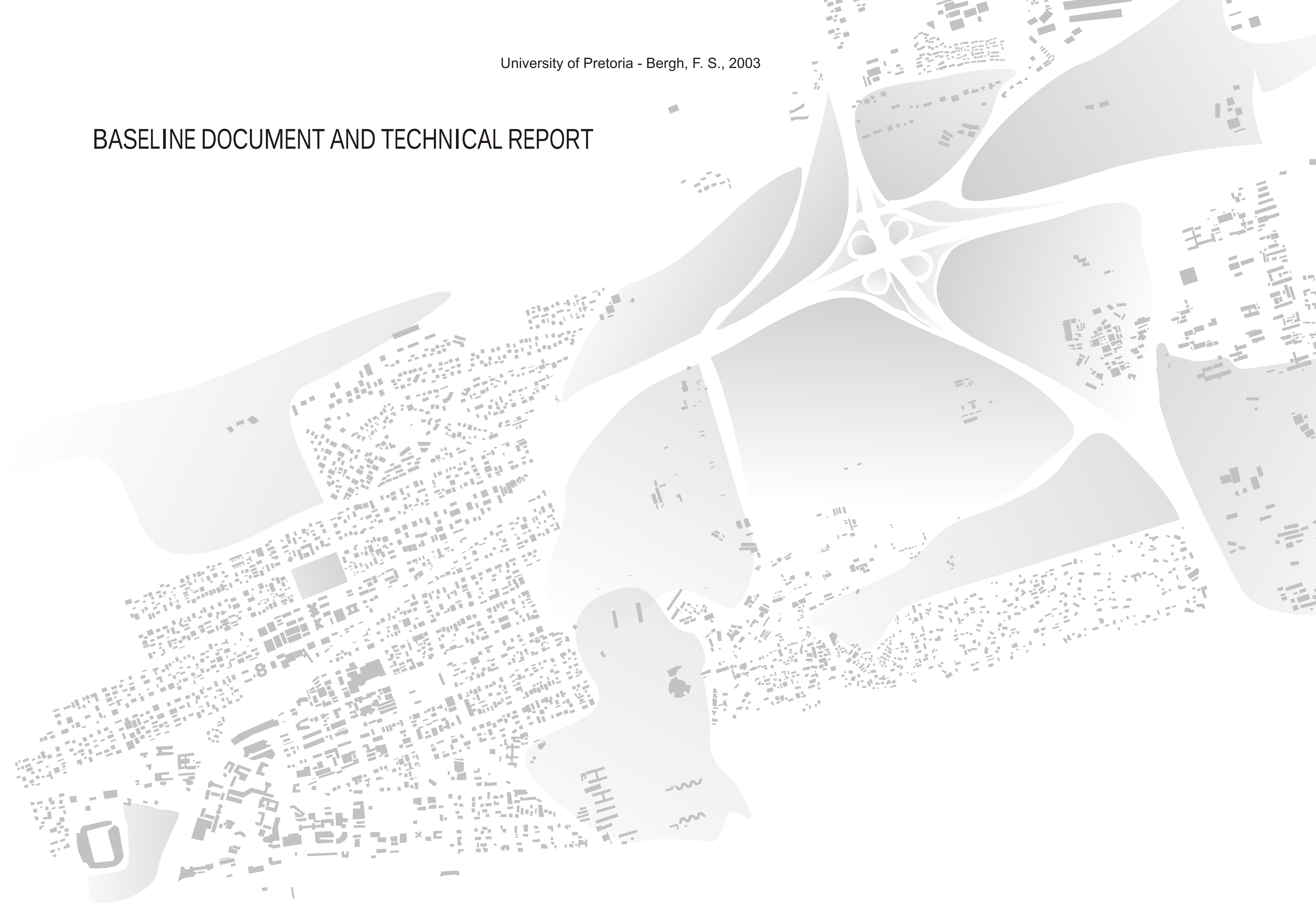
University of Pretoria - Bergh, F. S., 2003

BASELINE DOCUMENT AND TECHNICAL REPORT



Occupant Comfort:

The quality of environments in and around buildings has been shown to have a direct impact on health, happiness and productivity of people. Healthier, happier and more effective people contribute to sustainability by being more efficient and therefore reducing resource consumption and waste. However the quality of this environment needs to be achieved with minimal cost to the environment. [Gibberd, 2002]

Thermal Comfort:

Thermal comfort is achieved when the users of buildings experience adequate levels of temperature, humidity, and air movement and heat radiation. Thermal comfort, however, exists only within a small range of temperature fluctuation, this at the same time being the optimal thermal conditions for intellectual performance, presuming that other influencing factors are also ideal (air movement, humidity, surface temperature, clothing, age and degree of activity).

Perceived room temperatures ranging from 20-22 degrees Celsius are acceptable with certain ventilation systems (e.g. floor to ceiling ventilation and displacement ventilation). Thermal comfort is greatly influenced by the air movement within spaces. Ensuring user participation and control within naturally, cross-ventilated spaces should allow for adequate air velocity and in turn, thermal comfort.

Storing Thermal Energy:

A reason for incorporating mass into buildings is to create a positive ambient climate with the least amount of technology. Thermal storage in buildings is usually geared to reduce the heat load caused by exterior or interior gains without resorting to the use of cooling energy supplied by electrical gas motors or other technology. In these cases, the momentary loads are so changed by the storing elements that the heat-gain time function changes into a cooling-load time function. The room as a unit absorbs radiant heat at the interior surrounding walls, through windows (diffuse and direct solar incidence), from artificial lighting and from occupants, machines etc. all of which have an effect. The amount of heat penetration into walls or storage components depends on the type construction and the duration of radiation.

Surfaces are in a constant state reciprocal radiation exchange; depending upon air and surface temperatures, a convective heat transfer is effected from the surface to the air and vice versa. A rise in room temperature triggers a reduction in the cooling load from thermal storage. A fall in room temperature triggers an increase in the cooling load owing to heat release. The accuracy achieved in computation and stimulation procedures is now at a level that results relating to diurnal processes can be applied in the design stage of a building to predict how rooms will react to specific stress criteria and storage behaviour in any given climate. [Daniels, K. 1998]

The thermal comfort in the NAledi3DVR Factory will rely on passive principles. These include cross ventilation and the use of solar incidence to produce comfortable spaces. The louvres on the north facade are fully adjustable and each module can be adjusted separately to conform with the related functions within such module. Be it office space, lecture facilities, training stations or recreational areas.

The mortared stone cisterns on the western facade acts, not only as an aesthetic element, but also as solar buffers for unwanted late afternoon sun. The capacity and performance of these cisterns will be discussed at a later stage in this document.

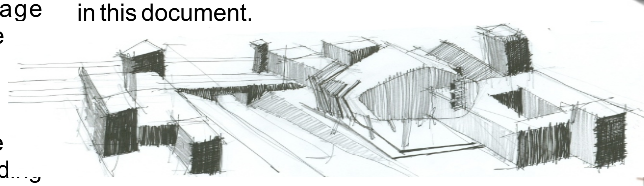


Fig. 81 : Concept Drawing Axonometric

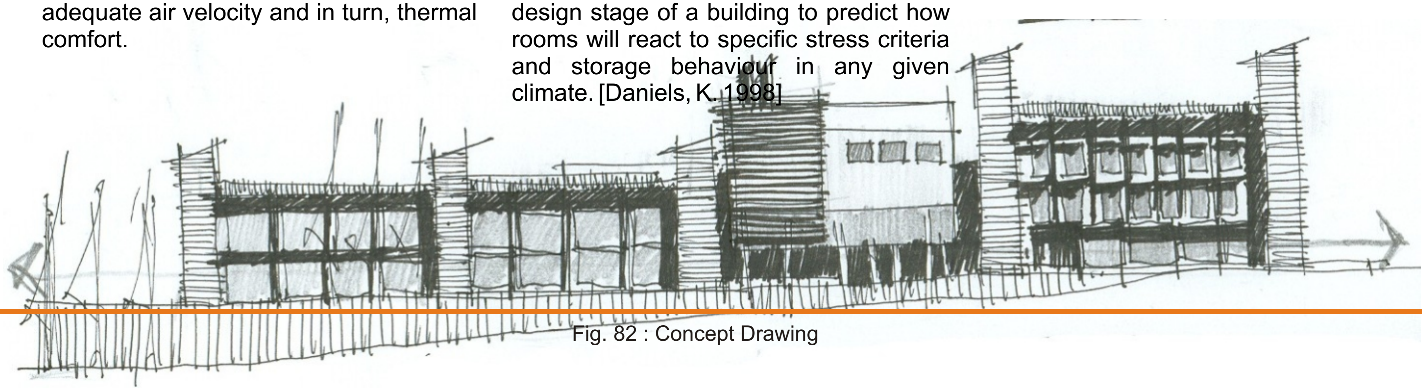


Fig. 82 : Concept Drawing

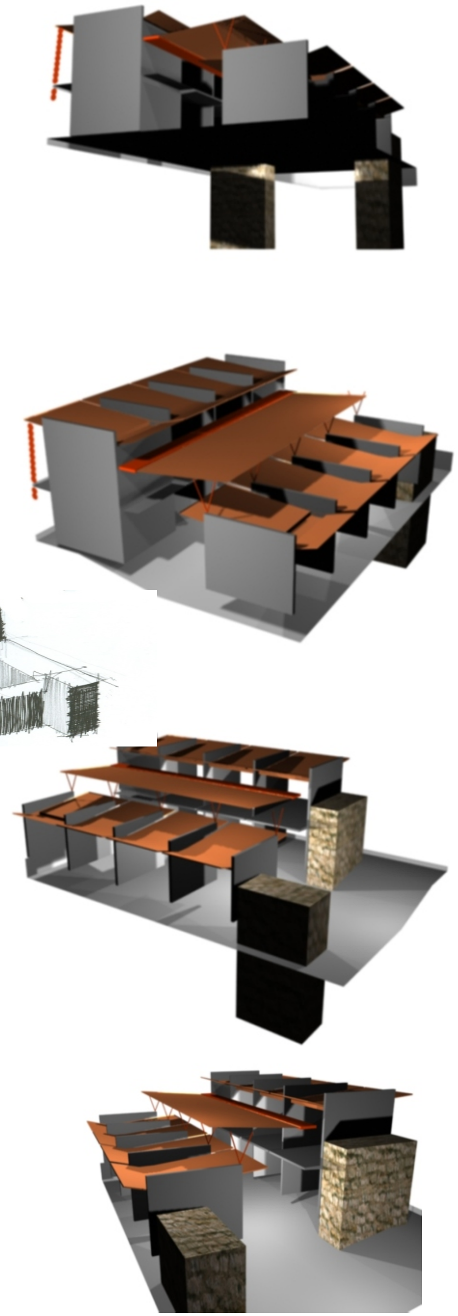


Fig. 83: 3D's with mortared stone cisterns

Lighting:

The internal spaces of the building should be well day lit, natural lit buildings are more cost effective and provides a good quality of light to patrons. The building should be orientated accordingly while brise soleil and overhangs should be calculated and applied to limit direct sunlight from entering the building. Dispersed lighting is more effective than direct lighting and cuts out the negative effects of direct sunlight.

The comfort of users of buildings can only be achieved if the path of the sun in winter and summer is taken into consideration at the design stage. Glare problems associated with visual-display surfaces such as computer monitors and undesired room temperature increases in summer make sun and glare protection necessary. Ultimately, the following conditions for light technology have been established as universally desirable [Daniels, K.1998]

- Sufficient daylight, adjustable to each person's needs
- A good mix of diffuse and direct light
- Good visual contact with the outside to experience the weather and the time of day

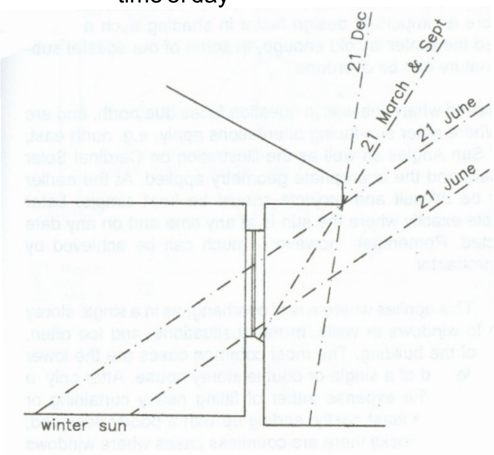


Fig. 87 : Sun Angles for Winter and Summer [Napier. 2000. P.4.12.3]

The louvre systems allows for direct incidence and also for diffused light penetration. Sunlight will be reflected into the building by rotating the louvres to the desired angle. As mentioned previously, each module can maintain its own quality of light and degree of incidence. The louvre system will produce total flexibility in terms of unwanted glare for desk work, computer work and lecture facilities.

The southern facade of the building will be transparent enough to provide good visual contact with the outside, and to experience the weather and the time of day. The views to the south are limited to the protected green open space and there are virtually no reflective elements or surfaces that might cause glare problems.

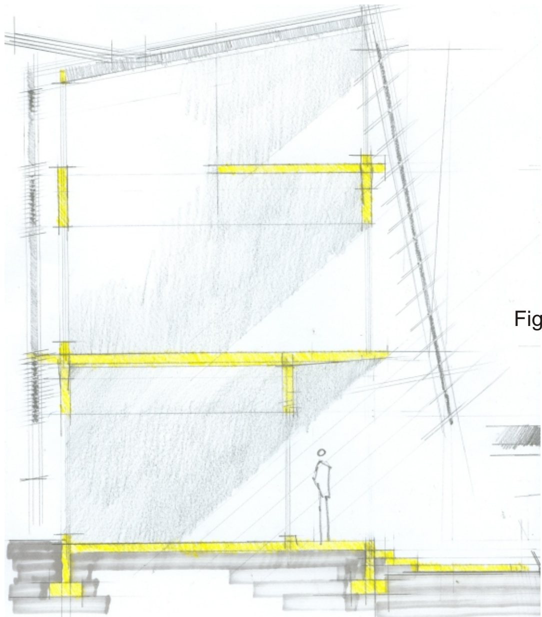


Fig. 88: Section with louvres for solar incidence

Fig. 84:Louvre position for maximum incidence

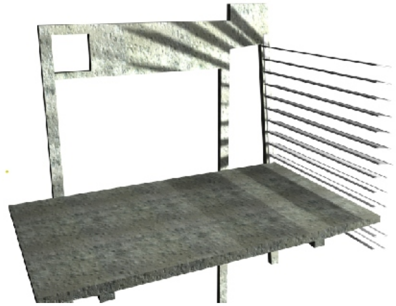


Fig. 85: Louvre position for diffused light

Fig. 86: Closed louvre position

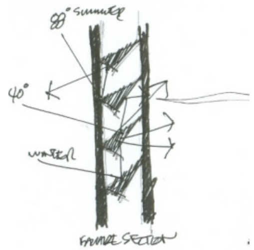


Fig. 89: Sun Angles and incidence

Recommended Lighting Levels:

Atria:
General movement - 50-200 lux
Plant Growth - 500-3000 lux

Assembly Shops:
Medium work 500 lux

Lecture Theatres 300 lux

Newsagent shops 500 lux

Offices:
Filing Rooms 300 lux
General Offices 500 lux

Public Rooms, Halls 300 lux

Teaching Spaces 300 lux

[Thomas, R. 1996]

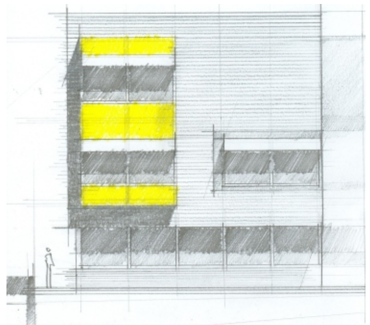


Fig. 90 : Elevation

Solar Energy:

The energy obtained from the sun can be harnessed and used to produce more energy efficient, passively ventilated and thermally comfortable buildings without the installation of high maintenance and expensive "secondary" systems. Dark surfaces absorb sunlight and generate heat energy (thermal energy), which can be used in passive ventilation applications such as solar stacks. Systems that can be used to transform sun energy into heat include window collector panels, air collector panels, transparent insulating materials in front of absorbing walls and collector systems.
By employing a hybrid of these systems the building will be able to ventilate by means of natural processes (with a user interface).
By using solar stacks on the northern façade the interior spaces will be ventilated by a stack effect. Solar screens allow for heat gain in winter months and blocks unwanted incidence in summer months.

The use of photovoltaic panels are discouraged due to the feasibility of the panels in this specific application. These panels could still be incorporated in other buildings in the Innovation Hub development and will generate electricity which will be worked back into the municipal grid. The VR Factory, however, will use solar panels for the heating of water to be used in the ablution facilities as well as the kitchen of the coffee shop.

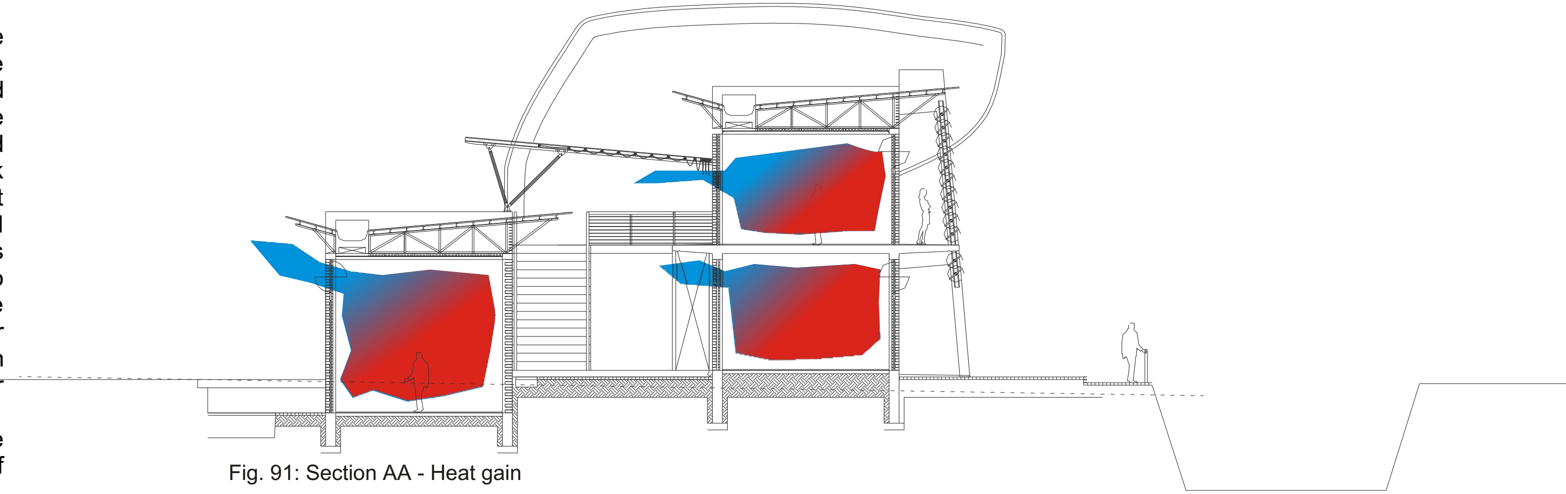


Fig. 91: Section AA - Heat gain

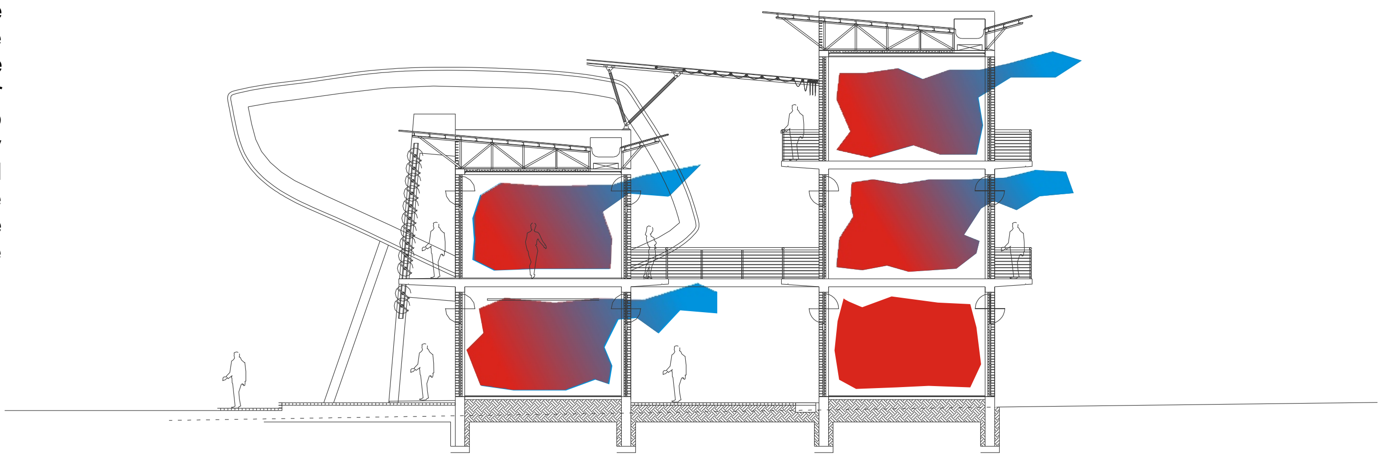


Fig. 92: Section BB - Heat gain

Ventilation:

It is proposed that mechanical ventilation will only be used in the ablution facilities and kitchens of the buildings in the development. Natural ventilation is essential in the design of the buildings. The footprint of the VR Factory is limited to a width dimension of 6-8m, which allows for adequate cross ventilation. Where the width exceeds 6m the use of solar stacks will be introduced to act as the catalyst for air circulation.

