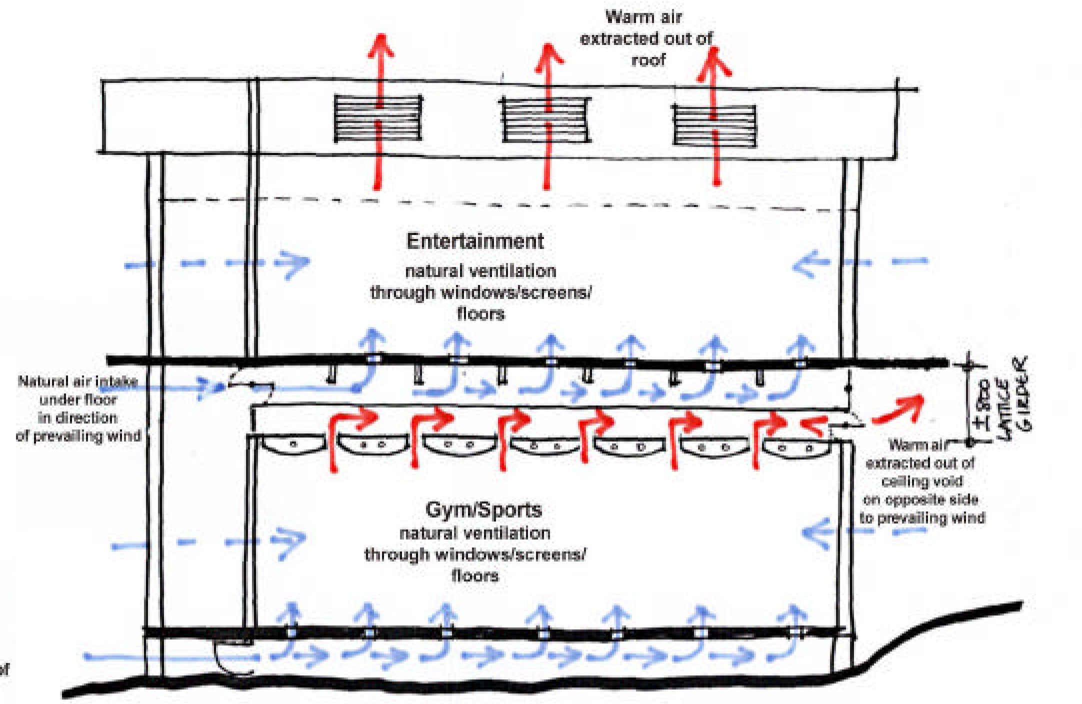
Section C - C

Air Conditioning to Computer Room and Offices

- Air to the computer room and offices is cooled by an absorption chiller. Most of the energy required to power the refrigerator is harnessed from the solar thermal collectors mounted on the roof.
- The reject heat is released to the outside through large air-cooled heat exchangers, located away from the air intake.



Section A -A



Section B - B

Additional Cooling & Heating

- For days with little or no wind, low powered fans would be installed in non-air conditioned spaces.
- Additional cooling could be provided by active concrete ceilings i.e. Cold water reticulated in pipes embedded in concrete.
- Energy efficient heaters for short winter periods e.g. gas