Hygienic Comfort:
The air quality in a room is determined by the quality of intake air, and by air-contaminating factors such as room usage. Intake air consists mostly of outside air, rarely of recirculated air. Outside air intake should ensure sufficient filtration of pollutants. The latter can be achieved by means of natural ventilation, if heat loss is kept low in winter and heat gain equally low in summer.
Further air pollution can arise from the processing of organic and inorganic elements such as:

- Gases and vapours
- Odours
- Aerosols
- Viruses
- Bacteria and spores

The air change, however, as a result of natural ventilation or the influence of air via a ventilation system guarantees the filtration and transport of pollutants and odours.

Air Requirements:

Occupancy	Min. Air Requirement l/s	Remarks
Public Halls:		
Assembly Halls	3,5	Air supply required per person
Auditoria	3,5	
Educational Buildings:		
Classrooms	7,5	Air supply required per person
Food and Eating:		
Restaurants	5,0	Air supply required per Person
Cafeterias, Cocktail Lounges	5,0	
Kitchens	17,5	
Offices:		
General	5,0	Air supply required per person
Meeting and Waiting Spaces	5,0	
Conference and Board rooms	5,0	
Cleaner's Room	1,0	Air supply required per m2 of floor area

[SABS 0400. 1990.p. 112-113]

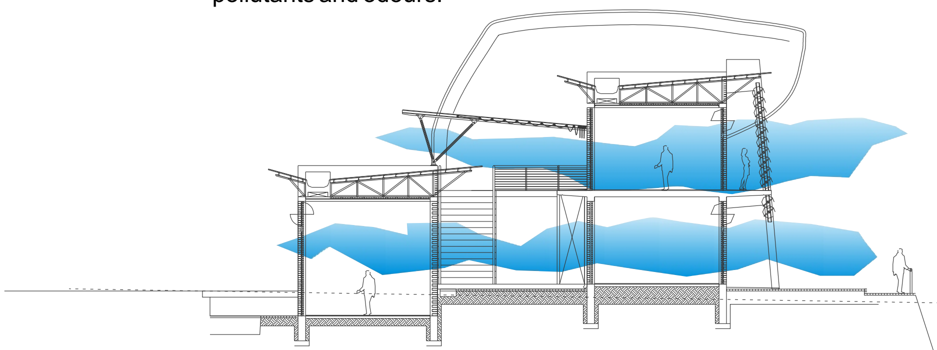


Fig.93: Cross-ventilation patterns in warmer months for section AA

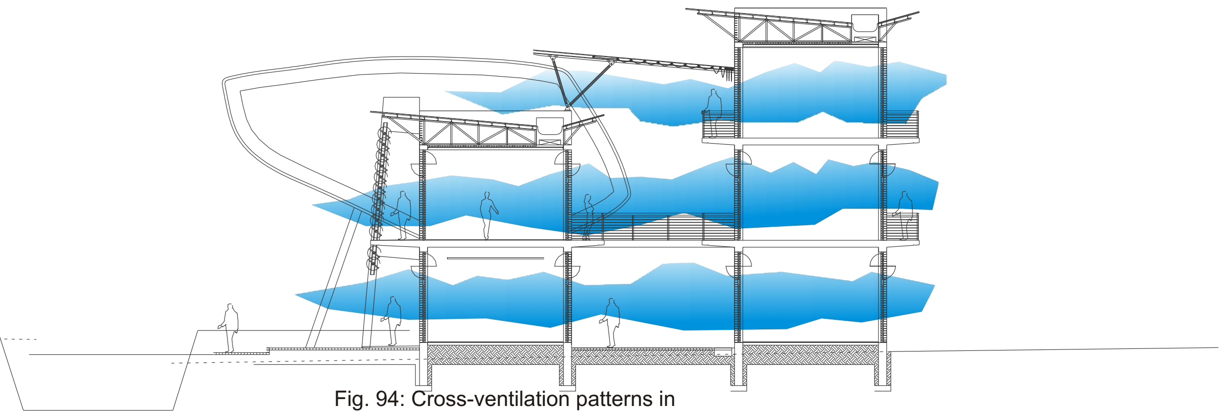
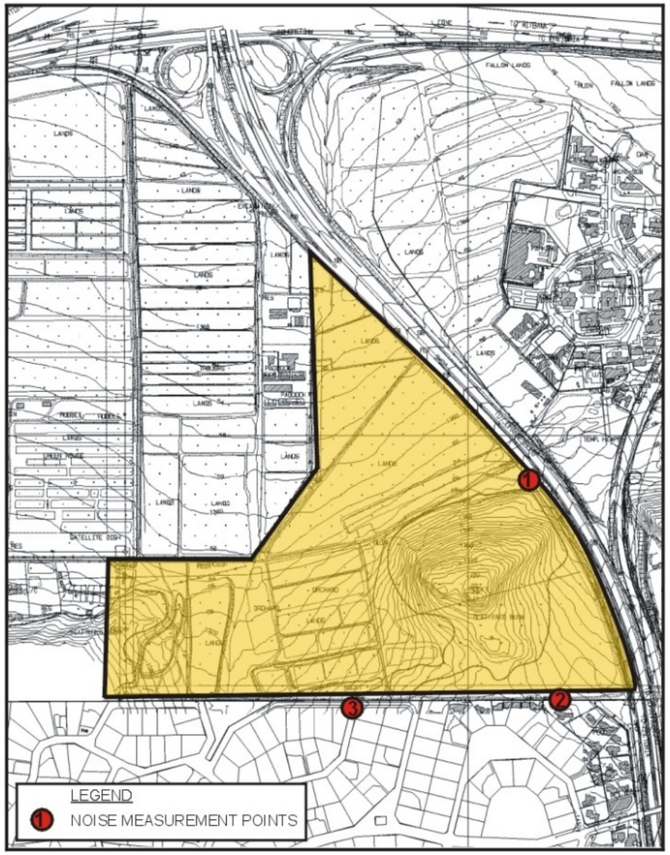


Fig. 94: Cross-ventilation patterns in warmer months for section BB



Location 1

Day/Date	Time	$L_{Aeq,I}$	L_{Amin}
Mon 22/10/01	16:15 - 16:25	76.7	67.8
Mon 22/10/01	16:27 - 16:37	77.1	68.1

Calculated value: $L_{Aeq,I}$ = 77.8 dB(A)

Location 2

Day/Date	Time	$L_{Aeq,I}$	L_{Amin}
Thur 18/10/01	16:12 - 16:22	65.1	61.3

Calculated value: $L_{Aeq,I}$ = 64.5 dB(A)

Location 3

Day/Date	Time	$L_{Aeq,I}$	L_{Amin}
Mon 22/10/01	16:47 - 16:57	51.0	44.9

Calculated value: $L_{Aeq,I}$ = 51.2 dB(A)

Noise:

Measured noise levels at the entrance to the Innovation Hub is measured at 77,8 dB (A) [JH Consulting, 2001] The buildings that are in close proximity to the entrance and effectively the measurement point, should respond acoustically to reduce noise levels for users and relevant functions.

Adequate noise levels:
Studios, concert halls, theatres - 25 db (A)
Offices, conference rooms - 35 db (A)
Measurements taken by acoustic experts are of concern since they indicate that more traffic translates into the doubling of noise levels every 10 years. In the information age, undisturbed environments are of paramount importance, and buildings must therefore provide surroundings where sound and noise levels are not perceived as unpleasant.

Activities which are not as affected by the noise generating from the highway, is located nearest to the bridge and the edge of the site. These include the security terminal,the ablution facilities the holography component and the water cisterns.The lecture halls will have double glazed glass panels on the southern facade.

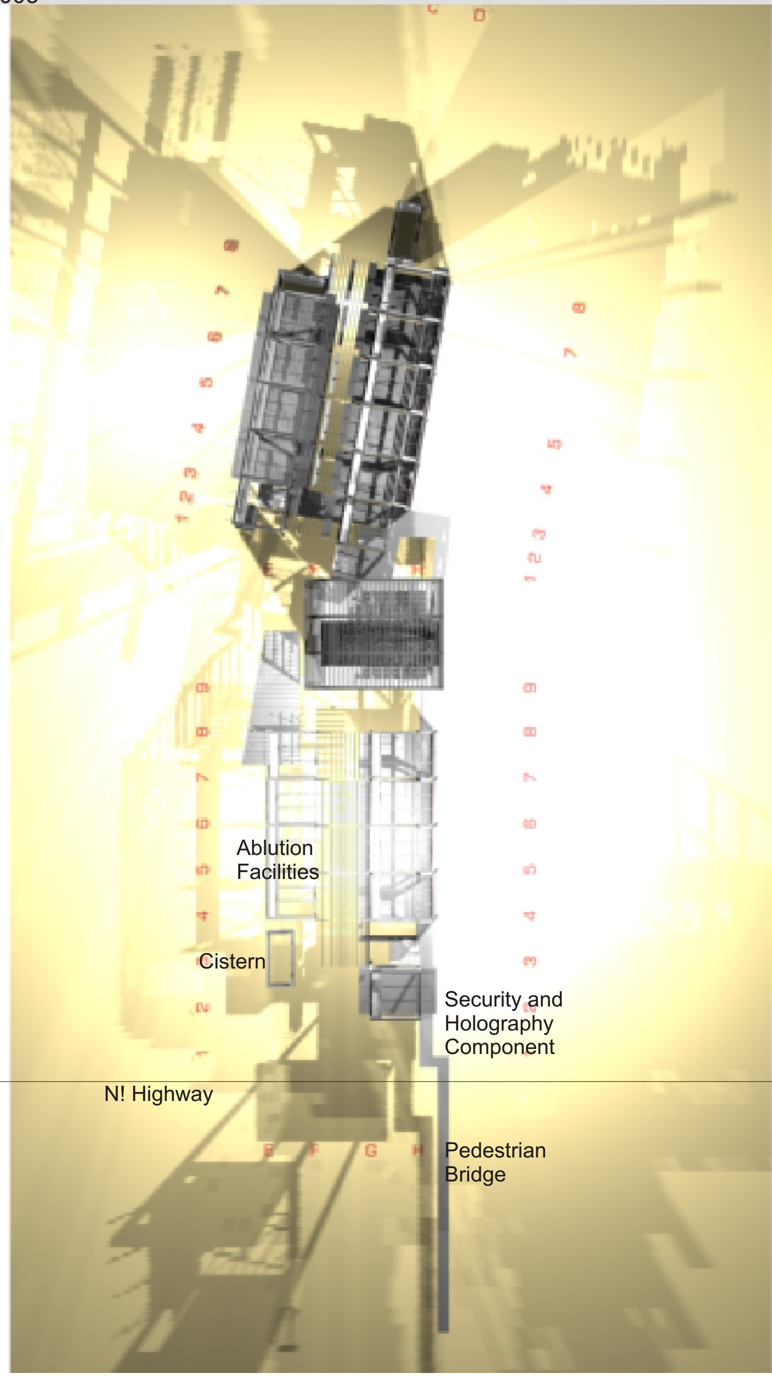


Fig. 95: Noise response

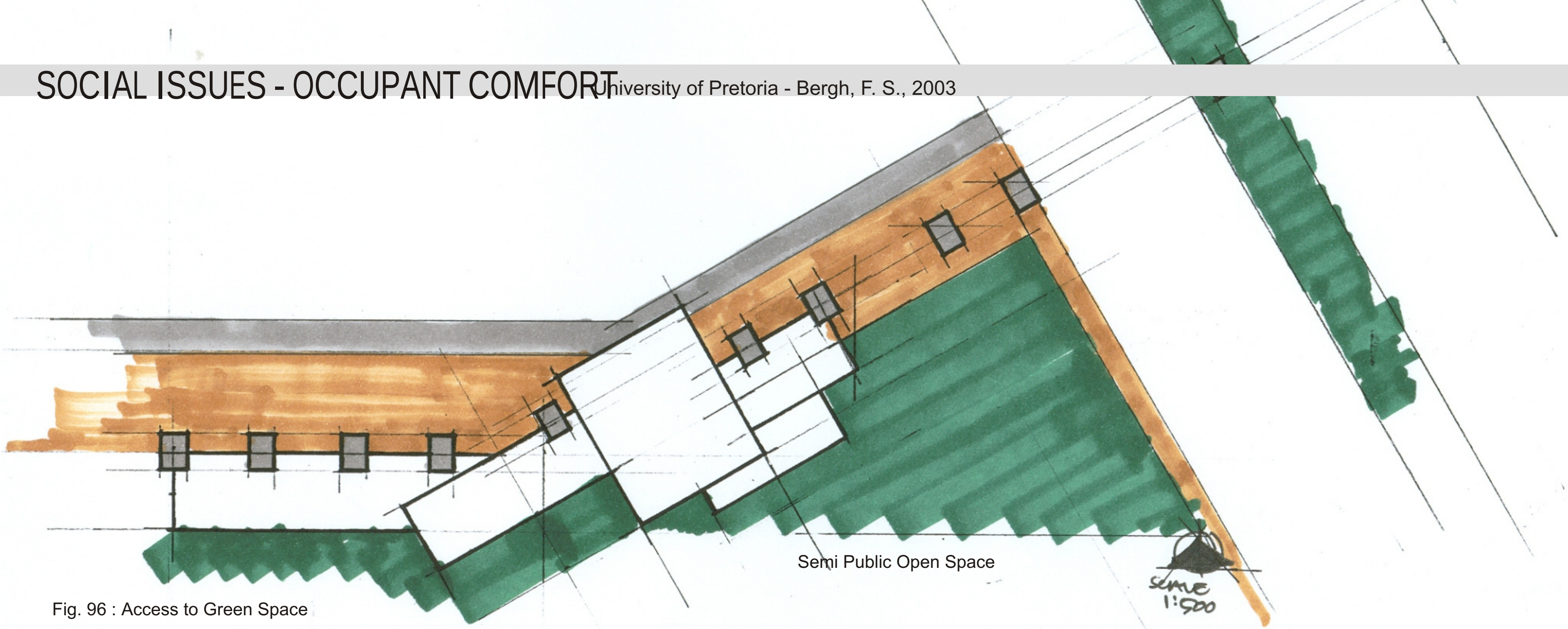


Fig. 96 : Access to Green Space

Views:
The Naledi 3D Factory is located on an important portion of the Innovation Hub development. The site offers views to the natural surroundings and also allows for commercial opportunities towards the N1 highway.

Access to Green Outside:
The building will have a private open green space where social activities or functions can take place. The area is shown on the accompanying drawings. The green area is of importance to allow for adequate breaks from the work environment and improve the working/corporate environment.

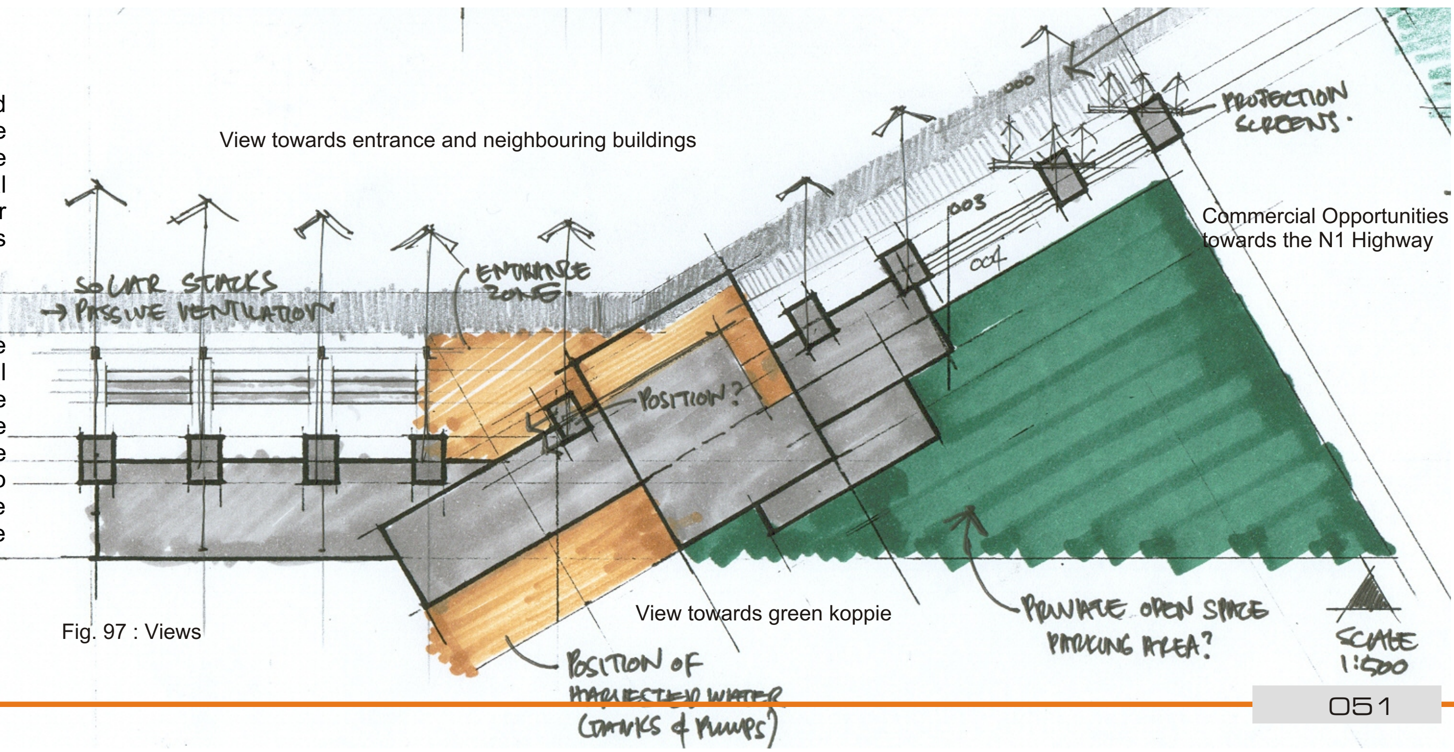


Fig. 97 : Views

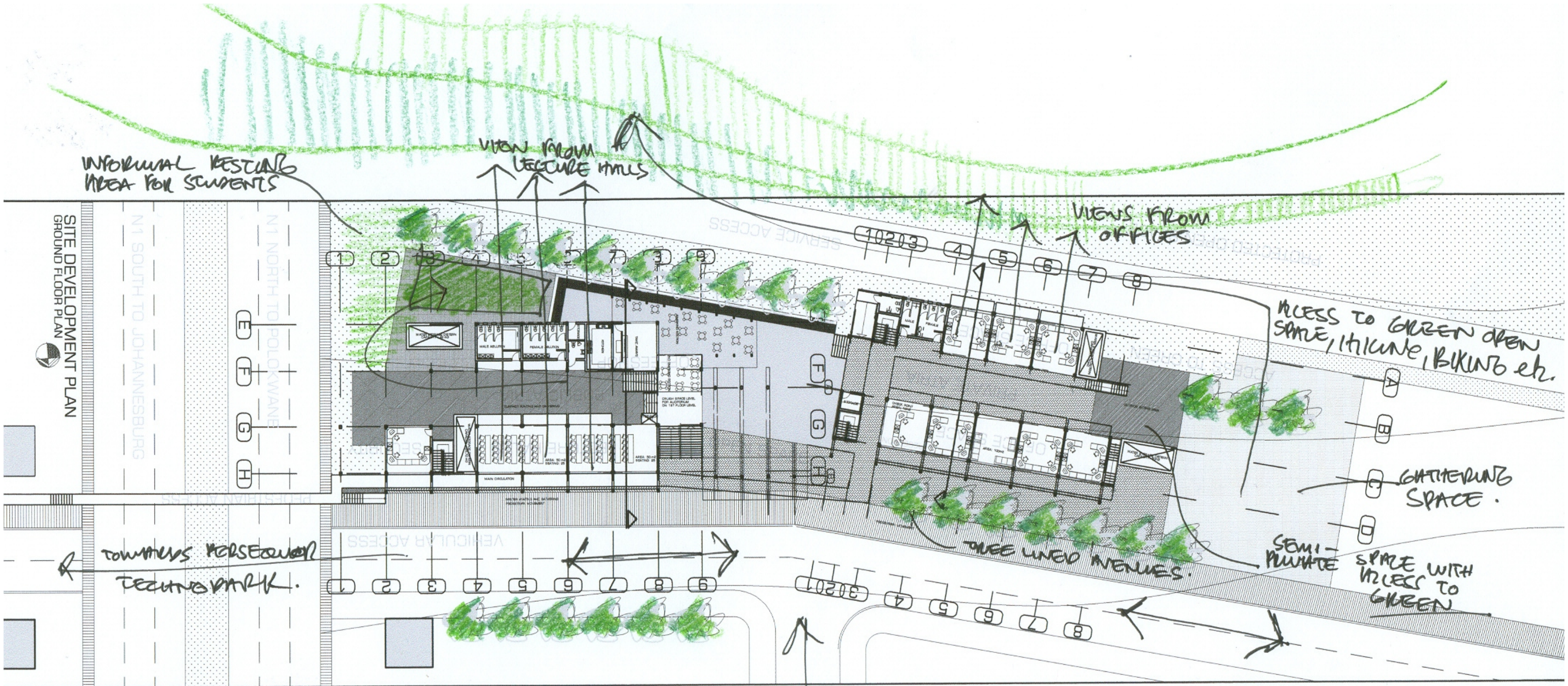


Fig. 98: Final Plan with Views and Access to Green

Inclusive Environments:

Buildings can be designed to accommodate an array of functions, or specially designed buildings have to be erected for the same purposes. Ensuring that buildings are inclusive supports sustainability as replication is avoided and changes of use supported.

Public Transport:
The development will have access to public transport amenities, a bus stop is proposed on the Proefplaas side of the development, which is centrally located to encourage pedestrian movement. The stop will approximately be less than 100m from surrounding buildings to be accessible by the disabled.

Routes:
The access to buildings will consist of routes and ramps, which are smooth, and of even surface to make it easily manageable by wheelchair.

Changes in Level:
All changes in level will be catered for with appropriate ramps of 1:12 fall or by wheelchair lifts.

Edges:
All edges between walls and floors will be visually contrasted by colour or texture to make it distinguishable by the visually impaired.

Ablution:
The building will house approximitely 100-120 employees. Ablution facilities should also be present for users of the auditorium and lecture theatres. The auditorium has a capacity of 150 and the two lecture halls a capacity of 50 students each. The required amount of sanitary fittings can be calculated from the Table 6 of figure .
[SABS 0400, 1990. P.126]

Ablution for Disabled persons:
In accordance with the National Building Regulations "where the combined total of more than 20 WC pans and urinals are required to serve the total population, not less than 2 WC pans shall be provided for the use of disabled persons" [SABS 0400. 1990. p. 154]

Also stipulated is that any disabled person should not have to travel more than 200m in order to reach the ablution facility.
The technical requirements for a compartment containing a WC pan for disabled persons are given in section SS5.2 and SS5.3 of the National Building Regulations. [SABS 0400. 1990. p. 154]

Auditoria And Halls:
Lifts:
A lift will be provided for the auditorium which has a minimum internal dimension of 1 100mm and 1 400mm in depth. The doorway of the lift must also have an obstructed width of no less than 800mm, and be fitted with handrails on two sides at a height of between 850mm and 1 000mm above the floor level.

Two spaces will be required in the auditorium for disabled persons and should be large enough to house a wheelchair in every space.

TABLE 6

1	2	3	4	5	6
For a population of up to —	Number of sanitary fixtures to be installed relative to the population given in Column 1				
	Males			Females	
	WC pans	Urinals	Washbasins	WC pans	Washbasins
15	1	1	1	2	1
30	1	2	2	3	2
60	2	3	3	5	3
90	3	5	4	7	4
120	3	6	5	9	5
	For a population in excess of 120 add 1 WC pan, 1 urinal and 1 washbasin for every 100 persons			For a population in excess of 120 add 1 WC pan for every 50 persons	For a population in excess of 120 add a washbasin for every 100 persons

Fig. 99: Table 6 from the National Building Regulations which shows the figures for the required sanitary fittings in the building [SABS 0400. 1990.p. 126]

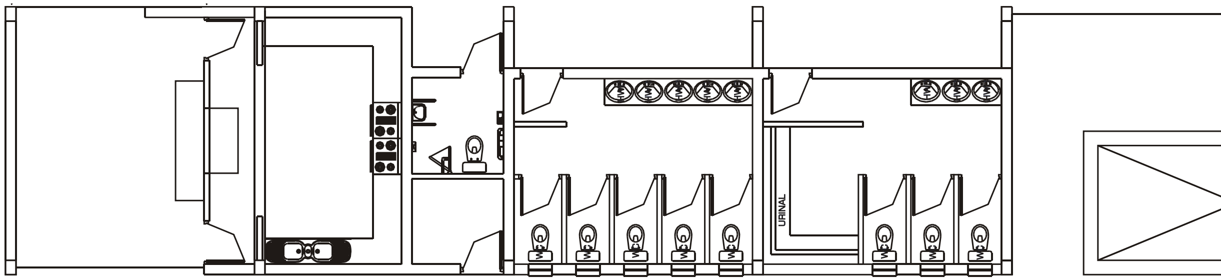


Fig. 100: Public Ablution facilities and Kitchen

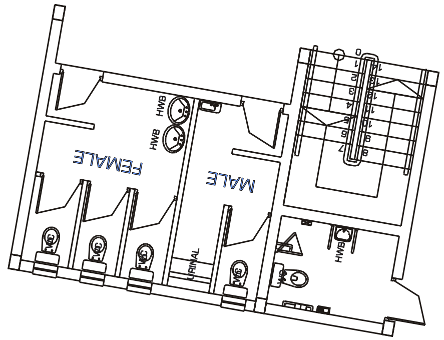


Fig. 101: Office Ablution Block

Access to Facilities:

Convention living and working patterns requires regular access to a range services. Ensuring that these service can be accessed on foot or on bicyc supports sustainability by increasir efficiency and reducing environment impact.

Childcare:
Childcare will be housed in th development.

Banking:
ATM's will be allowed, all banking will b done electronically and the appropria infrastructure will be provided.

Retail:
Commercial activities will include stationary shops, coffee shops and small-scale restaurants/ cafés etc.

Communication:
All relevant communication will be present; these include postal, e-mail, fax and telephony.

Parking:
The Urban Design Framework stipulates that 5 parking spaces be required per 100m2 of rentable area.
The development will thus require 3 159 parking bays. It is proposed that 1 864 bays be allocated in basements and the remaining 1 295 on surface level.
Special parking zones will be designated in strategic locations for disabled persons.

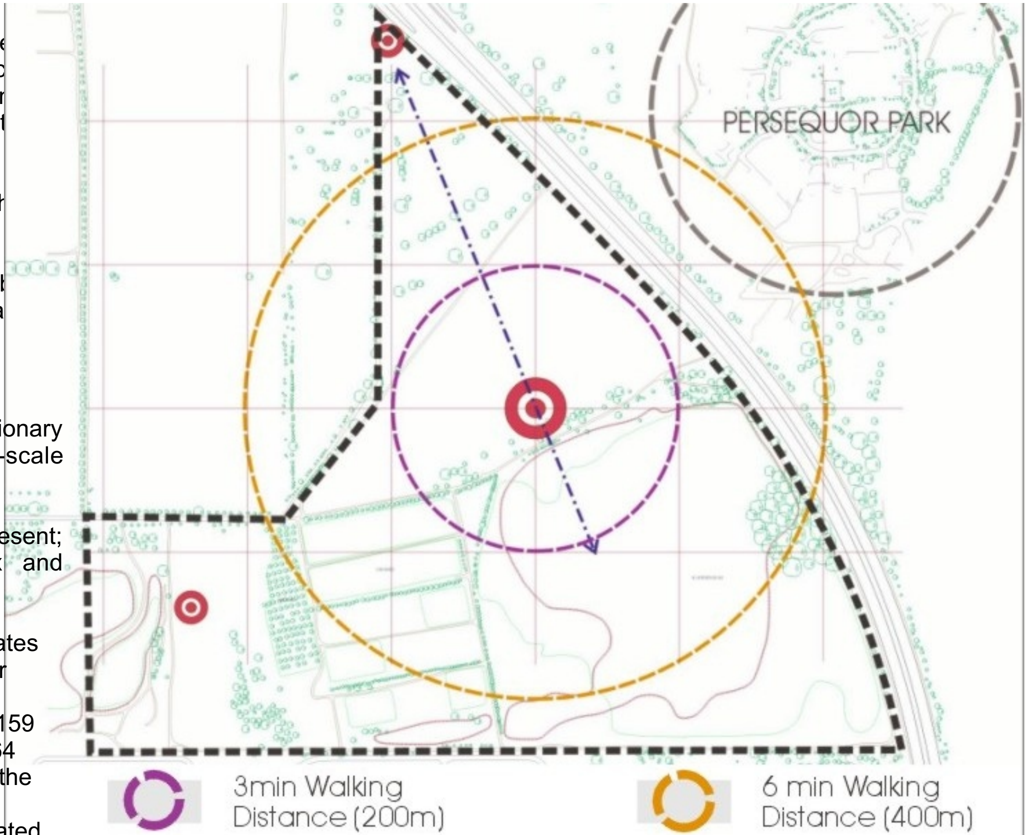


Fig. 102: 3-6min Walking distances

The parking areas will be allocated within 3-6 minute walking distance from the bigger company buildings.

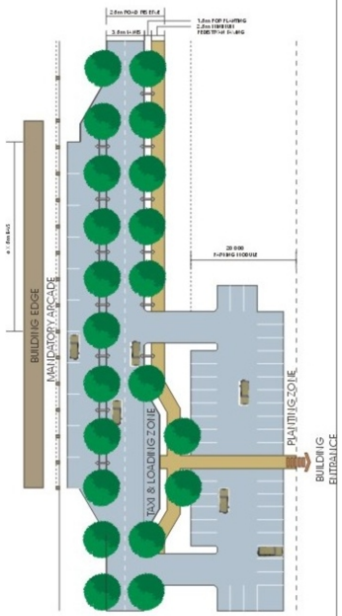


Fig. 103: Cellular Parking [UDF. JH Consulting. 2001]

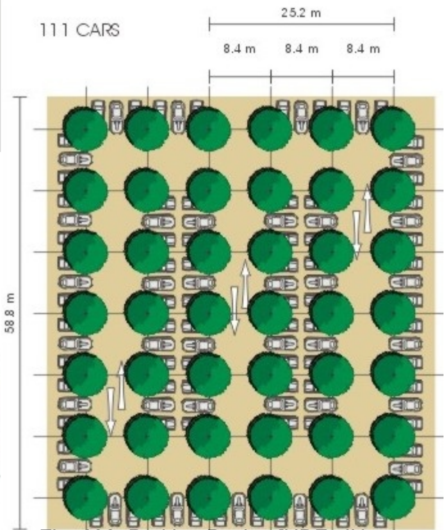


Fig. 108: Parking Pocket [UDF. JH Consulting. 2001]

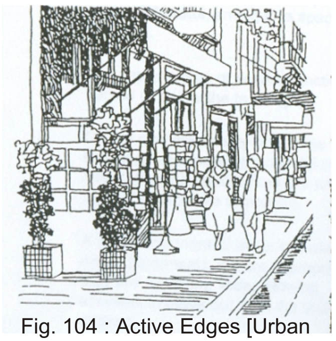


Fig. 104 : Active Edges [Urban Solutions. 2000. P. 2]

Fig. 105 : Social interaction [Urban Solutions. 2000. P. 12]

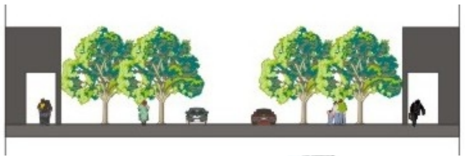


Fig. 106: Streetscape [UDF. JH Consulting. 2001]

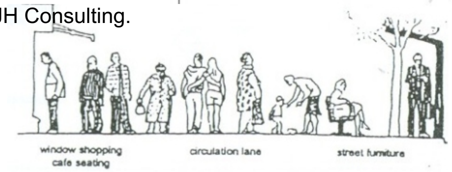


Fig. 107 : Pedestrian Circulation [Urban Solutions. 2000. P. 5]

Participation and control:

Ensuring that users participate in decisions about their environments help ensure they care for and manage these properly. Control over aspects of their local environment enables personal satisfaction and comfort. Both of these support sustainability by promoting proper management of buildings and an increase in productivity. [Gibberd, 2001]

Environmental Control:
The ventilation stacks will have adjustable louvres which controls the amount of airflow, windows will be able to be opened to increase/ reduce cross ventilation as required by tenants. The sunscreens will be fixed and provides natural light by calculation, which means that no environmental control is needed.

User Adaptation:
The offices are designed on a modular system, which enables the user to change office layouts, by the use of internal partitions and by simply moving furniture.

Social Spaces:
Because of the importance of interaction in the Innovation Hub development, social interaction is a top priority. The design must include easy informal/ formal interaction. Spaces shared between occupant's i.e. photocopying rooms etc. should be large enough to allow for interaction.

Amenity:
Easy access should be provided to refreshment facilities and WC's for all users of the building.

Community Involvement:
Multi-functional spaces will be designed to allow for programs including computer literacy etc. to encourage the extended use of the building (18 hour principle)