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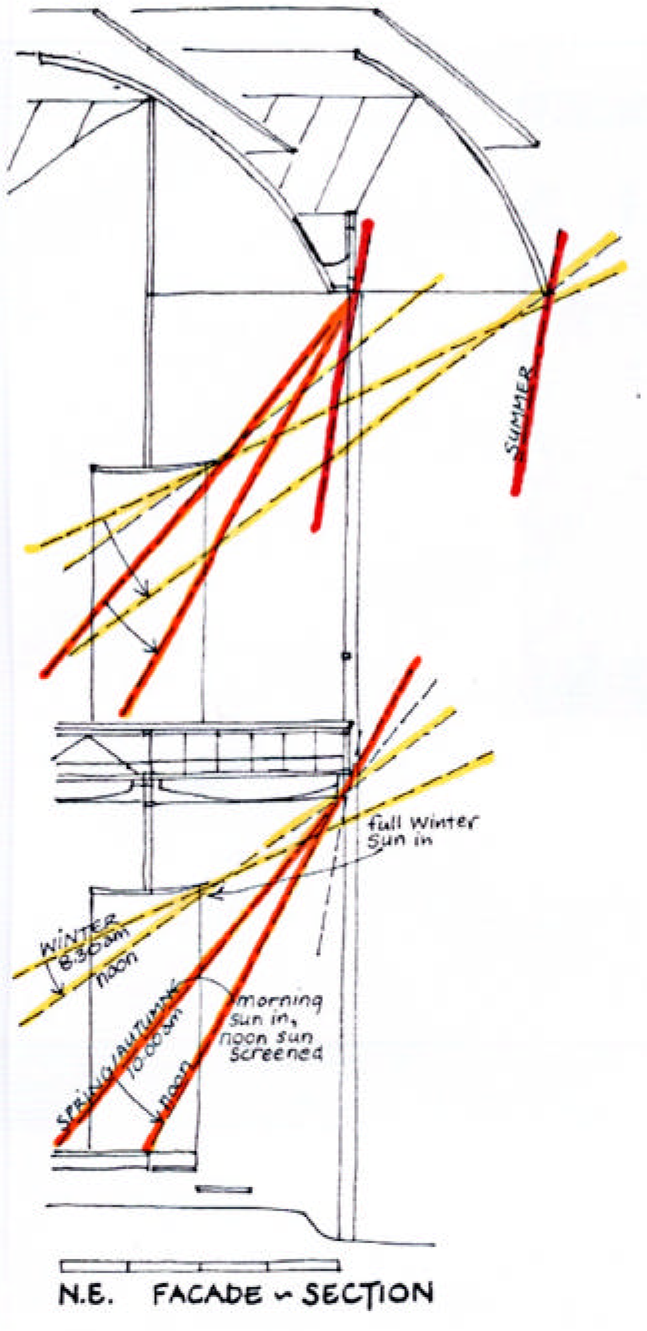
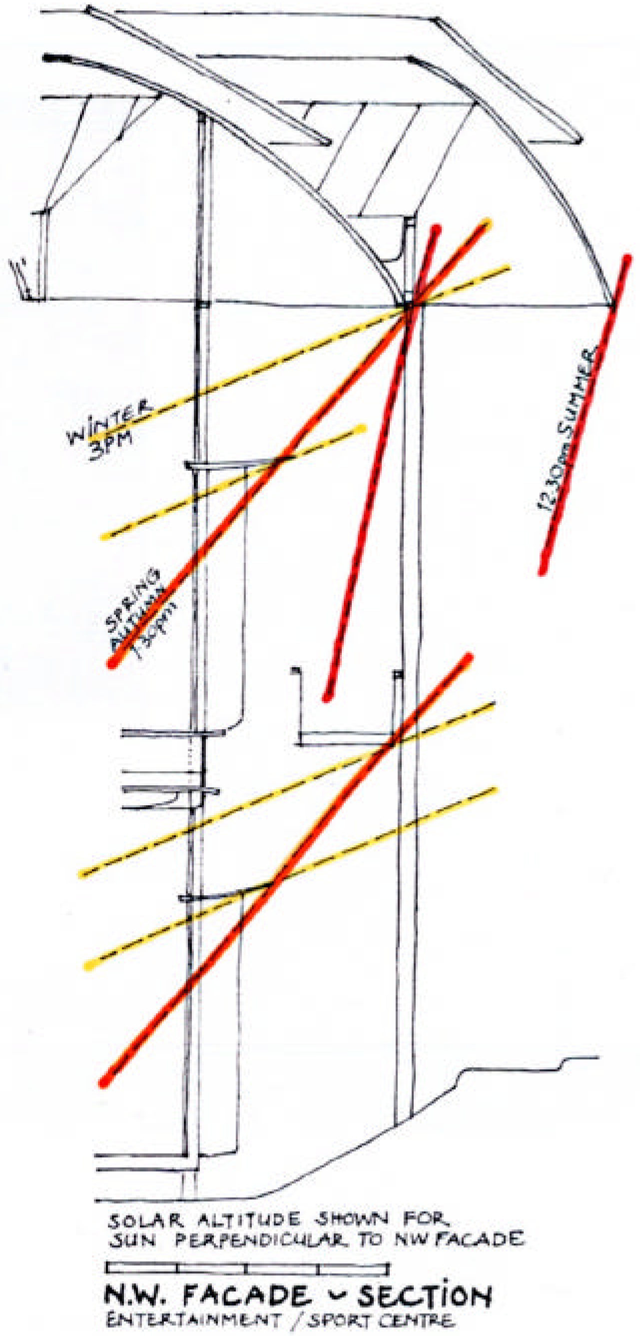
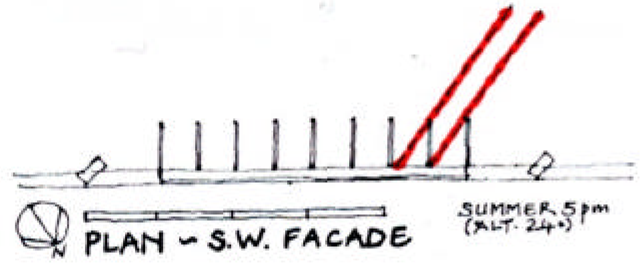
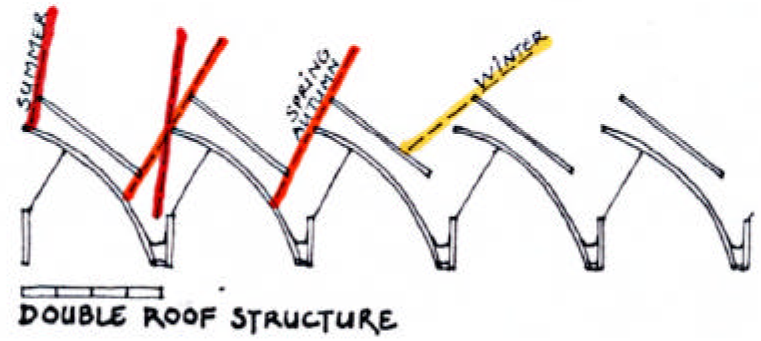
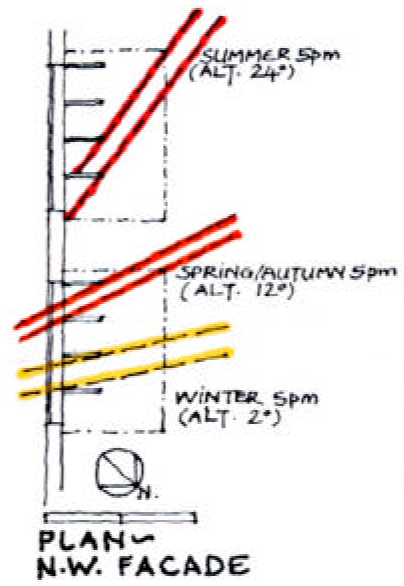


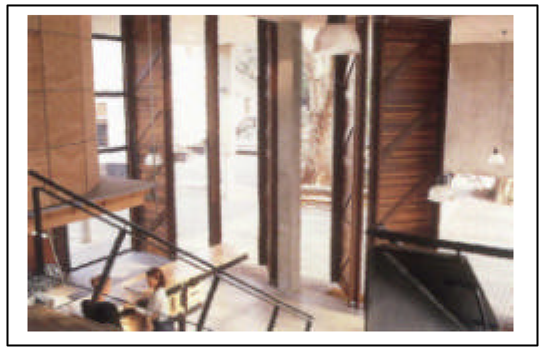


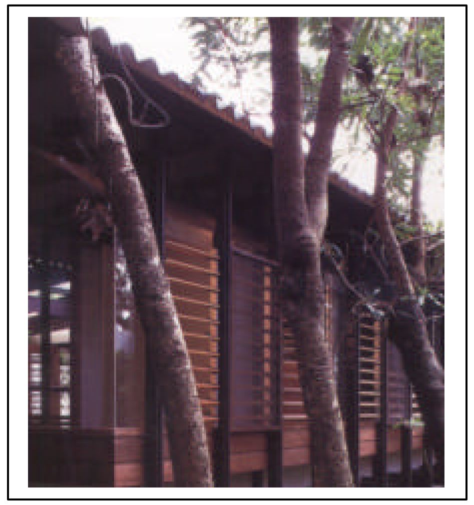






- For this climate, summer sun should be excluded altogether, and winter sun allowed to penetrate.
- During spring and autumn seasons only a small amount of sun shines into the building, as heat gains can still be a problem at the end of summer. The diagrams show that morning sun would penetrate, but noonday sun would be shaded by the overhang.
- The diagrams show how the roof overhangs are the most important shading element on the north east facade during the hottest part of the day. Morning sun is dealt with at the level of the facade screens - east facing panels to be solid, or use adjustable louvres.
- On the north west facade a combination of roof overhang and vertical screens to deal with late afternoon sun is better.
- On the south west facade vertical screens are the most important, as late afternoon summer sun at low altitude can cause major heat gains.
- On all facades, and especially in the office and computer room areas, flexibility of controls, and especially control by users are important.
- Screening systems therefore should be adjustable or removable as required.



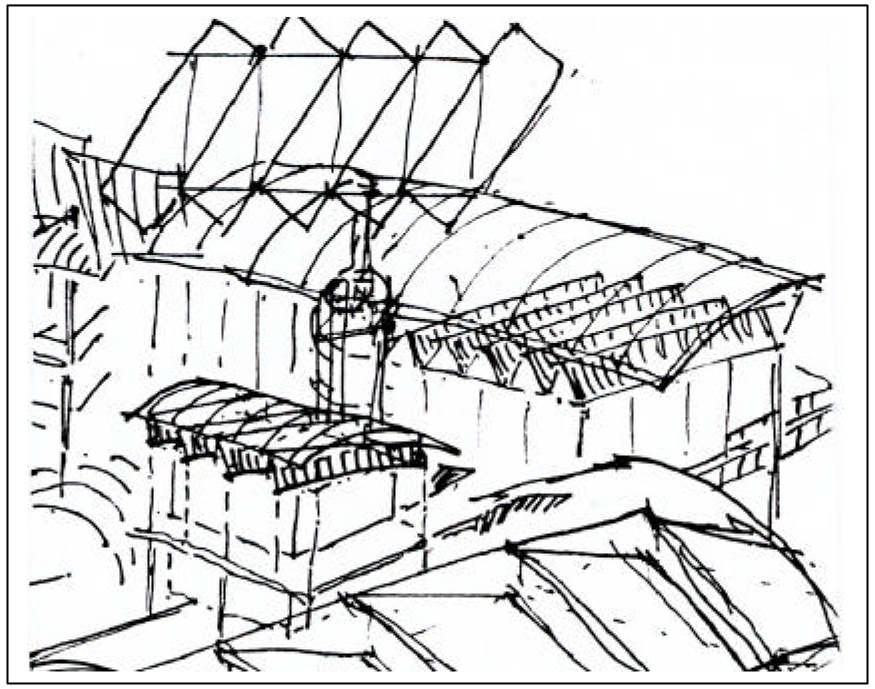


Examples of Screens

Solar Controls

Energy Systems

- Although situated in an area with access to the grid, use renewable energy systems where possible, e.g. Solar (photovoltaic electricity generation, hot water, air conditioning) or wind (electricity generation) and ventilation systems.
- The Youth Centre can use their renewable energy systems to become a grid-connected Independent Power Producer (IPP).
- All electrical fittings and appliances to be low energy, with special attention paid to lighting and cooking.