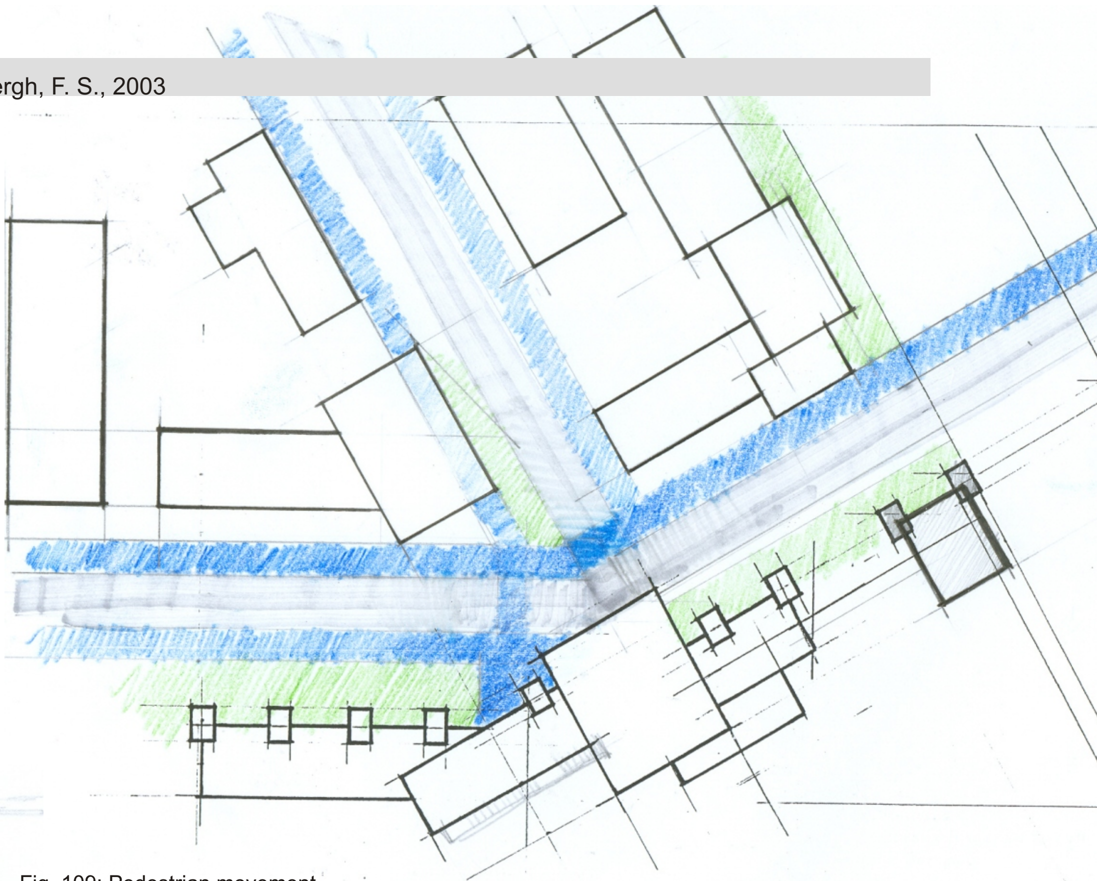


Fig. 109: Pedestrian movement

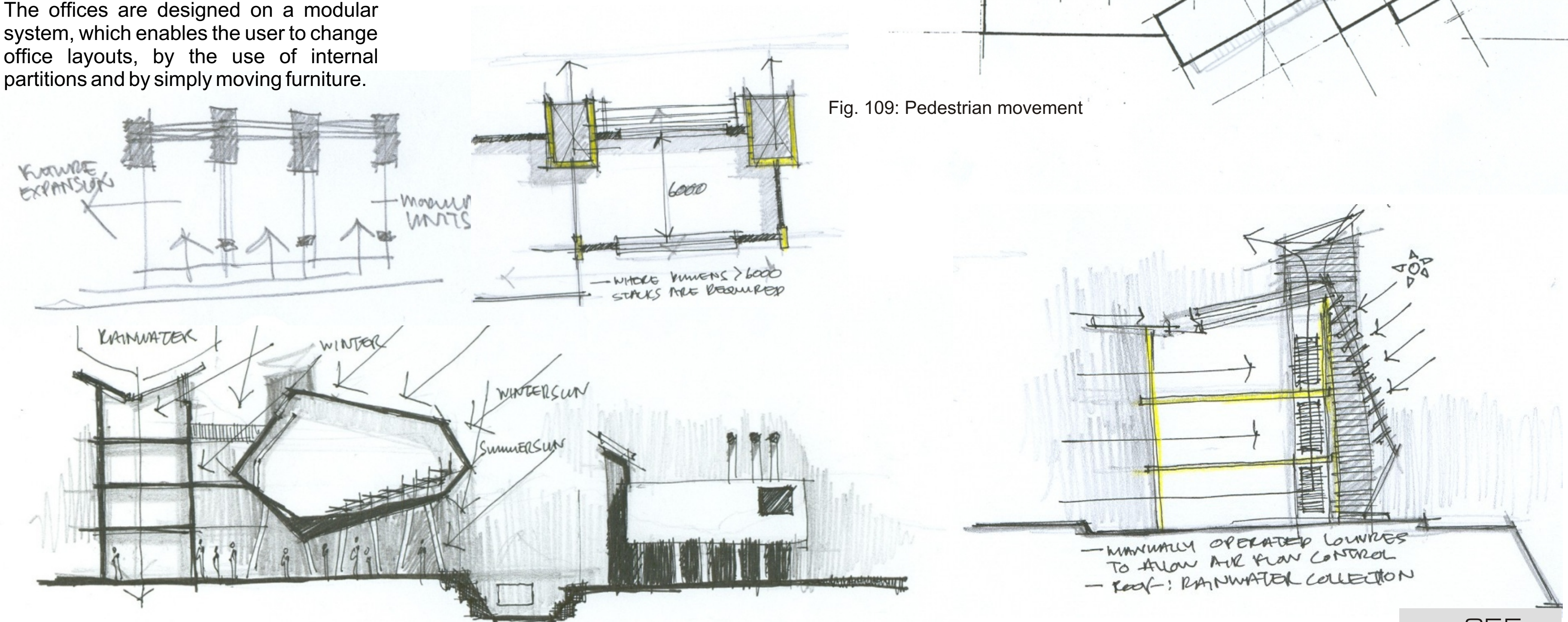


Fig. 110 : Participation and Control Concept sketches

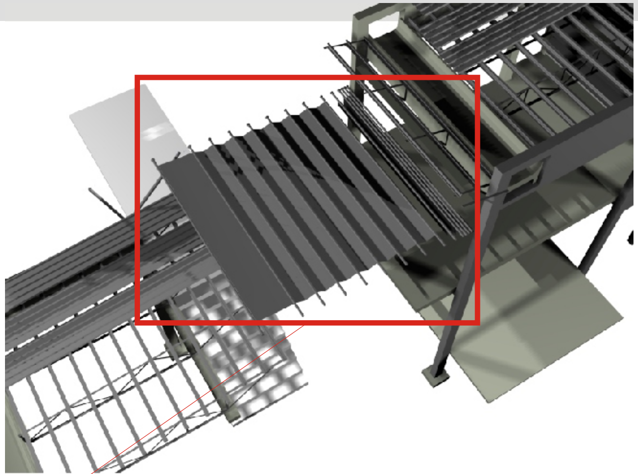


Fig. 112: Aerial View

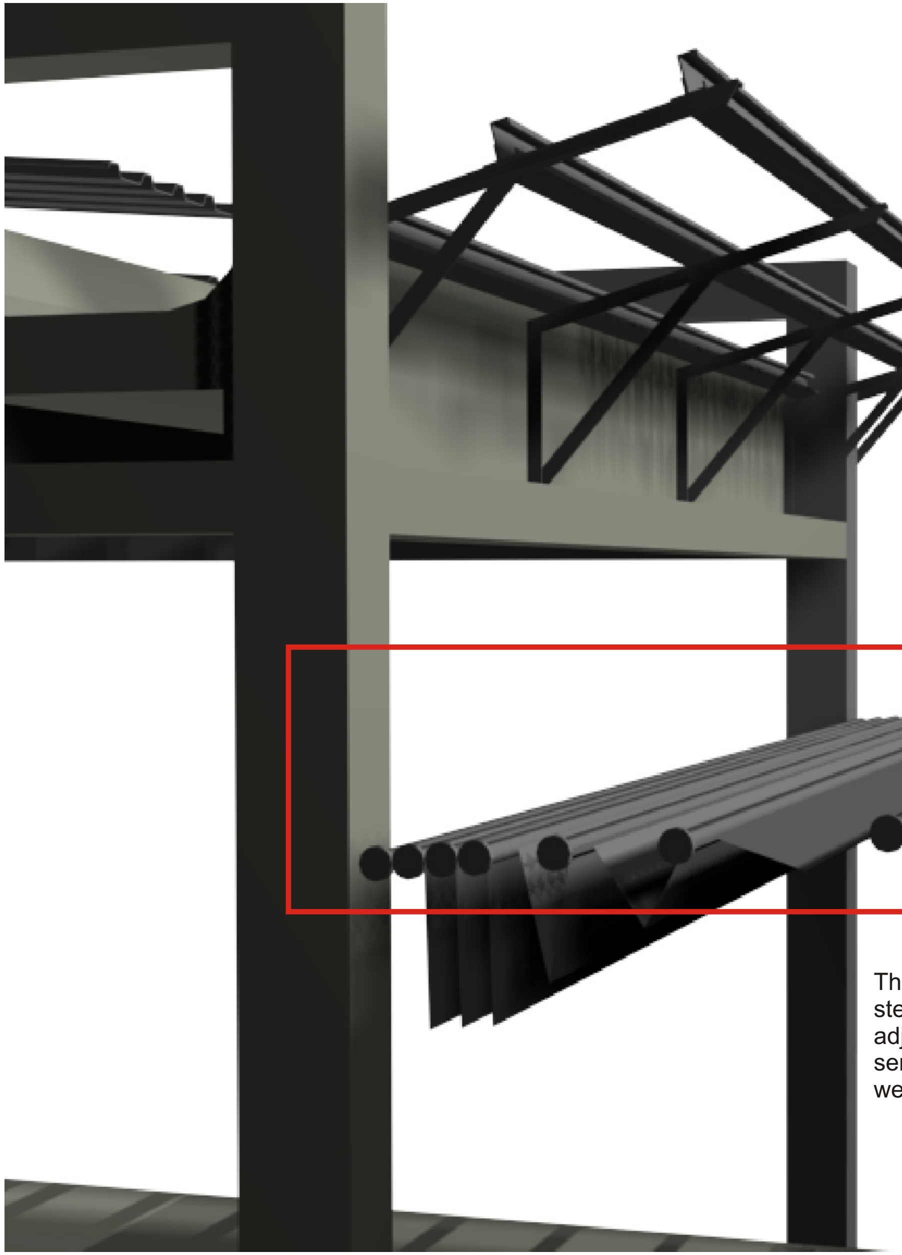


Fig. 111: 3D of retractable roof structure

The retractable roof consists of a steel frame structure with adjustable canvas sheeting which serves as shading devices as well as rain barriers.

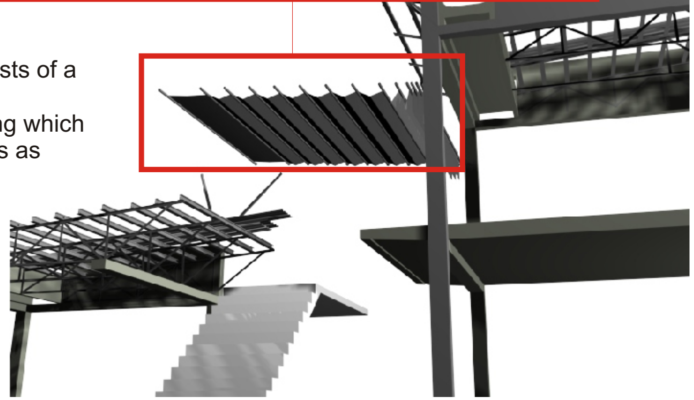


Fig. 113: 3D of Module

Education, Health and Safety:

Buildings need to cater for the well being, development and safety of the people that make use of them. Awareness, and environments that promote health can help reduce the incidence of diseases such as AIDS. Because of the activities associated with the Factory, other health issues will be promoted i.e. dysentery, cholera and malaria.
Learning and access to information is increasingly seen as a requirement of a competitive work force. All of these factors contribute to sustainability by helping ensure that people remain healthy and economically active, thus reducing the "costs" to society, the environment and the economy, of unemployment and ill health.
[Gibberd, 2001]

Education:
Access to support of learning is integral to the development. Skills transfer from established technicians, scientists, designers etc. to students as well as from companies with overlapping interests and business.

Security:
All entrances and access points will be boom controlled with guardhouses. The security will also include a digital transponder system for tenants. Perimeter fencing will be required with 24 hour digital CCTV monitoring. Internal fences will not be allowed and the design of the perimeter fence is essential and should not be determined by security requirements only.

Security will also be achieved by means of passive surveillance, the restriction of dark corners and spaces and the employment of security personnel who will patrol the development.

Health:
First Aid kits provided in central locations incorporated with social spaces i.e. tearooms etc. Policies have to be implemented to ensure effective use of these kits. Information has to be readily available on health, education and career development issues.

Smoking:
Outside areas only.

Safety:
Building must comply with all health and safety requirements. Policies implemented to ensure that these are complied with.

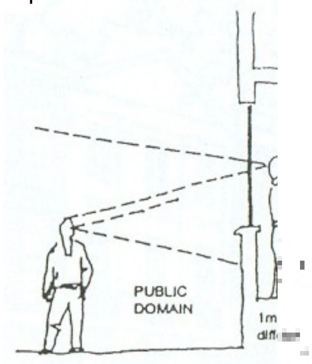


Fig. 114 : Passive surveillance [Urban Solutions. 2000.p. 12]

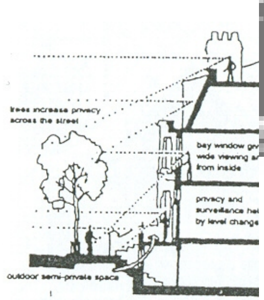


Fig. 115 : View Angles [Urban Solutions. 2000.p. 5]

Local Economy:

The construction and management of buildings can have a major impact on the economy of an area. The economy of an area can be stimulated and sustained by buildings that make use and develop local skills and resources.[Gibberd, J. 2002]

Local Contractors:
The use of local contractors is encouraged and furthermore, where outside contractors are used, local contractors must be present to acquire the skills involved.

Local Building Material Supply and Components:
The importance of local materials becomes apparent when these materials/ components have to be repaired, replaced or maintained. The use of local materials will limit the effects of disruption and downtime when work has to be done on the building.

Repairs and Maintenance:
Where local contractors are available and able to oversee repairs and maintenance, financial costs and the time used will be drastically less than the employment of specialists or international contractors.

Space Use:

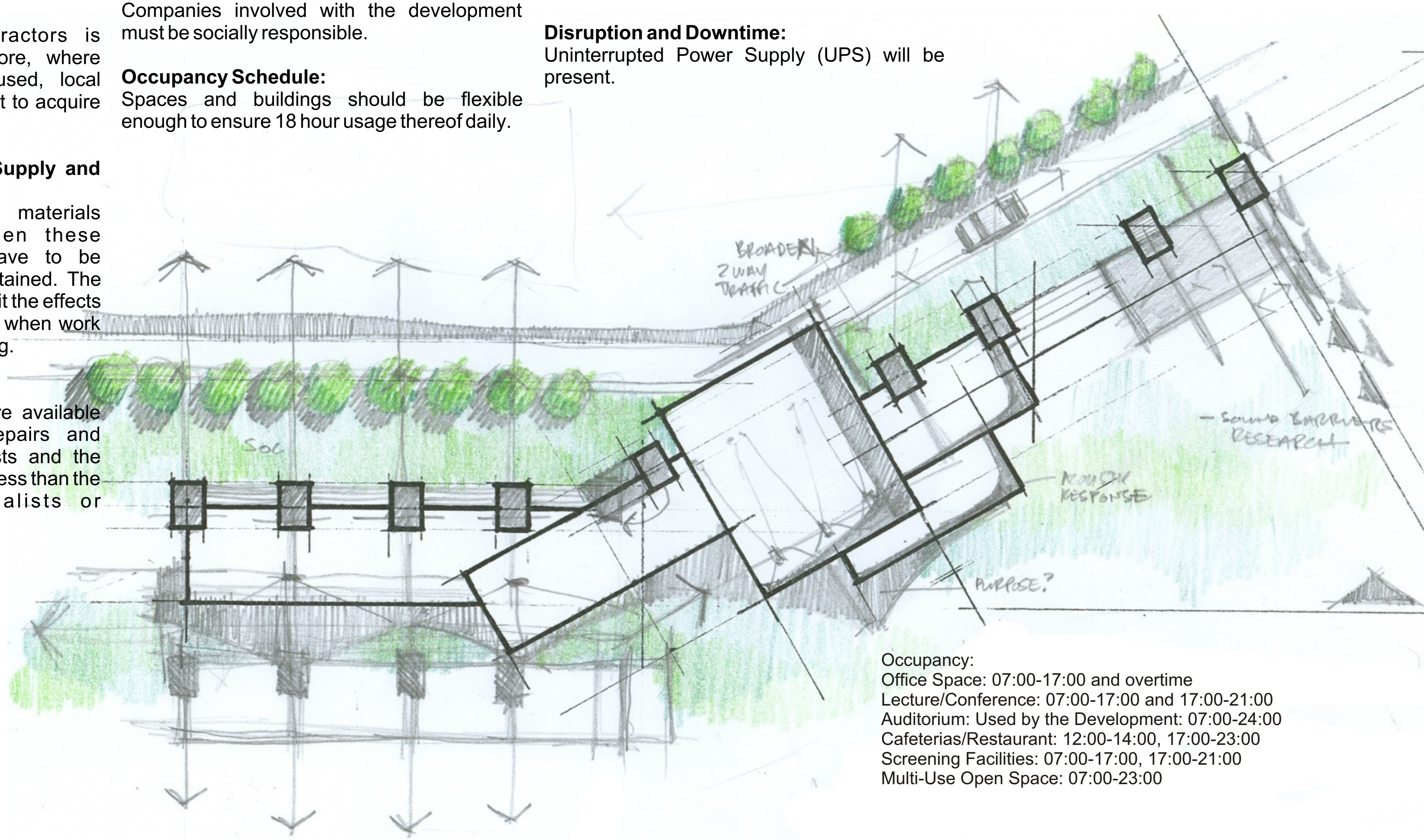
Space use should be optimal and should be more than the normal 09:00-17:00, traditional usage. The spaces should be used for 18 hours and less on average. Therefore, spaces should be multi-functional and programs should be introduced to facilitate optimum use. Programs include health education, computer literacy and career skills development. Companies involved with the development must be socially responsible.

Occupancy Schedule:
Spaces and buildings should be flexible enough to ensure 18 hour usage thereof daily.

Use of Technology:

Technology involved in the development include the security systems mentioned previously, the specialist technologies (bio-technology, photovoltaics etc.)
The VR Factory will have a holography component, Screening facilities, desktop application type virtual models, headsets, data gloves etc.)

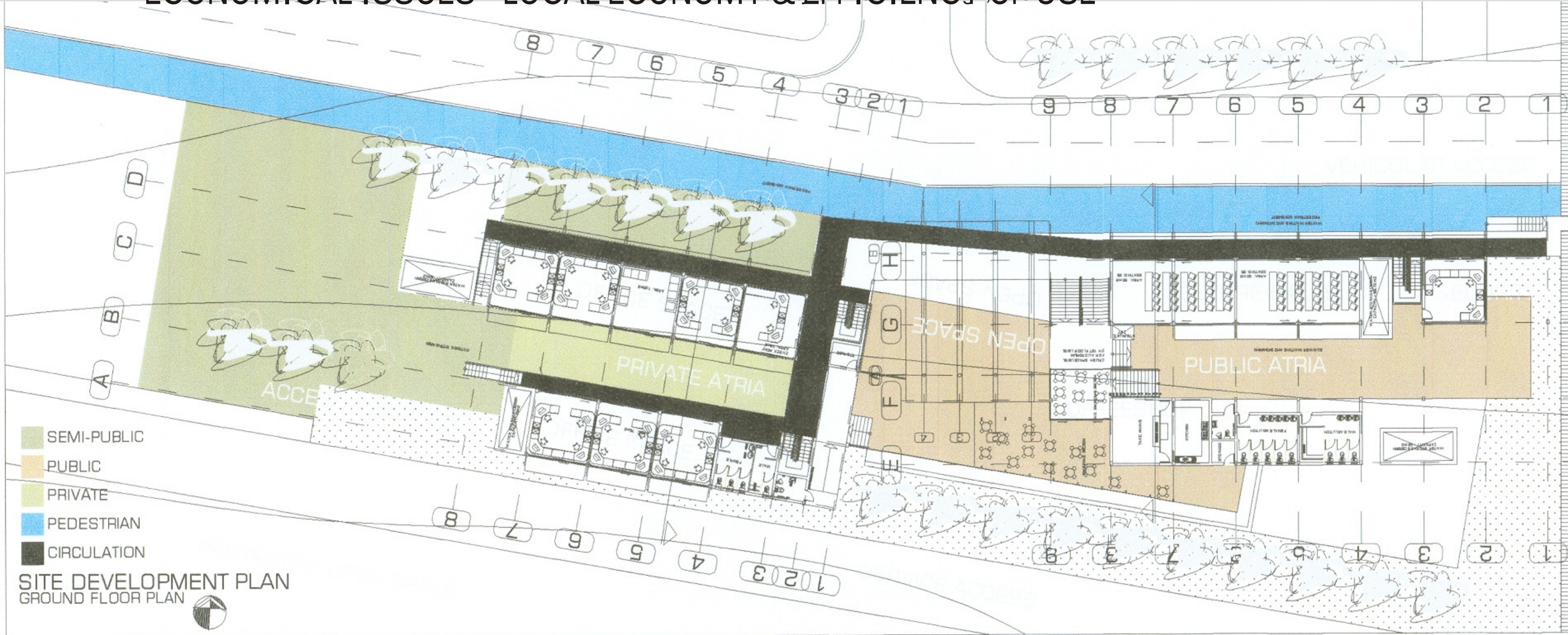
Disruption and Downtime:
Uninterrupted Power Supply (UPS) will be present.

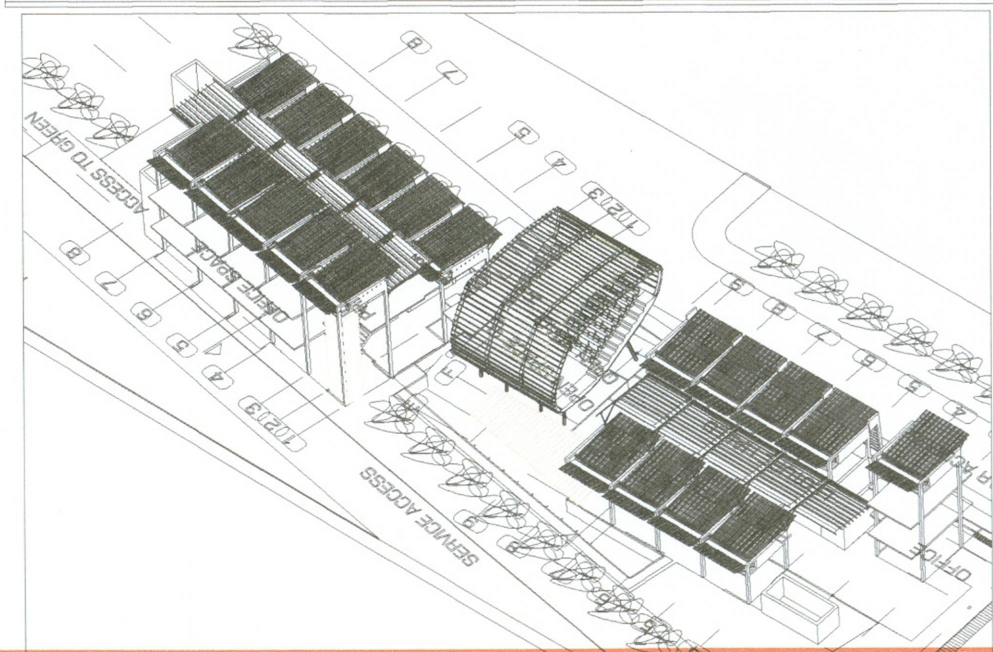


Occupancy:
Office Space: 07:00-17:00 and overtime
Lecture/Conference: 07:00-17:00 and 17:00-21:00
Auditorium: Used by the Development: 07:00-24:00
Cafeterias/Restaurant: 12:00-14:00, 17:00-23:00
Screening Facilities: 07:00-17:00, 17:00-21:00
Multi-Use Open Space: 07:00-23:00

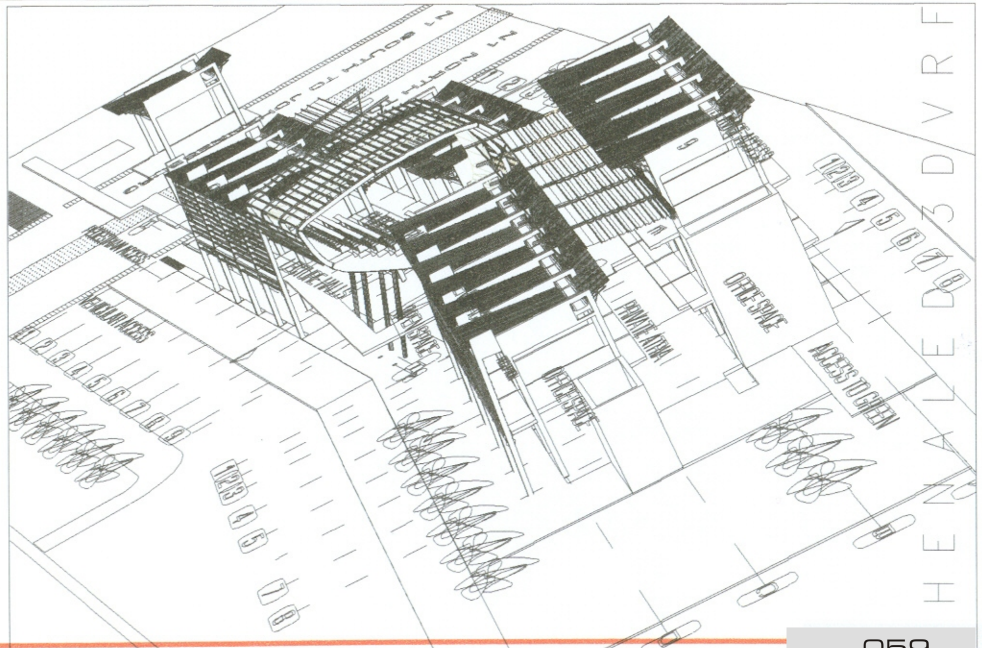
Fig. 116 : Conceptual Plan with Occupancy Schedule

ECONOMICAL ISSUES - LOCAL ECONOMY & EFFICIENCY OF USE





Aerial View of Public Open Space



Perspective of Private Atria

THE INNOVATION HUB - LOCATED ON THE AGRICULTURAL RESEARCH FARM, UNIVERSITY OF PRETORIA

Working Areas:
Nomadic Office:

Working at any location worldwide with the help of a portable telephone linked to a database (via the Internet). Project leaders and team members communicate exclusively via computer. This type of office will make up a large portion of the operations associated with the Naledi Factory.

Market Office:
A working environment, which has flexible interiors in order to create adequate working, spaces. This office also relies on a centrally located administrative sector, which is shared by several people or parties. Interior spaces are created for the exchange of ideas and concepts, and the formation of teams to generate new projects.

Virtual Office:
Information processing takes place online by telephone, fax and data-processing systems.

Festival Office:
Strategy meetings and workshops with specific goals take place over the course of several days at festival sites to underlie the importance of the event. Work is supported by all available information and communication technologies. The festival office is characterised by user friendliness, reliability and facilities for relaxation.
Because of the evolving market and associated technologies, many opposing forces will influence the urban and regional development in a complex and differentiated manner. It will also impact site patterns for industry, trade and living. Cyberspace communities will play a key role in the new economic order emerging together with the new infrastructure.