Assessment of the performance of the solar roof

Solar collector area: 400 m2 (not shaded by winter sun)

An absorption chiller with cooling capacity of 90 kW requires approximately 150m2 solar thermal collectors.
250 m2 of photovoltaic panels can be installed, which can produce 20kW of power, or approximately 100kWh per day.

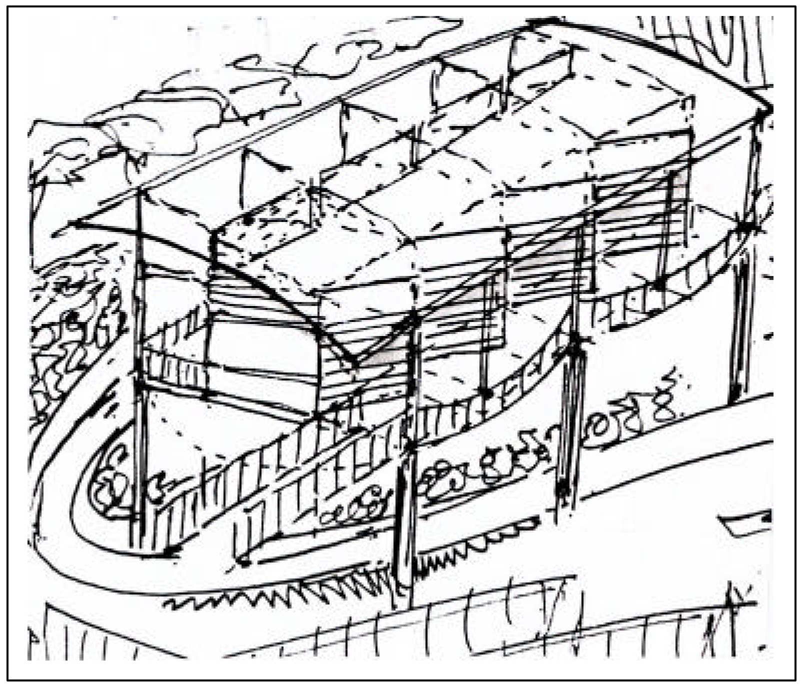
Assumptions for approximate daily energy loads for the Youth Centre:
Computers: 24kWh
Fans etc needed for cooling equipment: 24kWh
Lighting: 2kWh
Refrigeration: 3kWh
Total: 53KWh

Therefore approximately half the energy produced is needed to supply the energy needs of the building, and half can be fed back into the grid.

The approximate cost of such an installation could be in excess of $70000, therefore very expensive. Such an installation would have to be funded by an agency promoting the use of renewable energy technologies.

In Durban, wind energy is also a feasible option as average wind speeds are about 5m/s. Wind turbines with power output of 20kW may cost approximately $10000, therefore promising to be more economical.

A more detailed assessment would be required to show whether wind, solar or a combination of the two would offer the most effective, economic power generating solutions.



Further Design Development

Should this design process continue, various improvements and refinements could be implemented, especially in the area of optimising the energy systems, yet the level to which climate controls are implemented, has to be balanced against user expectations and requirements in the context of an African city. The important thing is to settle on the most appropriate combination of elements that would allow the building to be sustainably used and managed.

Naturally ventilated areas

- It is very important for these areas to be of light construction and for facades to open up as much as possible when required.
- The areas utilising natural ventilation only should contain a number of low power fans to circulate air on no wind days.
- The air circulation as proposed through the floor could be improved by taking the exhaust air in small ducts all the way to the roof, instead of venting at facade level. Small back-up fans in the ducts would be necessary for no wind conditions.

Cooled areas (computer room and offices)

- These areas could function using natural ventilation for some of the time. The cooling systems are put in place to deal with the hottest times of the year. This is a way of reducing the energy demand of the building.
- The construction would be modified to contain some thermal mass, e.g. concrete floor & ceiling structure, some brickwork.
- Detail for air tightness of the enclosure, and insulate.
- Consider splitting the cooling systems for the offices and computer room, as the heat load patterns are very different (internal heat gain resulting from use of computers does not change, as climate and season based heat gains would). It could be an advantage if only the computer room could be cooled, and not the offices. A mechanical system may be necessary as back-up.
- The technical systems could be located within the roof structure. This would be better for optimal functioning of the exhaust system.
- Cold season heating is not a great requirement in this climate, but could be supplied simply by portable gas heaters in the workspaces.
- There are also options of utilising 'active concrete', i.e. piping hot water from solar thermal collectors or cold water through ducts in the floor slab. The disadvantage of this system is the time lag (could be several days) before the heating or cooling effect is felt.

Budget

- For the purposes of this project, the budget was not considered a constraint. However, should the project be properly contextualised, this would be a factor. Though the design could possibly be rationalised in a number of ways, it is hoped that design for low energy demand resulting in low running costs, and excess power produced by the solar roof, can offset some of the initial capital investment.

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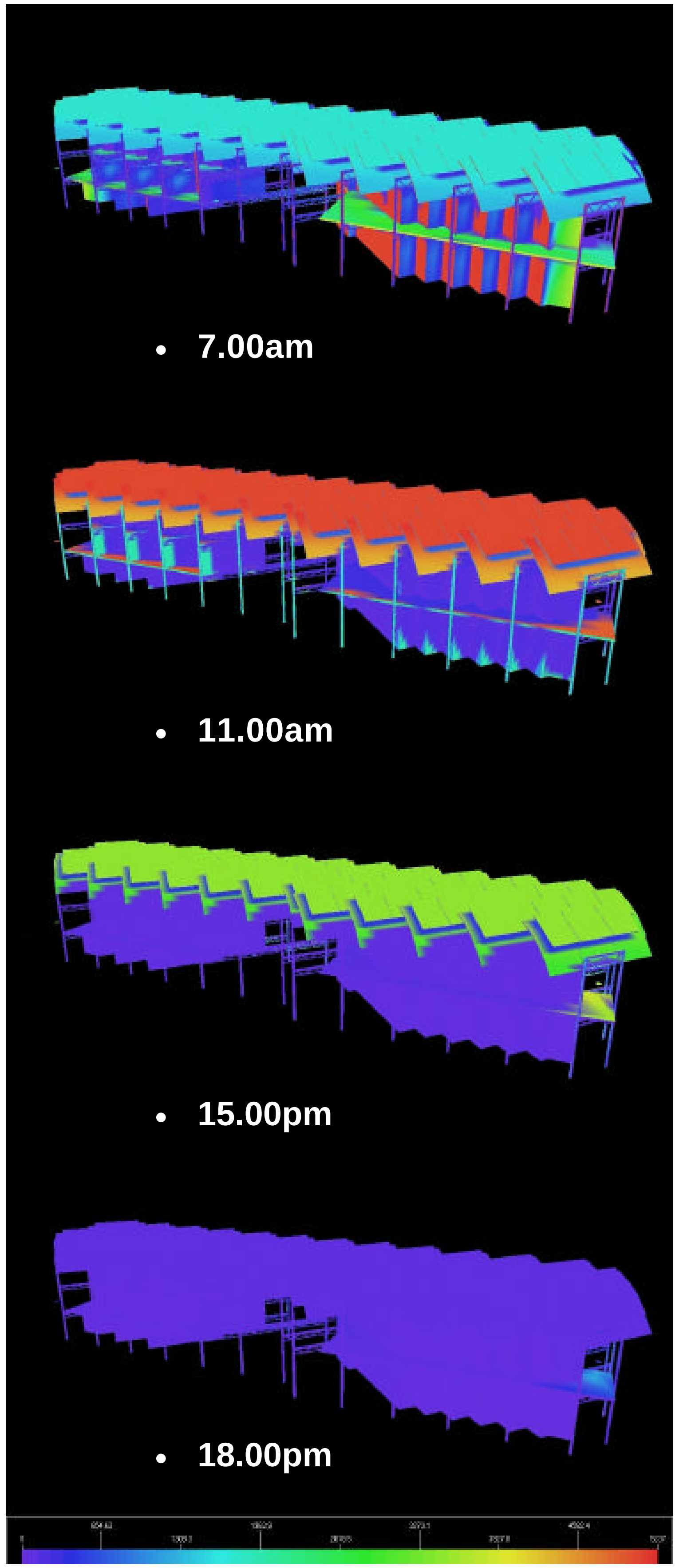
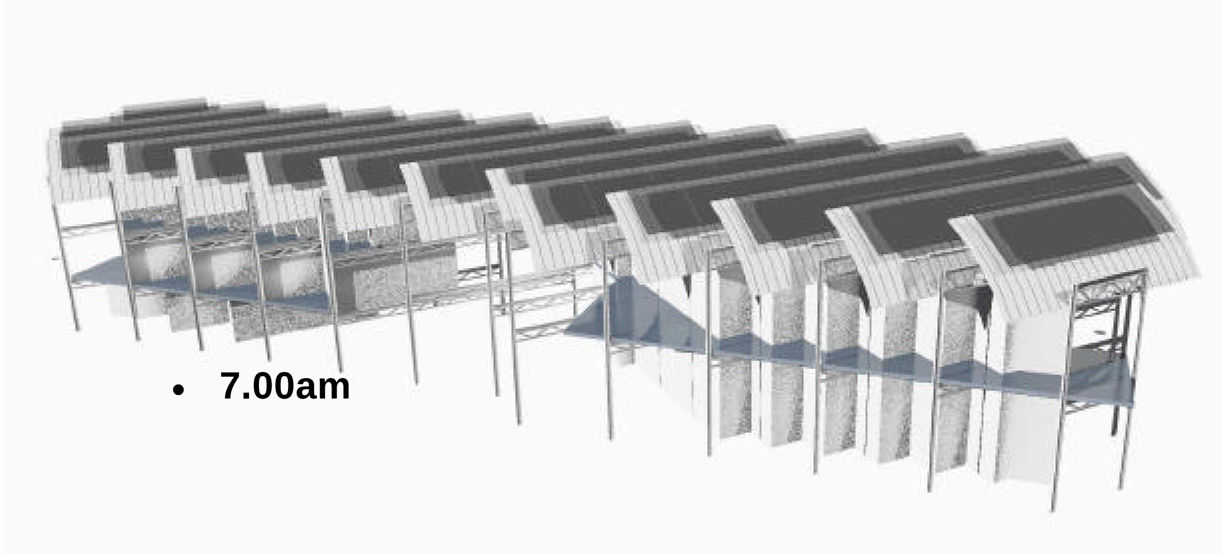
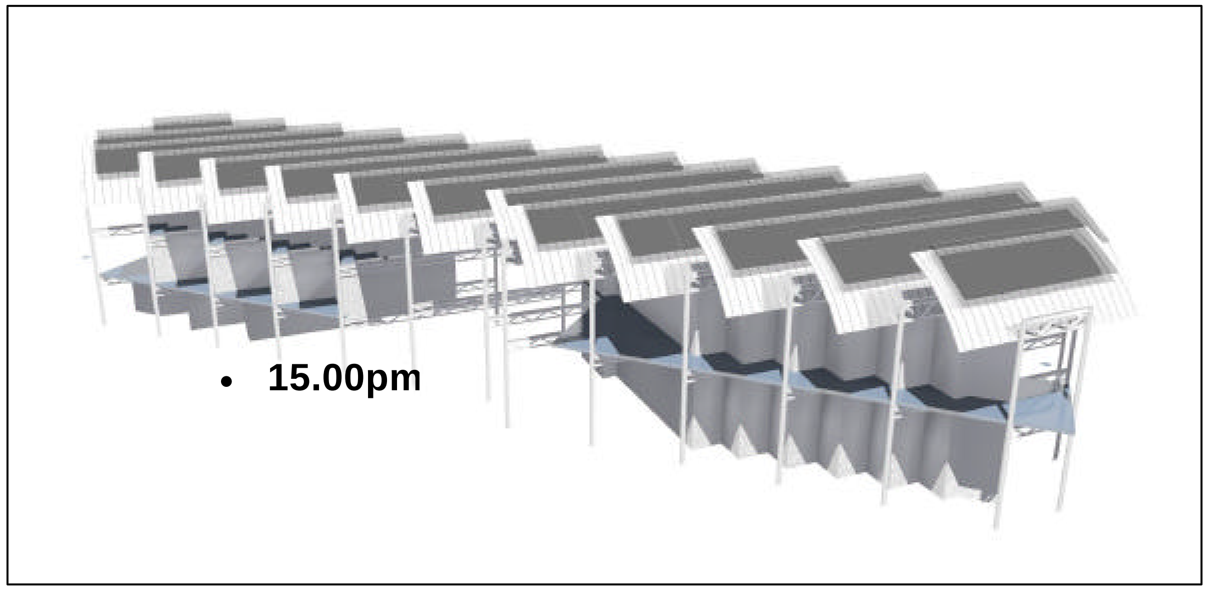