Type of space	Number of persons	Typical space required per person	Type of use	Provision and equipment	Location
Provision at the workplace					
1 Meeting at desk	2–3	2·00–2·75 m²	Short discussions, briefing subordinates, personal interviews	1 or 2 visitor's chairs at work station	Located in screened area if in planned open office environment
2 Meeting area	4		Working discussion with the members of staff or visitors	Conference table and chairs Related equipment—pinboard, chalk board	
Provision for a group of workplaces					
3 Meeting area	6–8	1·50–2·25 m²	Working sessions between members within group or personnel from outside involved with same project. May last several hours	Conference table and chairs with some screening from surrounding work stations. Related equipment: flip charts, pin up space, chalk board. Provision of permanent notice board or chart board for use of group	Located in group area adjacent to primary circulation, to limit disturbance of individuals
Provision for all members of staff					
4 Interview room	2–3	1·50–2·00 m²	Interviewing personnel or sales representatives. Discussions with members of public. Short periods of use up to ³/₄ hour	Aural and visual privacy required	Adjacent to main entrance and departments with major usage. May require waiting area adjacent if used frequently
5 **Meeting room**	8–12	1·50–2·00 m²	Meetings with outside visitors or internal policy making and planning meetings. 2–3 hour meetings	Slides, overhead projector, flip charts, dimmer lights, good ventilation. Storage for drinks, audio-visual equipment	Ease of access to all departments. Easily serviced with refreshments. Access for outside visitors without going through work areas. Coats area adjacent
6 **Rest area**	12–15	2·25–4·00 m²	Primarily used for refreshment breaks, but may also be the area where general notices, scheduling charts etc can be displayed. This area may become an important point for the exchange of information and ideas. Used throughout day for short periods	Vending machines, stand-up counters, low tables and easy chairs. Display board. Screening from work areas	Adjacent to cloaks, wcs and rest room. Equally accessible to all personnel on each floor
7 **Assembly area**	100–150		Infrequent meetings. Involvement of all staff		May use cafeteria or recreation space
8 **Board room**	16–24	1·50–2·00 m²	Formal board meetings, signing of contracts. Management meetings. Business lunches and entertaining. 2–3 hour meetings	Formal layout. Audio-visual equipment. Good ventilation essential. Telephone extension. Space and facilities for stenographer	Anteroom (for refreshments and leaving coats) attached. Easy access for refreshments. Two visits
9 **Conference room**	15–20	1·50–2·00 m²	Presentations. Working discussions with outside visitors	Audio-visual equipment. Dimmer lights and black out. Storage for equipment and furniture. Allow sufficient space for alternative layouts	Easy access for visitors
10 **Lecture room**	50–100		Large conferences, presentations, lectures and training sessions furniture display systems	Closed circuit tv system. Control room for projector, lighting, curtains, tv and audio systems. Storage space for Several entrances	Adjacent area for audience to assemble before meeting.

Fig. 117 : Types of meeting spaces, characteristics and requirements [Tutt, P. And Adler, D. 1998.p. 128]

Adaptability and Flexibility:

Most buildings can have a life-span of at least 50 years. It is likely that within this time that the use of the building will change, or that the feasibility of this will be investigated. Buildings which can accommodate change easily supports sustainability by reducing the requirement for change (energy, costs etc.) and the need for new buildings. [Gibberd, J. 2002]

Vertical Dimension:
Vertical dimensions will be 3500mm to allow for vertical flexibility.

Internal Partitions:
Internal partitions must conform to the modularity of the structure to allow for user participation in the setting up and the layout of offices.

Fig. 118: 3D's of Modular Unit

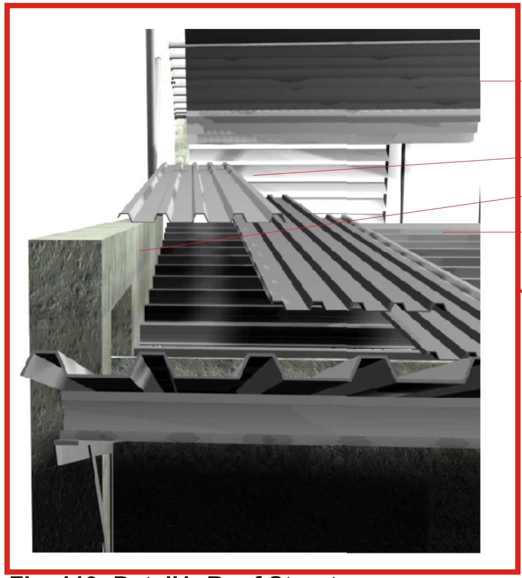
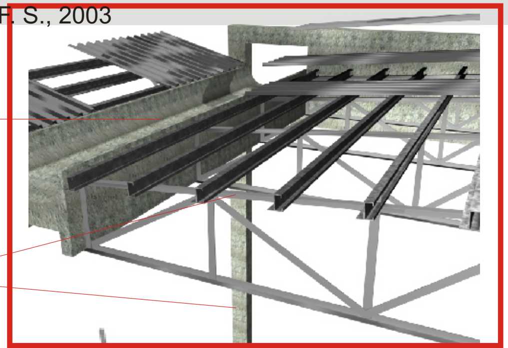
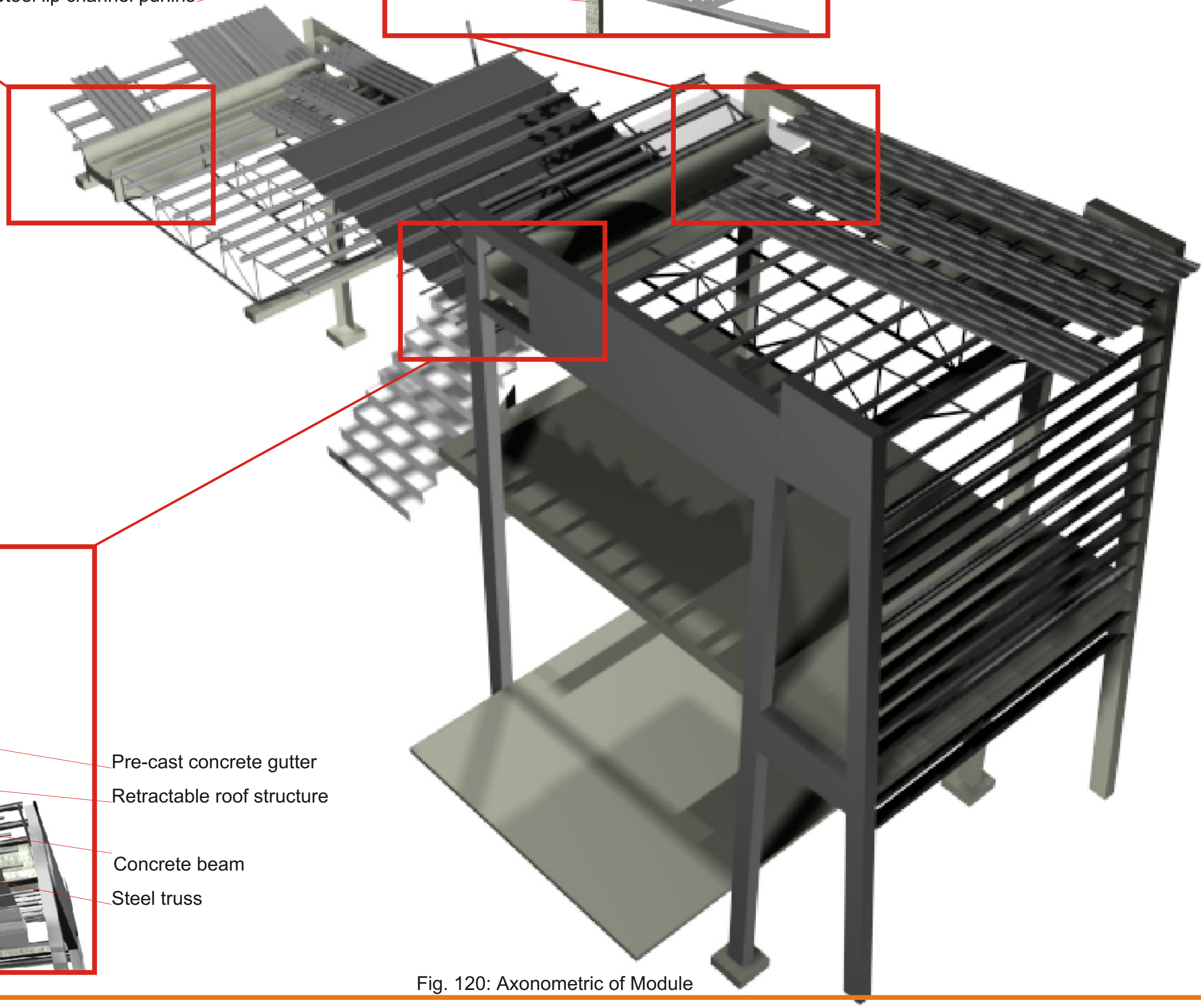


Fig. 119: Detail1: Roof Structure





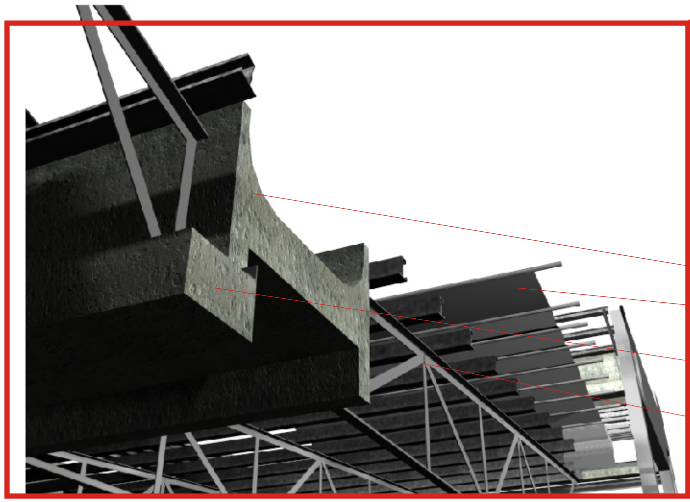


Fig. 120: Axonometric of Module

Capital Costs:

Buildings are generally one of the most valuable assets that people, and often organisations or governments own. Money spent on buildings is not available for other uses such as health and education. Often too, the high cost of buildings results in the services and the accommodation being beyond the reach of the people with the lowest incomes. Cost effective buildings support sustainability by helping provide access to accommodation and services for low-income areas and by enabling money to be spent on other areas that supports sustainability. [Gibberd, J. 2002]

Use of Existing:
The site was previously utilized for agricultural purposes and the only existing buildings are small, single storey sheep paddocks, which do not affect any design decisions.
On the side of Persequor Technopark some of the buildings will be upgraded to allow for the Innovation Hub development. These include gateway buildings, the vehicular underway towards the Proefplaas and the introduction of a pedestrian bridge crossing the N1 highway.

Shared Cost:
The buildings in the development will have a multi-functional aspect in order to complement and encourage the idea of skills transfer. The development should be designed as an integrated whole, with a denser, urban character with the emphasis on individualism, innovation and the collaboration of systems, on a social and economic level. Therefore, shared cost will be inherent in the design.

According to Daniels (p.77), work in the information age and in the industrialized countries of the future will be characterised by:

- Time-sharing and regrouping for smaller tasks
- Integration and overlapping of computer and Internet links
- Fulfilling ecological and environmental requirements

The labour market will become more flexible through time-sharing if a large volume continues to migrate to other countries or if “full employment” shared by many becomes the ultimate goal. In a time of growing economic globalization, it does no good to merely offer incentives to the employed and government charity to the unemployed. Wages will rise only in areas with above-average work performance [Daniels, K.1998]

Proportions of cost to Building Size:
The building size should be able to adapt to future needs and further development. Therefore the initial cost of the building should not reflect its feasibility but rather the long-term projections.

Plate Efficiency:
Elevation to Floor area. The coefficient should not exceed 0,4.

Ratio of Capital to Ongoing Cost:
The building will be designed on passive principles, which could mean that the capital cost would exceed the cost of similar buildings without the sustainability principles. The ongoing costs however, will be considerably less than the latter, because the building will have less power and water consumption.

Ongoing Costs:

Maintenance:
The design of the building should allow for the easy maintenance therof. Light fittings should be reachable and materials used should require the minimum amount of maintenance.

Cleaning:
Measures should be taken to limit the requirement for cleaning. Hard wearing solid flooring or industrial carpeting could be specified to limit the impacts of cleaning. Windows etc. should be reachable to streamline the cleaning process.

Security/Caretaking:
The development should be designed to allow for the most effective use of passive surveillance. Verandas with views towards neighbouring buildings, mixed-use facilities and the use of spaces on the 18 hour principle are a few examples.

Insurance/Water/Energy/Sewerage:
The costs of the above should be monitored and the fluctuations noted. Research could be undertaken to determine the source of rises, or declines in costs, and strategies could be implemented to manage these.

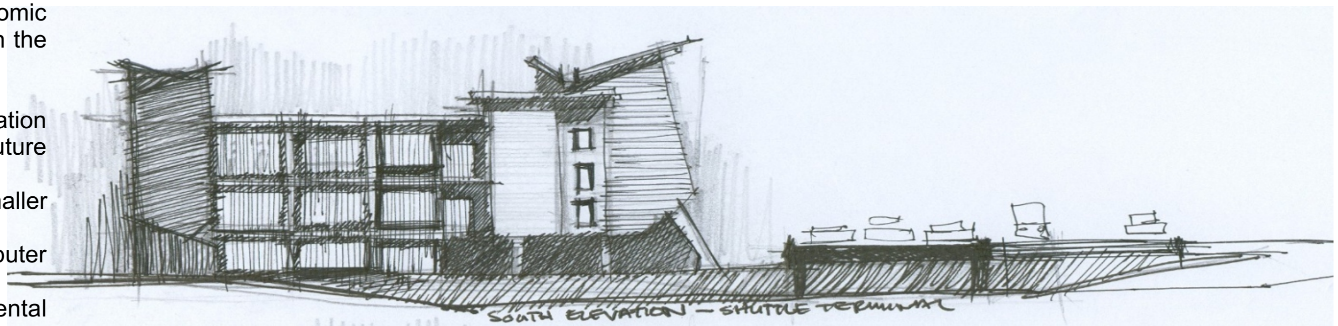


Fig. 121 : Conceptual Elevation of Neighbouring Building

Water:

Rainwater:

A hybrid system will be used at the Factory. Rainwater will be harvested by means of designated surfaces and will be stored in cisterns. Harvested water will be used as for all greywater systems. Municipal water will be applied as the secondary system and would mainly provide potable water to the tenants.

Fresh water is our most valuable resource, and has no adequate replacement. Yet, in Europe, potable water is being used to flush toilets (approximately 33%) and large amounts are used for watering gardens and plants, washing cars and general cleaning. The collection of rainwater will dramatically improve potable water consumption even if it is only applied as greywater for cisterns, irrigation or for cooling purposes.

Rainwater harvesting:

An old technology, has in recent times, been rediscovered and re-instated with the development of sustainable design principles. Rainwater harvesting in cisterns and on roofs, is being looked at by designers with renewed interest. For landscape architects, rainwater collection as means of irrigation offers many advantages, including lower water costs over the lifetime of the system, no withdrawal of groundwater, and a better quality of water for cultivation and for the maintenance of water-using equipment. As the cost of water escalates the concept of water preservation more apparent, rainwater harvesting systems, and buildings incorporating these technologies, will become increasingly popular.

The best roofing materials for rainwater collection are stainless steel or galvanized steel with a baked-on enamel, lead-free finish. The roof should be sited, whatever roofing material, away from overhanging branches, reducing the risk of contamination from leaves, bird droppings and insects.

The rainwater is conveyed from the catchment area to a filtration or storage unit via gutters, downspouts and piping. Different piping materials are appropriate; these include copper, aluminum, and stainless steel. Galvanized steel and PVC. A common sizing calculation method is used which determines that 32mm of rain should be handled by the downspout over a period of 10 minutes. Leaf screens are commonly installed at downspout inlets, and thrust points should be firmly secured.

Probably the most costly component is the storage unit or cistern. The size of the storage unit not only dictates the amount of water available for use, but also the structure needed to support large quantities of water and the necessary pumps required. The most common shape of cisterns is cylindrical, because it provides the greatest strength-to-weight ratio. Covers are necessary to prevent sunlight (which supports algae growth) or small animals from entering and to eliminate evaporation. In hot climates, at least 300mm of water should remain inside the concrete structure to prevent the shell from drying out and cracking. In addition to the inlet, an overflow should be located at the desired water level, allowing excess water to be released from the cistern. A drain can also be installed at the base of the cistern, allowing any standing water to be drained for cleaning or maintenance. A variety of materials are used, depending on cost, volume of water being contained, and availability of materials.

Galvanised Steel is one of the most common cistern materials found on farms and in rural areas. If edible plants are to be watered, a sealer on liner is recommended.

Concrete tanks are typically cast on site, but there are also pre-cast units available in relatively small capacities. Often these tanks are located below grade, allowing a reduced thickness of the walls. Once roofed, the tanks can support small structures and live loads above, serving either as building additions or as independent free-standing structures.

Ferrocement is a form of thin-wall cement construction relying on steel reinforcing that provides high strength, ease of use for building, and relatively low cost, making this an increasingly common cistern material.

Mortared Stone: Construction and material costs are relatively high, but the cistern can be applied aesthetically.

Fibreglass is inexpensive, lightweight and readily available.

Polyethylene tanks are readily available, lightweight and easily transported.

Probably the largest limiting factor restricting rainwater collection is the high construction cost when compared with the lower initial cost of municipal water supply. However, the issues of sustainable building and design, is now more pressing than ever before.

A high-tech and advanced development such as the Innovation Hub must employ these technologies to exhibit the potential of technological advanced industries and buildings, which are environmentally friendly.

[Winterbottom, D. 2000. Landscape Architecture. P. 40-46]

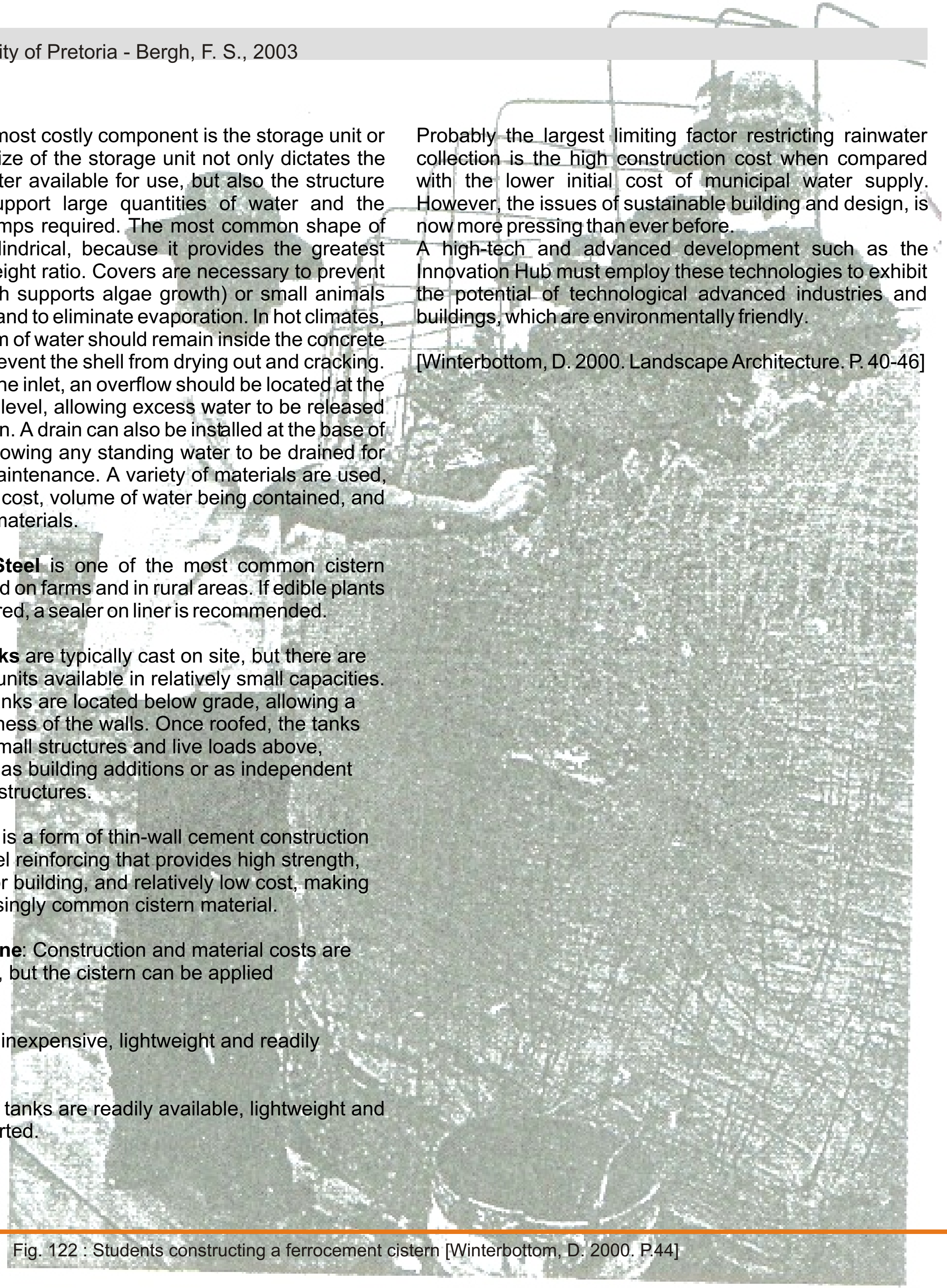


Fig. 122 : Students constructing a ferrocement cistern [Winterbottom, D. 2000. P.44]

Water Use:
Harvested water will be used for irrigation and ablution facilities.
The Municipal supply will service the kitchen and other potable water supplies, which include tap water and water for food preparation.