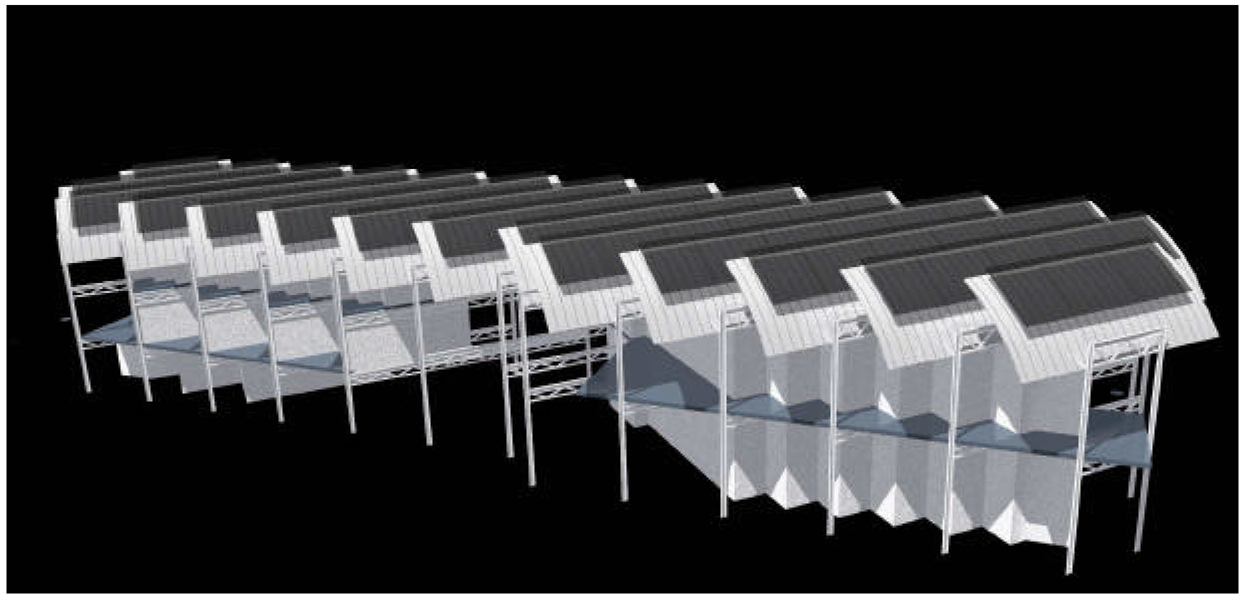


A heat gain analysis illustrates the effects of the sun on the facades

The red and yellow facades need the most attention with regards to sunscreens and material choice.