Greywater:
Harvested water mainly.

Run-off:
The run-off water will be harvested and used primarily for irrigation purposes. It will also facilitate the wetland system on the northern apex of the development. Hard surfaces should be limited.

Planting:
A policy must be implemented to ensure that indigenous species only will be planted. The systematic removal of alien species is also proposed.
The functional aspects of plants are of great importance when their intended use includes an integrated building design. Plants can be used to protect against extreme environmental conditions, against wetness, cold or heat. Wall planting can be incorporated as weather protection, windshields can be created by hedges and shading through climbing plants in summer. Peak precipitation can be absorbed by planted roof surfaces, passing on the moisture in a time-release process. Passing it through or letting it seep into planted ground layers before it flows into the groundwater can cleanse surface water. The intelligent application of these passive design principles can lead to correct building operation. The leaves of large trees filter toxins from the surrounding air, increases the humidity in the immediate surroundings and reduce temperature by virtue of an interaction between evaporative cooling, reflection of solar radiation and absorption of energy from solar radiation.

Calculations:

TotalArea of Harvesting Surfaces: 602m2
602m2 x 686mm/year
= 4129, 72m3/year

The daily water usage in office primary occupancy: 23 litres/day/person

Thus: 23 litres x 365 days x 120 people
= 1 007 400 litres per year for office occupants
= 1 007m3 harvested water per year

A Cistern with dimensions of 10m x 10m x 10m will be adequate to supply harvested water to the building for one year.

The water will mostly be used for irrigation purposes as well as grey water.

A hybrid system will be used in drier months which will make use of the municipal connection as well as the harvested water.

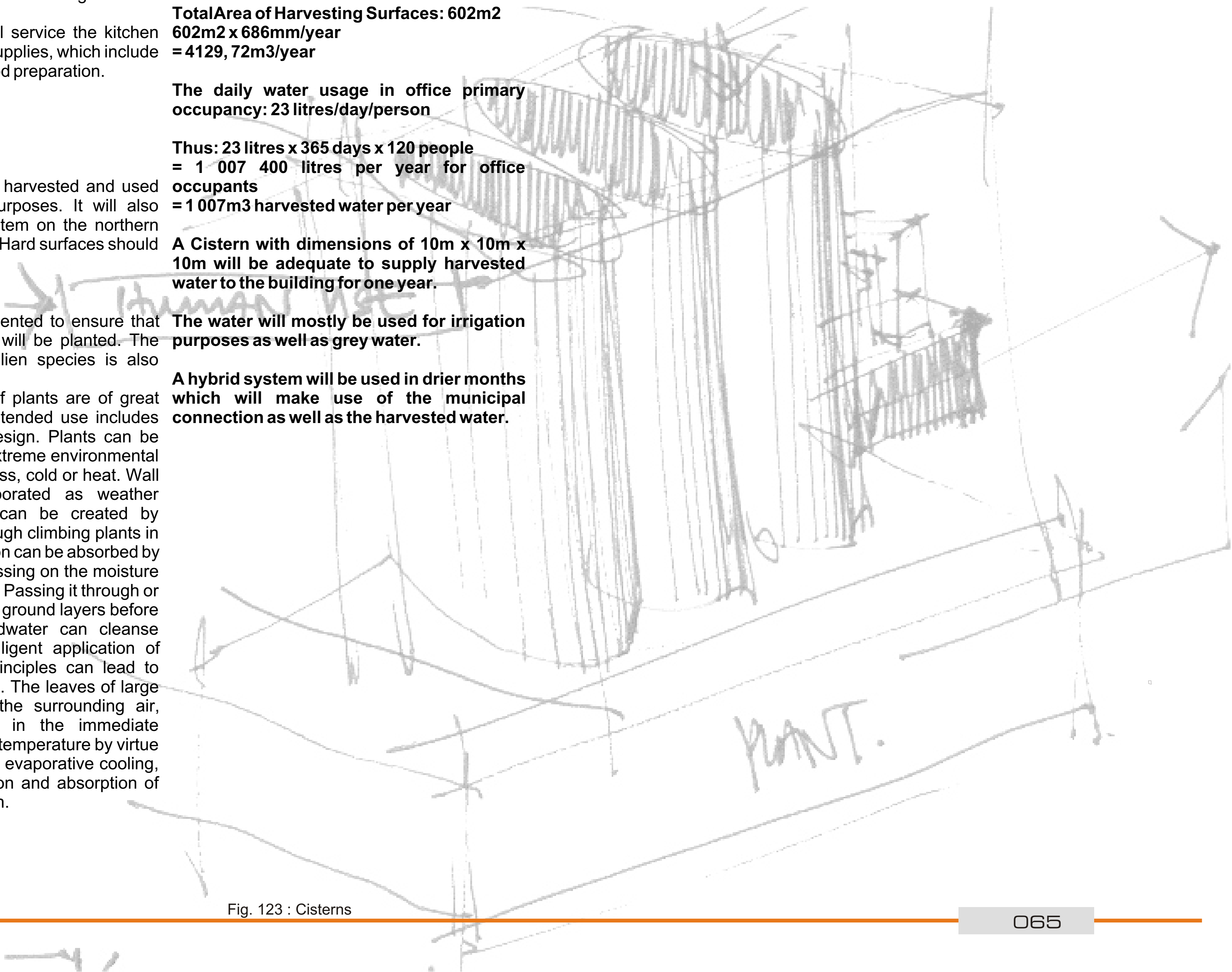


Fig. 123 : Cisterns

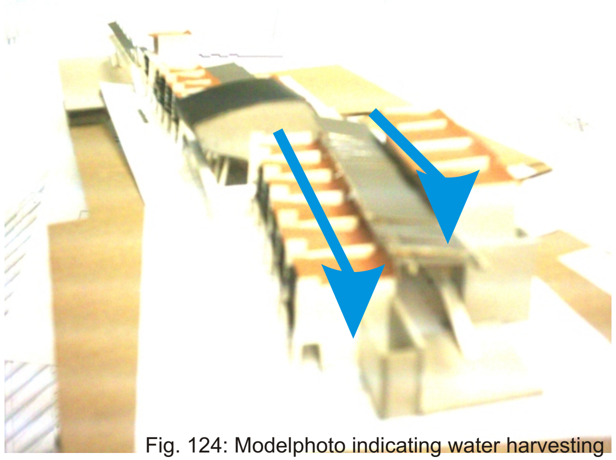


Fig. 124: Modelphoto indicating water harvesting

The water is harvested from the roof modules and are diverted into the cisterns as shown in the model photo's. The cisterns supply water to the proposed extension of the existing CSIR greywater system which will link up with the Persequor Technopark and the Innovation Hub development.

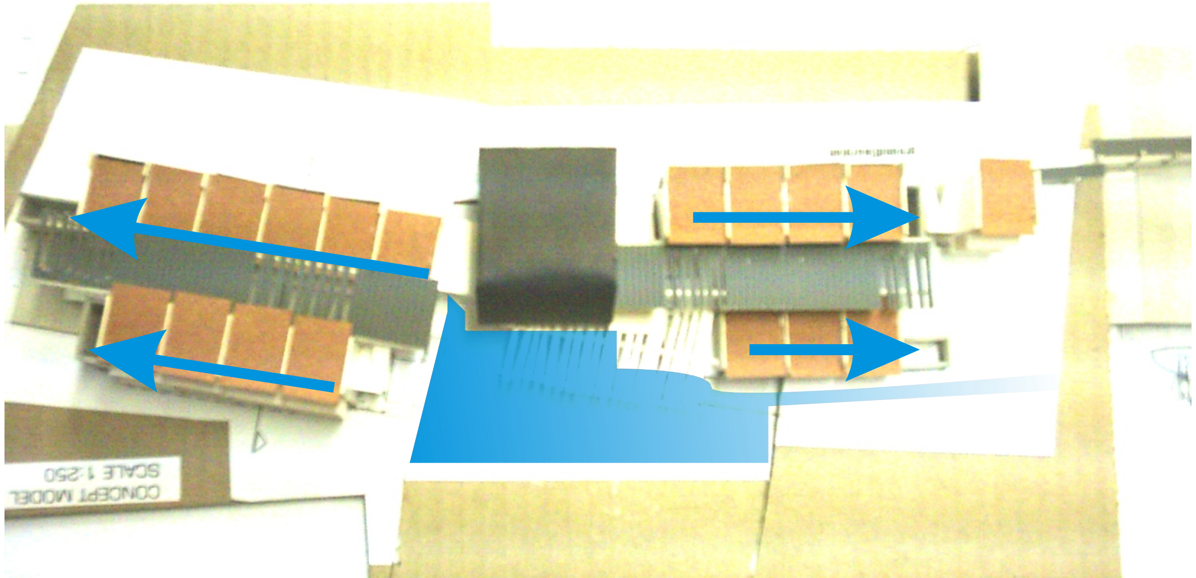


Fig.125: Roofplan indicating water harvesting

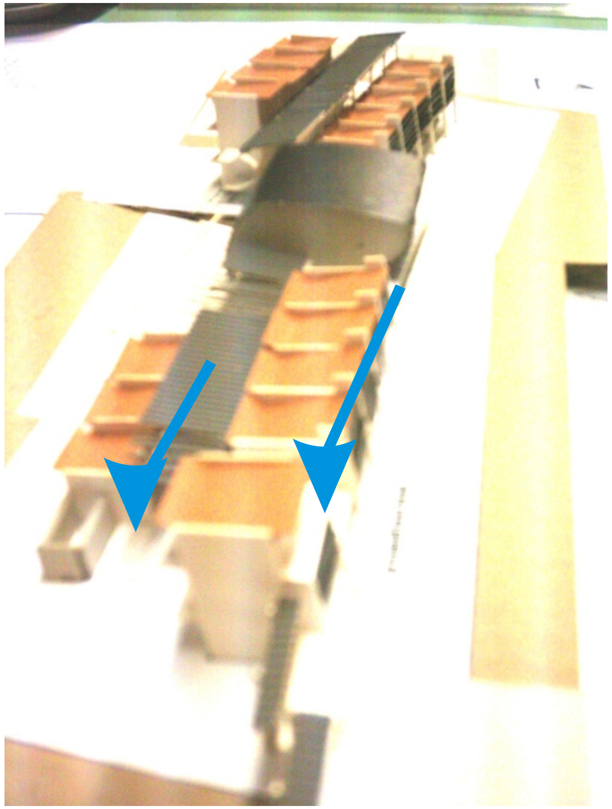


Fig. 126: Modelphoto indicating water harvesting

Calculations:

Total Area of Harvesting Surfaces:
18 Roof Modules : 37.5m2 per Module
18x37.5 x 686mm/year
= 463.05m3/year

The daily water usage in office primary occupancy: 23 litres/day/person

Thus: 23 litres x 365 days x 120 people
= 1 007 400 litres per year for office occupants
= 1 007m3 harvested water per year

Cistern 1: 8mx6.5mx2.5m
Cistern 2: 5mx6.5mx2.5m
Cistern 3: 5mx6.5mx2.5m
Cistern 4: 3mx5mx2.5m

Total: 330m3
Overflow will be channelled as stormwater which will go directly to the greywater processing plant.

A hybrid system will be used in drier months which will make use of the municipal connection as well as the harvested water.

Waste:

Organic Waste:
Where feasible, organic waste should be composted for landscaping applications.

Inorganic Waste:
Affiliated companies for recycling should allocate separate containers to sort glass, paper and plastics for easy removal.

Sewerage:
A wetland system is proposed on the northern apex of the development.

Materials and Components:

Embodied Energy:

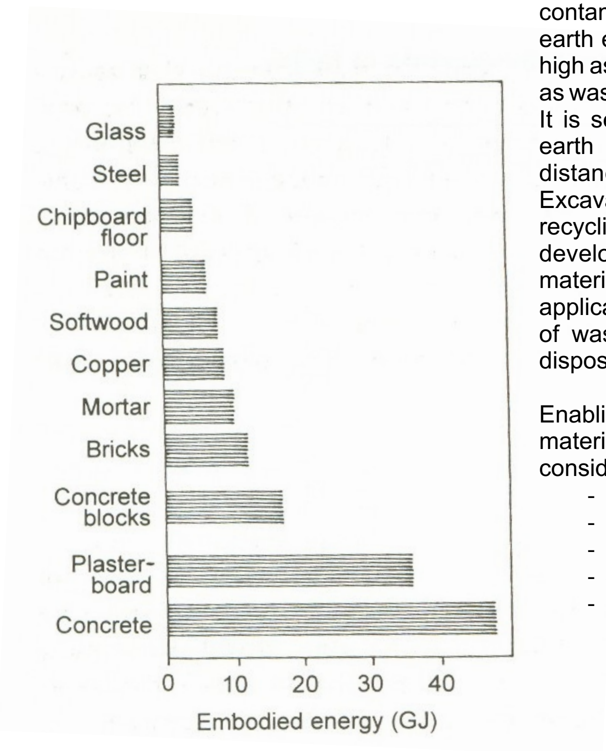


Fig. 127 : Embodied Energy [Thomas, R. 1996.p. 72]

Recycling and Re-use:
Recycling instead of single use products:

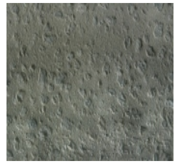
A constraint associated with the Naledi 3D Factory development is the fact that a Greenfield site is to be used. Therefore, keeping future development in mind, the building should be adaptable and flexible to prolong its life cycle. Materials used in the building must be easily recyclable to ensure that further development will not impact negatively on the site and surrounding environment.

Excavations will be done on site; these include the structural excavations for buildings and the excavations done to ensure access underneath the highway. In building excavation, it is necessary to differentiate between uncontaminated and contaminated earth. In the case of uncontaminated earth excavations, the recycling factor can be a s high as 100% - in the sense of recycle it is not seen as waste but rather raw material [Daniels, K. 1998]. It is sensible to determine where the excavated earth can be re-used on site, to avoid great distances covered for the disposal thereof. Excavated earth can be used for recultivation. The recycling of building material is the basis for the development of an intelligent and judicious material economy in the building sector. Concepts applicable include waste avoidance, material use of waste, the thermal use of waste and waste disposal.

Enabling the highest possible rate of building material recycling, the following conditions must be considered:

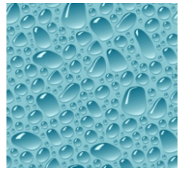
- Material homogeneity
- Separability of materials
- Low material diversity
- Building material identification
- Recovery when possible

Materials:



Mineral building materials:
For example concrete, calcareous stone and bricks are easily re-used. Light building materials such as aerated plaster; drywall and foam mortar can be channeled through separate cycles into the new production of these building materials.

Metals:
Metals can be treated and re-used without any loss in quality. Coatings somewhat limit the recycling options. The embodied energy associated with different materials should also serve as criteria for selection.



Glass:
The recycling of glass depends principally upon the pollution abatement in the manufacturing of the glass panels.

Bituminous Materials:
A rolled building material, such as tarpaper for roofing, is recyclable; coatings with a mineral base can easily be re-used as rubble or ballast. Coatings for insulating materials can only be separated through complex and difficult processes and are usually disposed of completely. The same applies to composite materials.

Insulating materials:
Polystyrene can be integrated into the recycling process as an insulate (granulates, insulating grist, or new panels)

Synthetics:
All types of thermoplastics such as roofing, framing materials etc. are in principle recyclable.

The basic premise, easing the treatment and processing of building materials, must be to avoid any pollutants (heavy metals, organic solvents etc.)
The building industry has come to understand that a positive corporate image cannot be maintained in the future if ecological sensibilities are ignored. Recycling creates new service industries and markets. The best form of recycling is undoubtedly ensuring the longest possible lifespan for each building [Daniels, K. 1998]

Energy:

Transport:
Strategy:
-Gradual reduction in the number of individual cars through car-pooling, car sharing and other communal use.
- Promoting alternatives to transportation by car by improving public transport
- The prevention of unnecessary transport through collective shopping and amenities within walking distance

Applications and Fittings:
Low energy consuming and energy efficient fittings and applications should be used in the development.

Site:

Brownfield:
The site consists of Brownfield on the Persequor side of the development and a Greenfield site on the side of the Agricultural Research farm.

Neighbouring Buildings:
The project will be developed from a holistic approach. A policy will be implemented to ensure that different design firms will work on the development together. Buildings must have a unique character but should also respond to the context, urban scale and fabric.

Construction Process:
Excavated land reintroduced in other areas of the development.