Note: Effect of solar screens shading of main roof





Heat Gain Analysis

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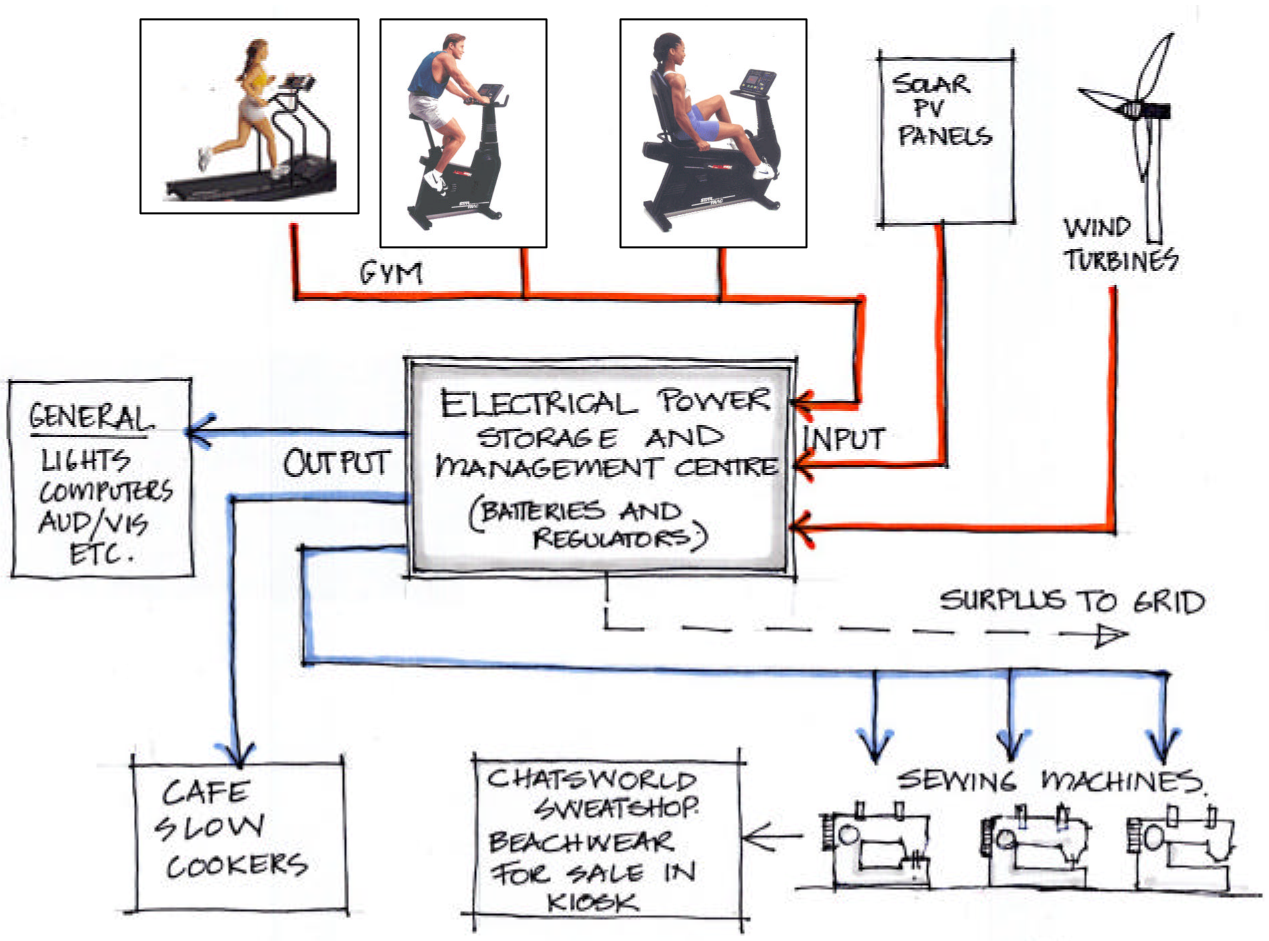
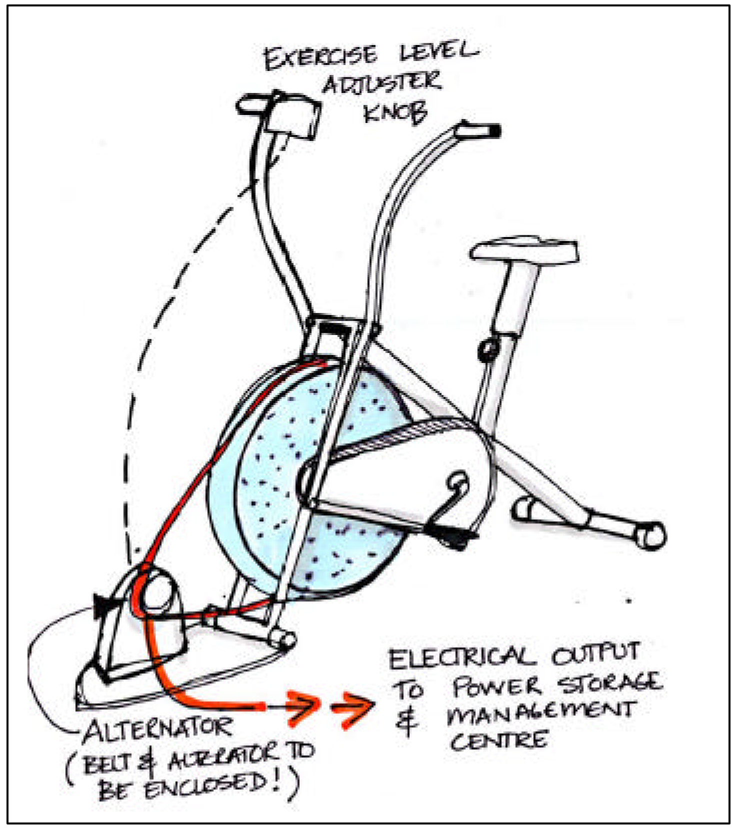
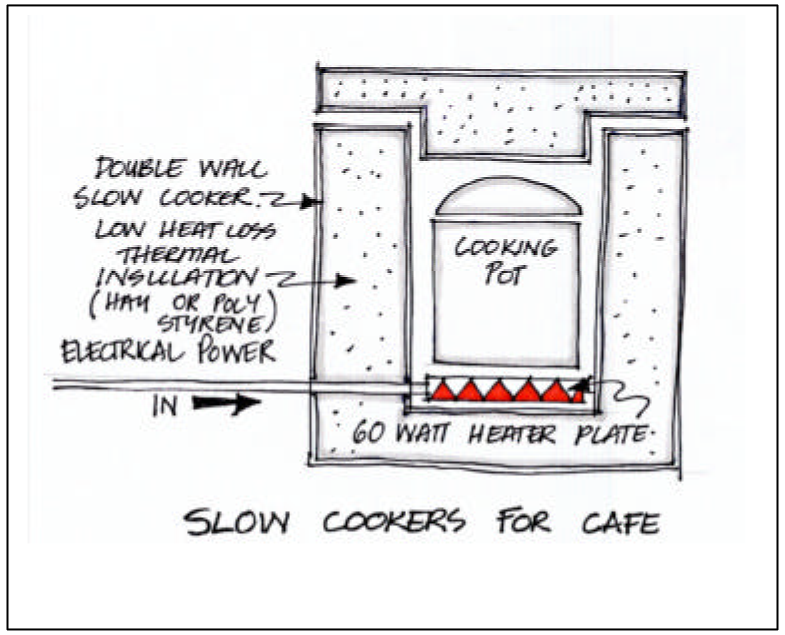
Chatsworld youth centre







A system for energy recovery and reutilisation.

Introduction

Health Clubs have become a common feature of suburban life, assembling a substantial number of people over waking hours, exercising themselves at one location on a variety of equipment, all of which dissipates any work done as wasted heat. A healthy person on an exercise machine can generate as much as 60 watts of available power. One hundred people exercising simultaneously can create six kilowatts of electrical power, enough to supply a small commercial or light industrial job-creation undertaking with its power needs. As an example, six kilowatts will operate one hundred and twenty 50-watt sewing machines continuously. If the sewing machines are run half the time, typical of actual use, their number can be increased to two hundred and forty sewing machines.

Health Club Exercise Machines

These take the form of bicycles, rowing boats and treadmills. Force applied by the user is absorbed by a rotating mechanical system, which applies some form of braking, to make the users exert themselves.

The modification to these exercise machines

Each of these exercise machines is fitted with an ordinary automotive alternator, which is an easily available and reasonably priced item, this replacing the braking system originally in the exercise device. The user of the exercise device is provided with a control to the alternator power output, in order to match exercise load with the user's stamina. These alternators can provide either 12-volt or 24-volts DC electricity, that can be routed to a power management system, charging battery banks, that will then provide 240-volt AC through inverter packs on demand to the electrical appliances, in this case, the sewing machines.

Solar and wind power back-up

Additionally, the building may have solar-electric panels fitted to the roof, providing a supplementary source of electricity during daylight hours, increasing the average amount of electrical power that can be supplied by the combined system. Further augmentation is possible with "wind-chargers", an advantage in locations where average annual wind-speeds are high, as is on the coast at this site.

Advantages

Besides a small empowerment industry being supplied its energy needs without an electricity supplier's charges, the decrease in demand for electricity generated from coal, oil or nuclear power will have a positive effect in terms of overall environmental impact. Members of the health club will also have a sense of accomplishment in knowing that their exercise efforts have been put to creative and constructive use.

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