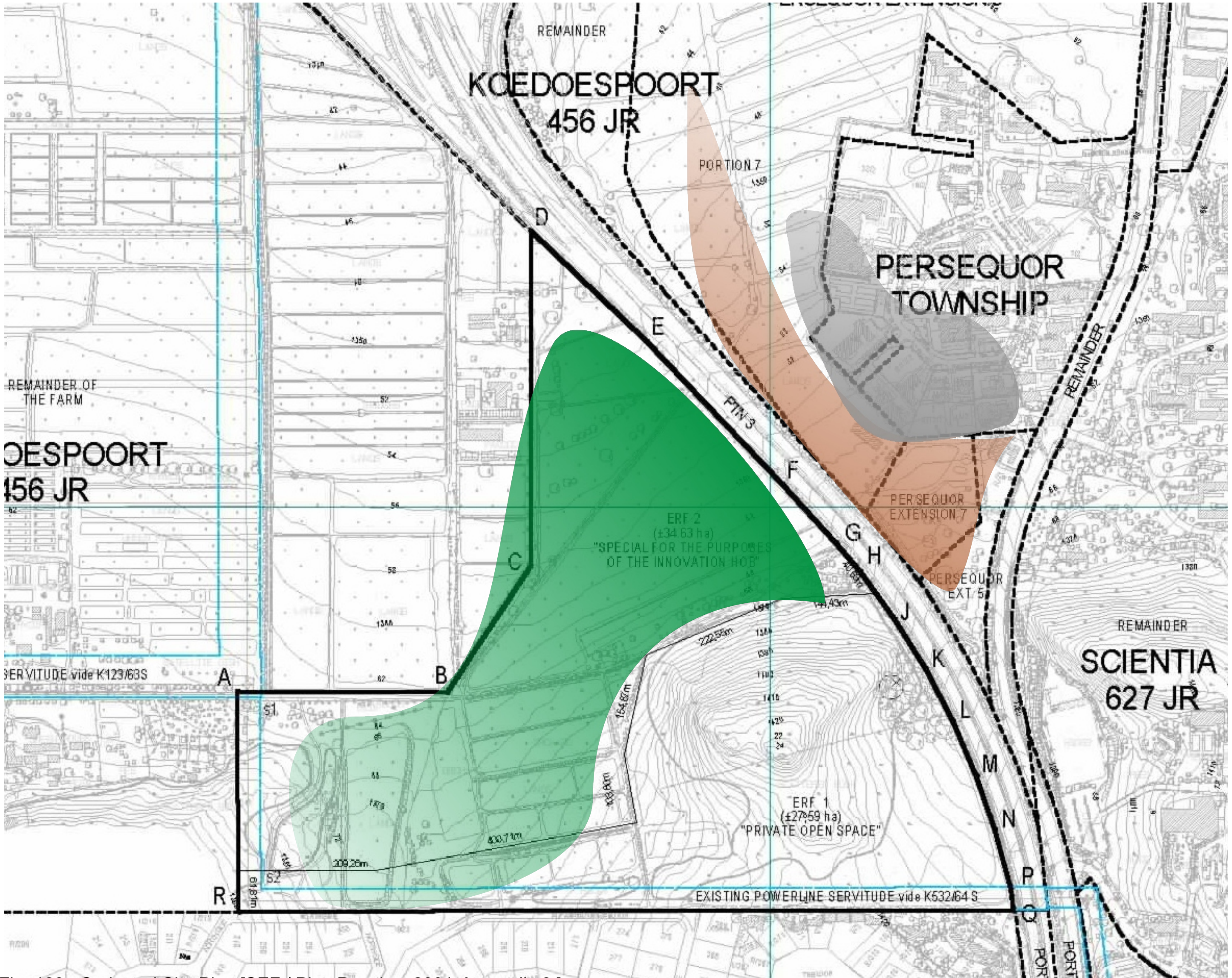
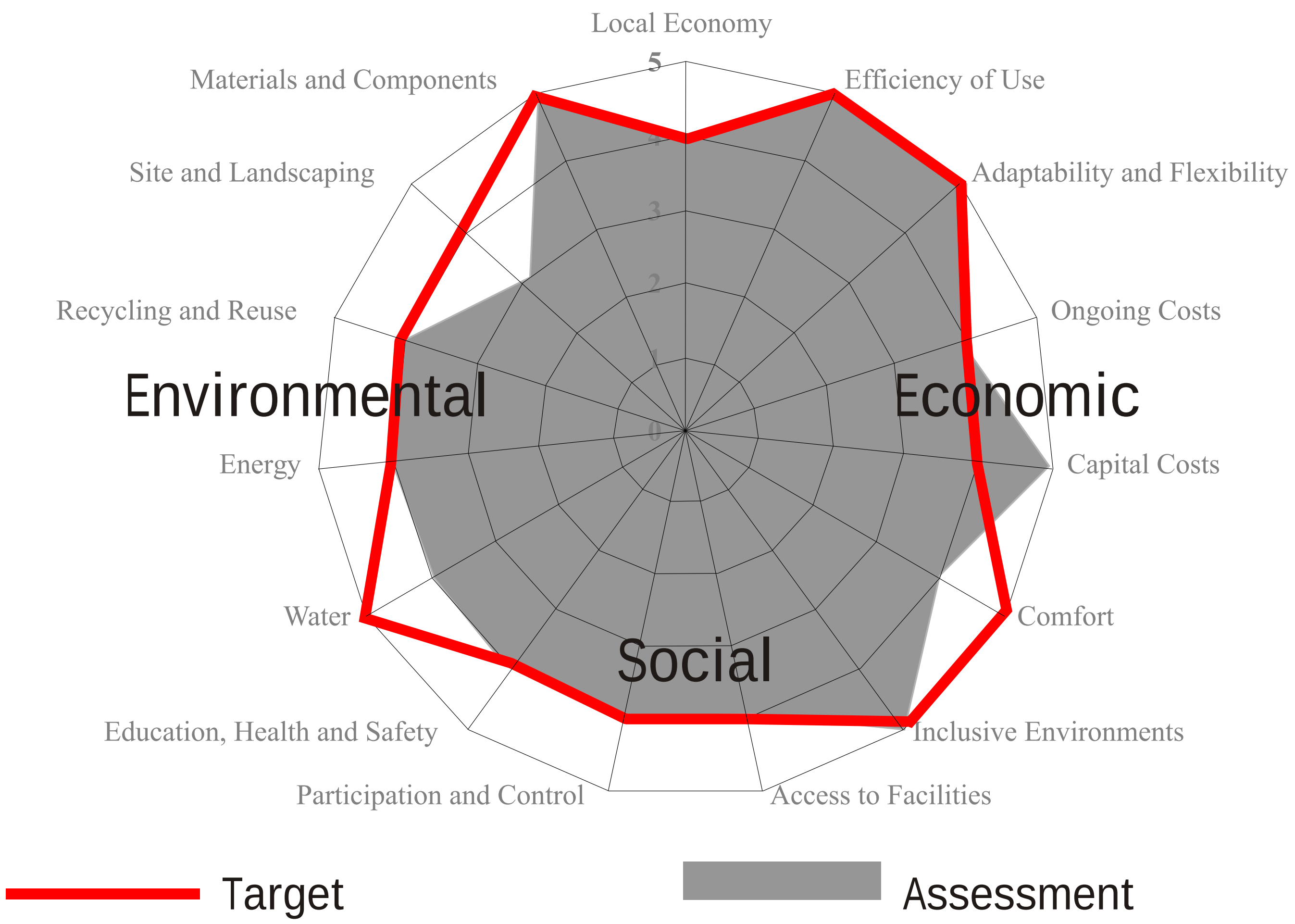


Fig. 128 : Cadastral Site Plan [SEF./ Plan Practice. 2001. Appendix 8.]

Greenfield Site | Brownfield Site | Neighbouring Buildings


Local Economy
Efficiency of Use
Adaptability and Flexibility
Ongoing Costs
Capital Costs
Comfort
Inclusive Environments
Access to Facilities
Participation and Control
Education, Health and Safety
Water
Energy
Recycling and Reuse
Site and Landscaping
Materials and Components
5
3
2
1
0
Environmental
Economic
Social
Target
Assessment

CAD LAYOUTS

University of Pretoria - Bergh, F. S., 2003

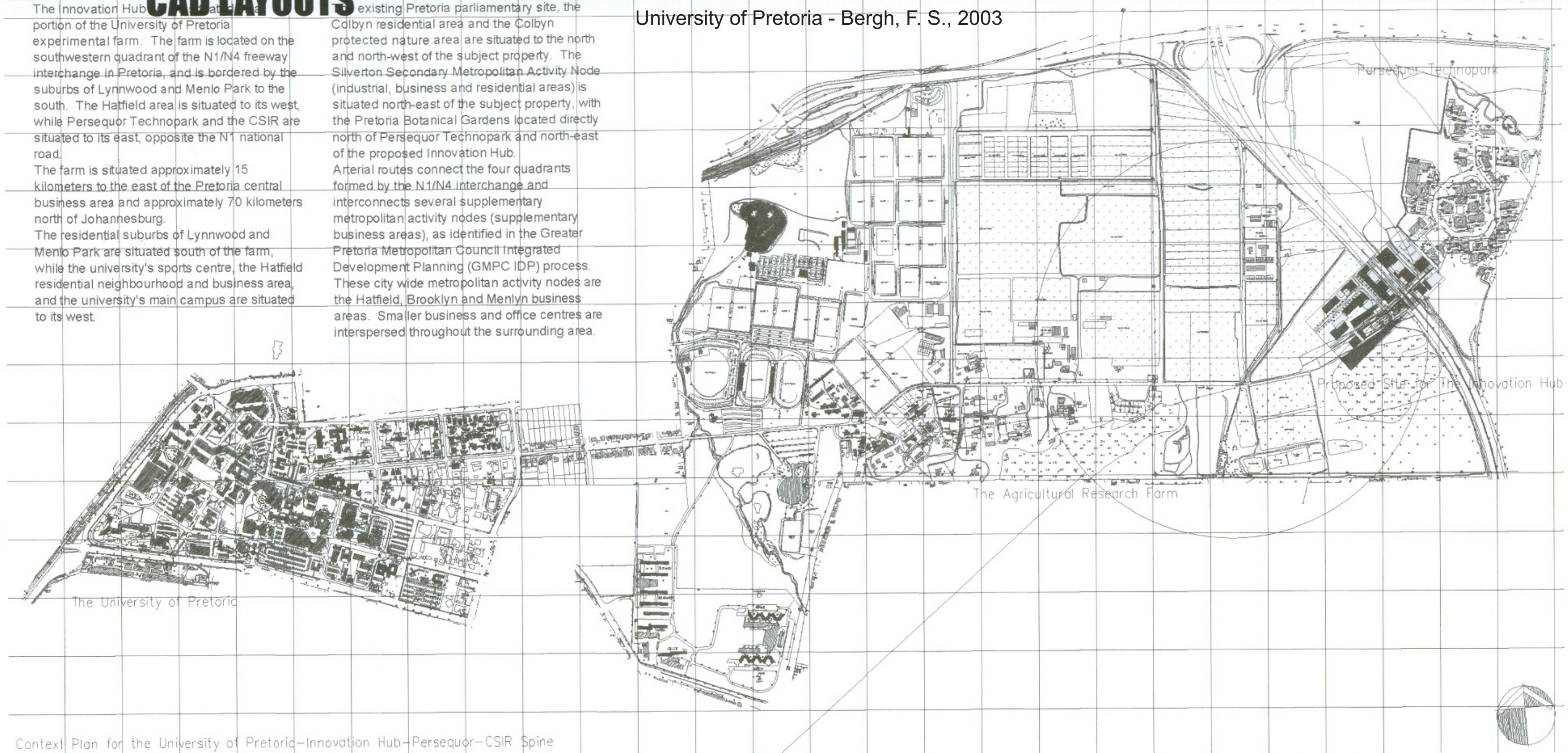
The Innovation Hub [illegible] portion of the University of Pretoria experimental farm. The farm is located on the southwestern quadrant of the N1/N4 freeway interchange in Pretoria, and is bordered by the suburbs of Lynnwood and Menlo Park to the south. The Hatfield area is situated to its west, while Persequor Technopark and the CSIR are situated to its east, opposite the N1 national road.

The farm is situated approximately 15 kilometers to the east of the Pretoria central business area and approximately 70 kilometers north of Johannesburg.

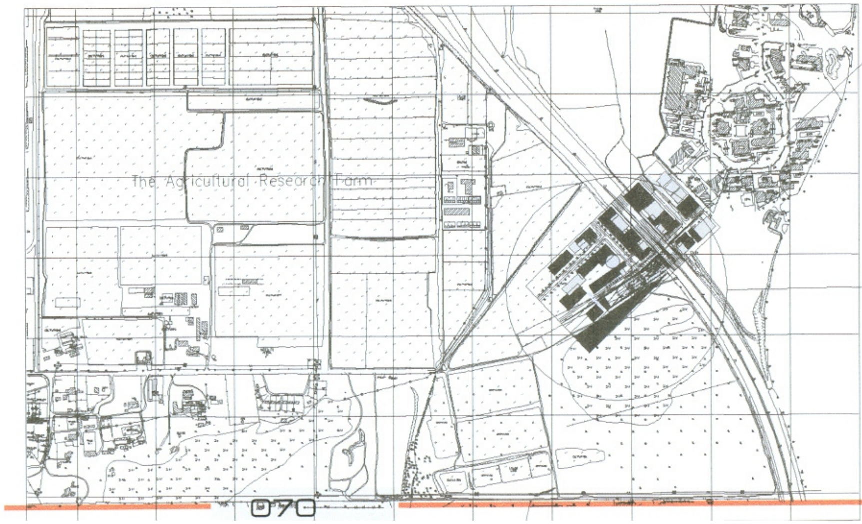
The residential suburbs of Lynnwood and Menlo Park are situated south of the farm, while the university's sports centre, the Hatfield residential neighbourhood and business area, and the university's main campus are situated to its west.

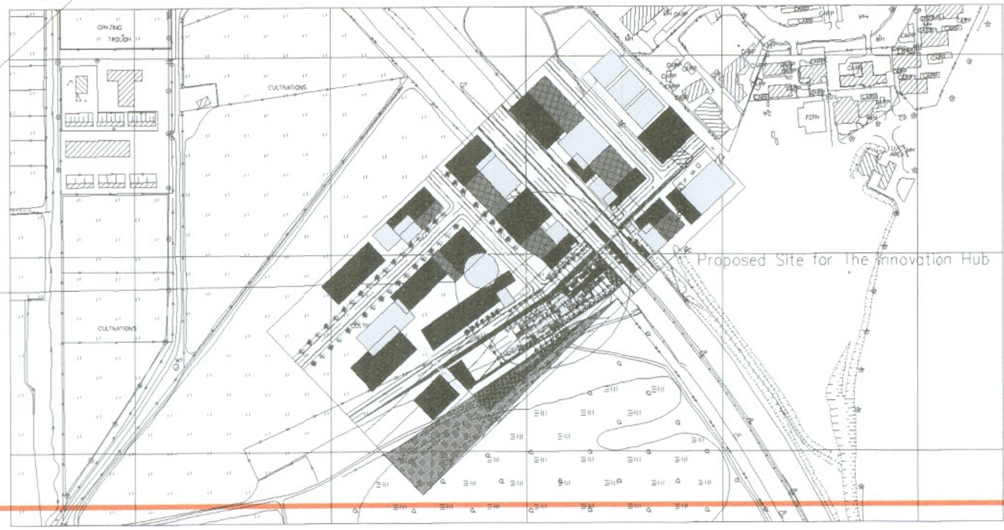
[illegible] existing Pretoria parliamentary site, the Colbyn residential area and the Colbyn protected nature area are situated to the north and north-west of the subject property. The Silverton Secondary Metropolitan Activity Node (industrial, business and residential areas) is situated north-east of the subject property, with the Pretoria Botanical Gardens located directly north of Persequor Technopark and north-east of the proposed Innovation Hub.

Arterial routes connect the four quadrants formed by the N1/N4 interchange and interconnects several supplementary metropolitan activity nodes (supplementary business areas), as identified in the Greater Pretoria Metropolitan Council Integrated Development Planning (GMPC IDP) process. These city wide metropolitan activity nodes are the Hatfield, Brooklyn and Menlyn business areas. Smaller business and office centres are interspersed throughout the surrounding area.

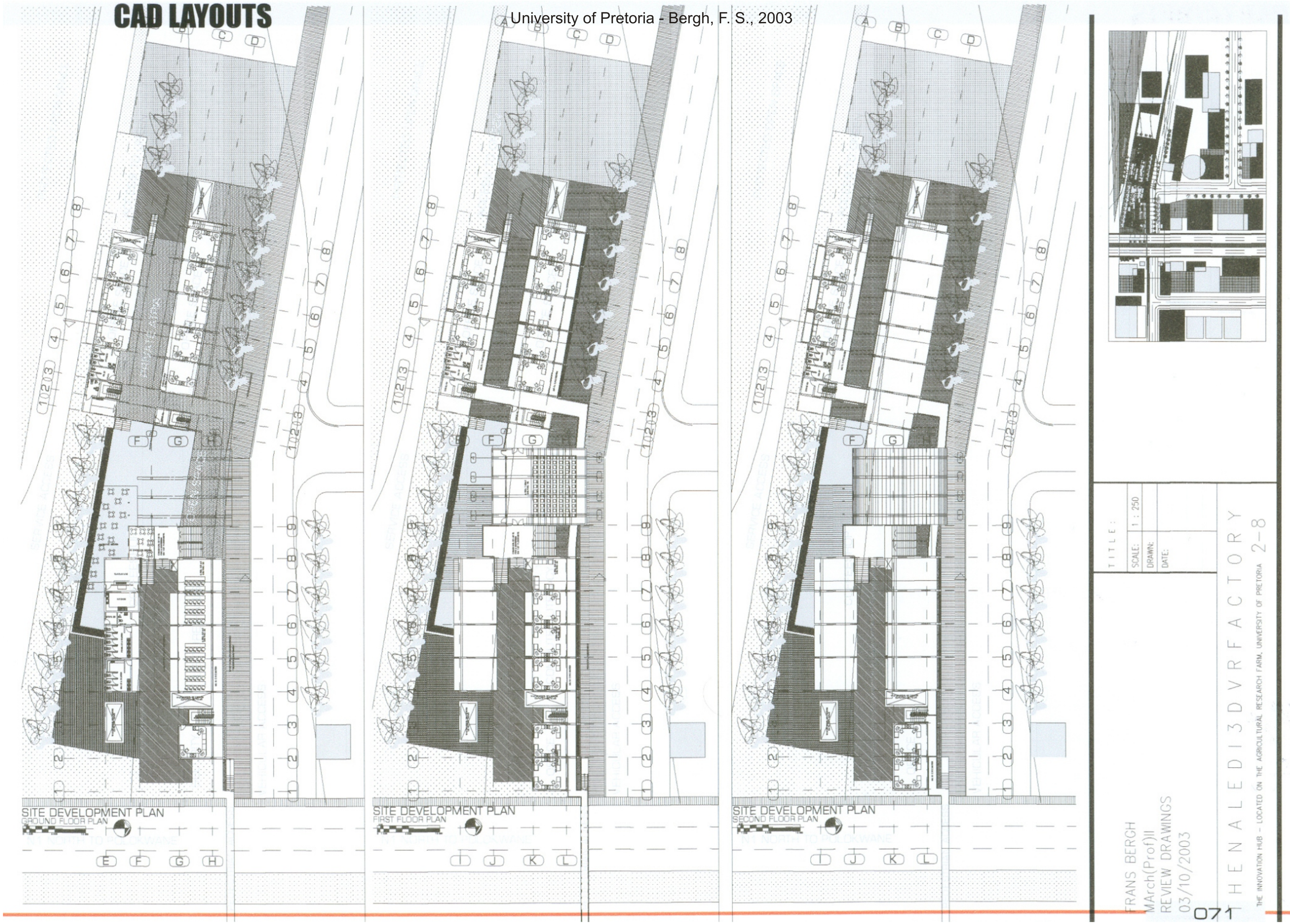


Context Plan for the University of Pretoria–Innovation Hub–Persequor–CSIR Spine

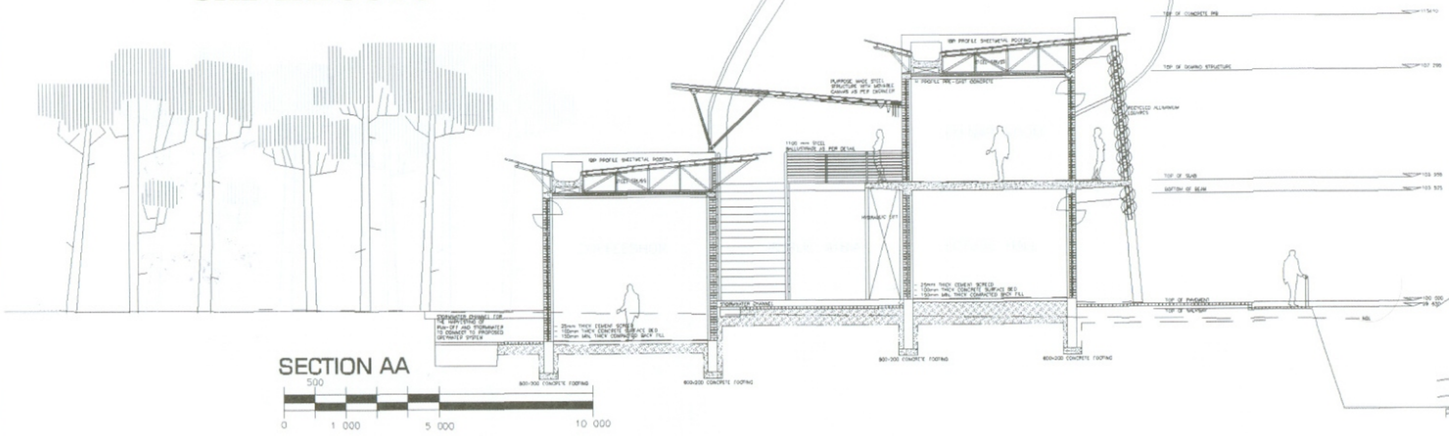


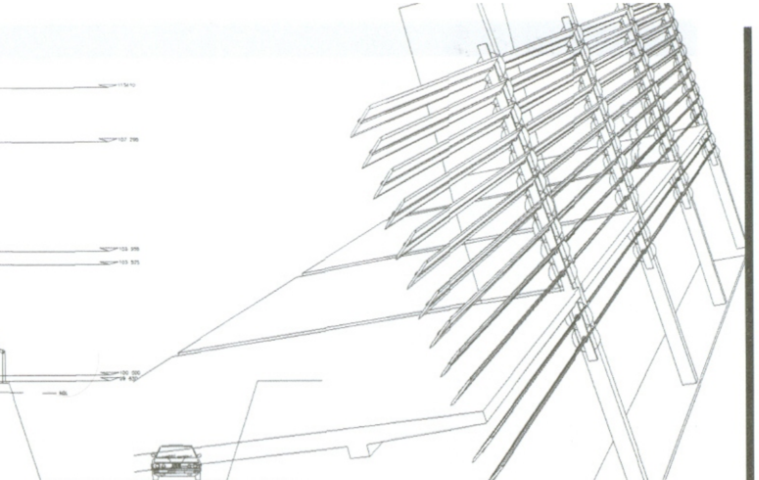


CAD LAYOUTS

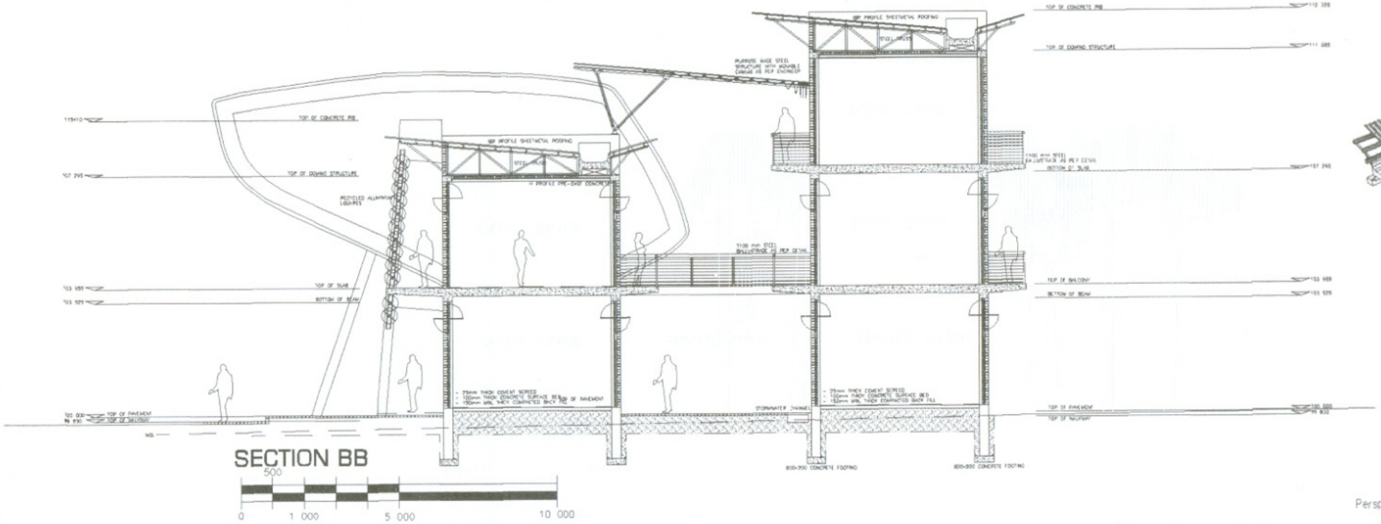

SITE DEVELOPMENT PLAN
GROUND FLOOR PLAN
SITE DEVELOPMENT PLAN
FIRST FLOOR PLAN
SITE DEVELOPMENT PLAN
SECOND FLOOR PLAN
TITLE:
SCALE: 1 : 250
DRAWN:
DATE:
THENALEDI3DVRFACTORY
2-8
THE INNOVATION HUB - LOCATED ON THE AGRICULTURAL RESEARCH FARM, UNIVERSITY OF PRETORIA
FRANS BERGH
MArch(Prof)II
REVIEW DRAWINGS
03/10/2003

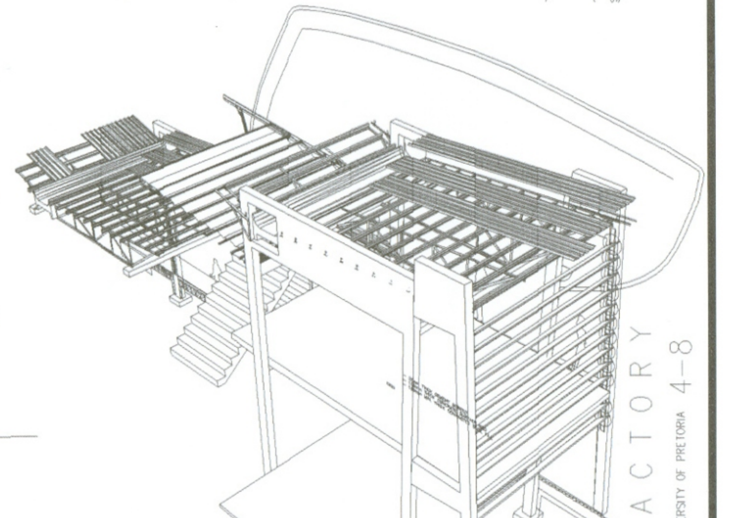
CAD LAYOUTS





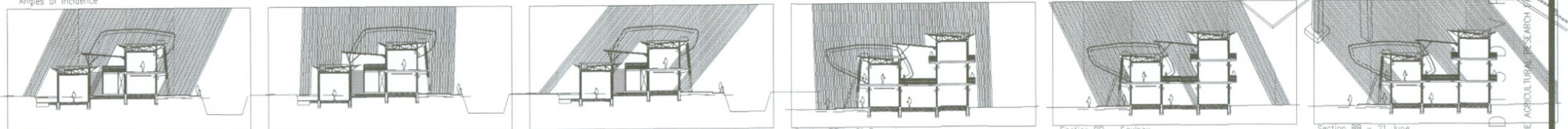
Perspective of Louvre System





Perspective of Modular Unit

Angles of Incidence



Section AA - Equinox

Section AA - 21 December

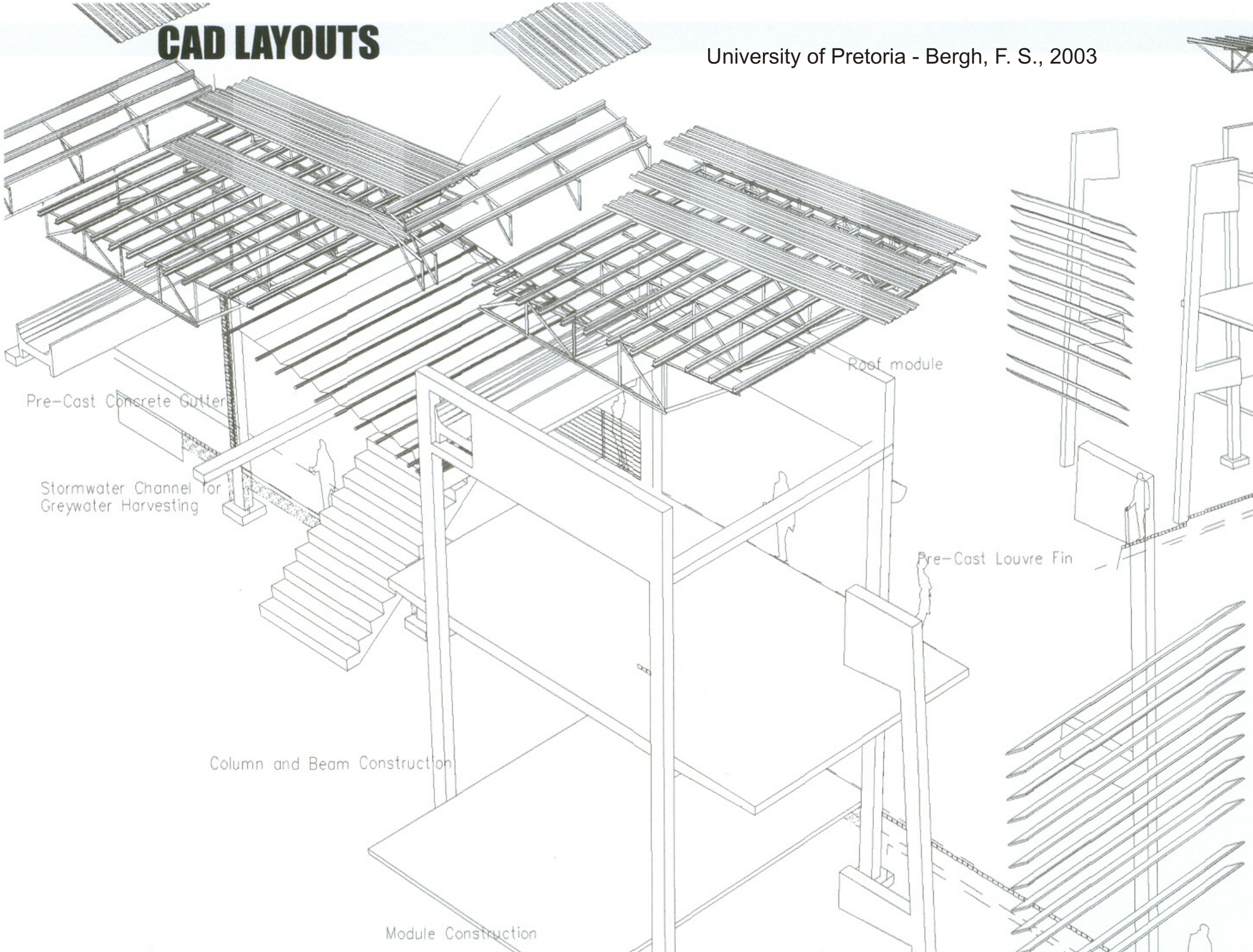
SEction AA - 21 June

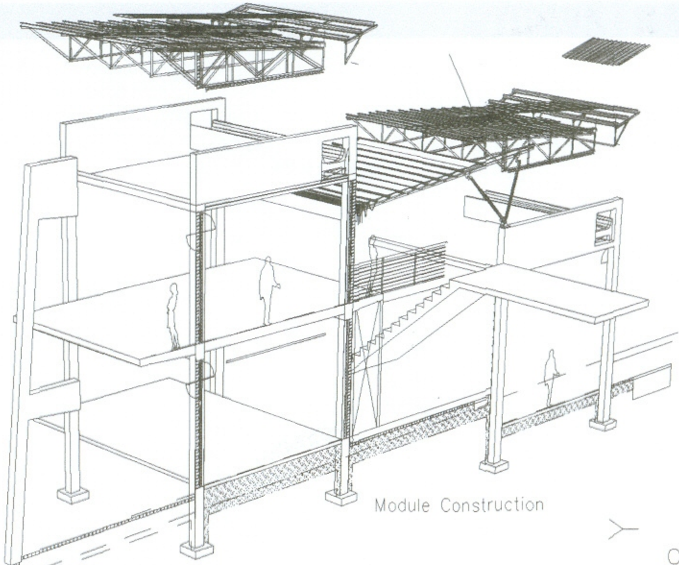
Section BB - 21 December

Section BB - Equinox

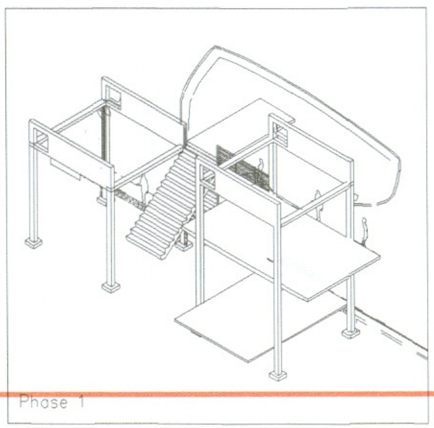
Section BB - 21 June

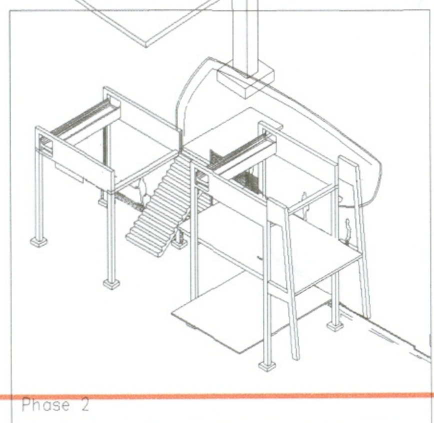
CAD LAYOUTS

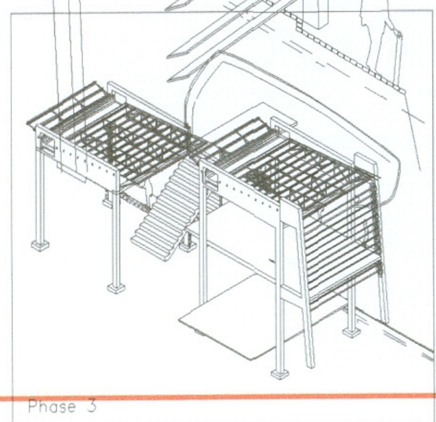


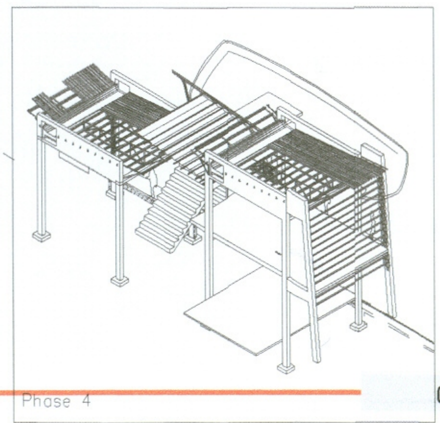


The structure of a single moduleconsists of in-situ column and beam construction with brick and glass infill on the southern façade, and similarly on the north façade, with the addition of the pre-cast concrete louvre structures. The concrete ribs allow for open plan office layouts and increases the flexibility of the interiors. The ribs are constructed on 5m centers with a floor to ceiling dimension of 3500mm. Flexibility in the vertical is also achieved. The addition of secondary cooling systems can be introduced in relation to the function the spaces are used for e.g. class rooms, computer rooms, office space. The 170mm concrete floor slab cantilevers 1100mm on both sides of the external walls. The cantilevers form the balconies on the south, and the circulation walkway behind the louvre system on the north façade. Pre-cast gutters fit into the holes in the concrete ribs, where they join to other modules. The h-profile concrete gutters act as service ducts at the bottom of the profile and forms the gutter at the top of the profile. The guttersurface is covered by stainless steel plate to achieve the necessary quality of water, which is allowed for the greywater system.
The roof structure consists of steel trusses with stainless steel IBR-profile roof sheeting.

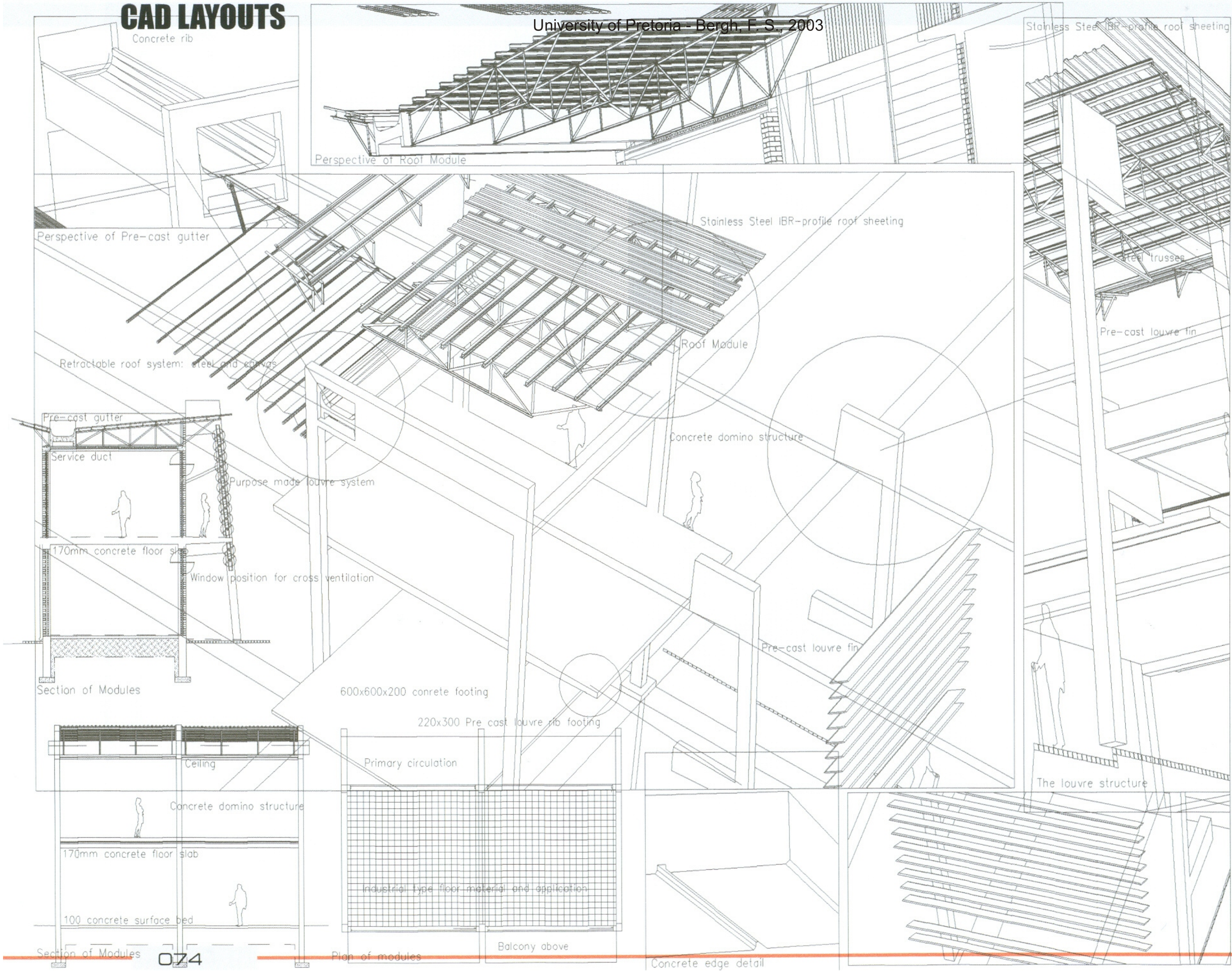






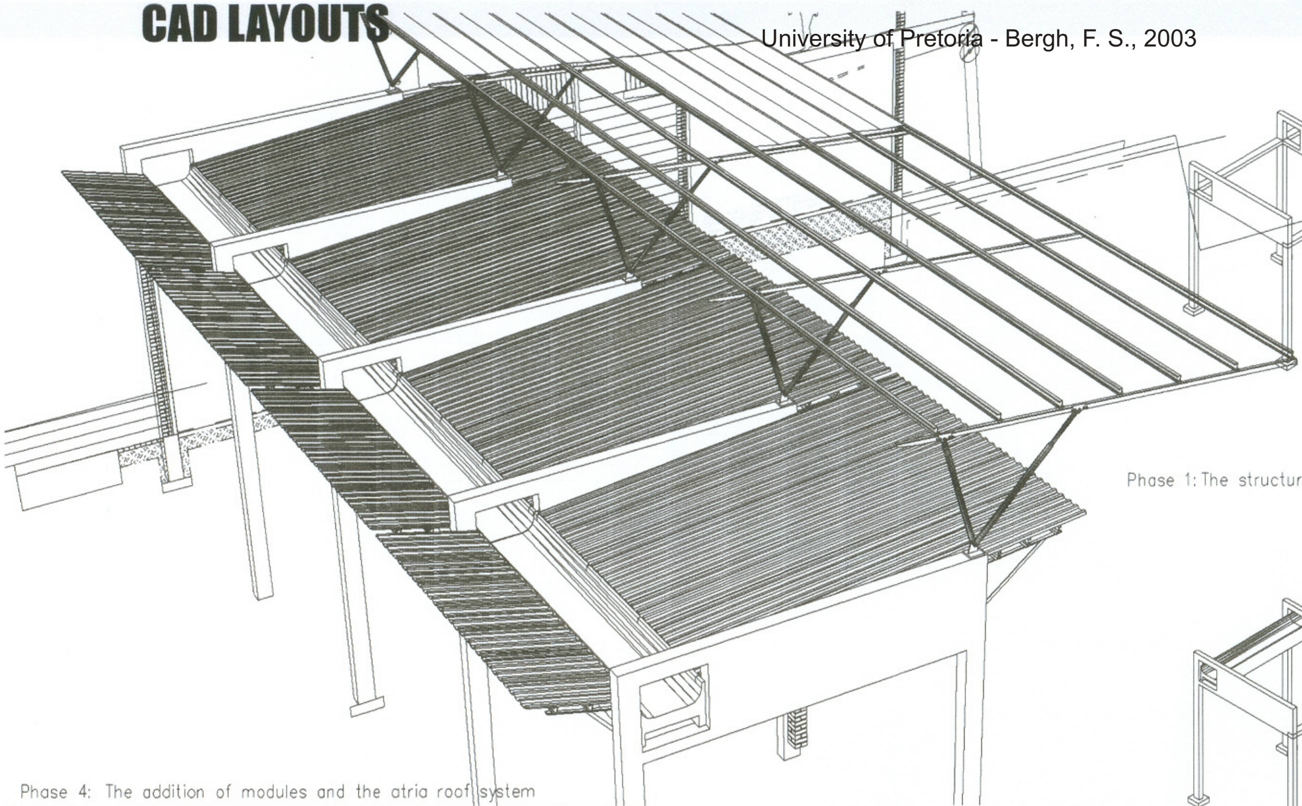


CAD LAYOUTS

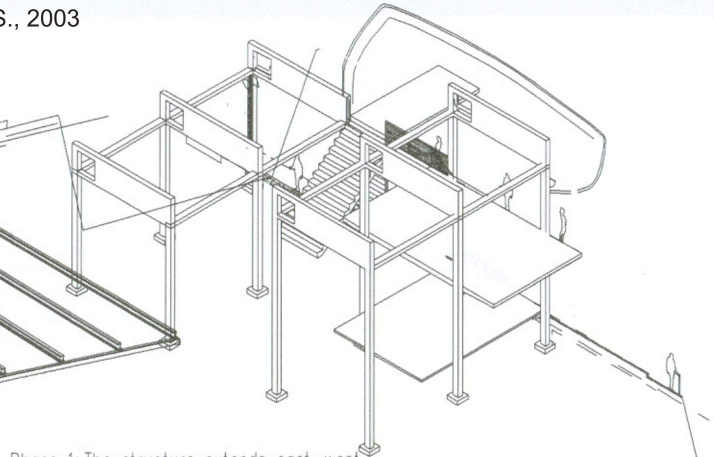


THENALEDI3DVRFACTORY 5-8

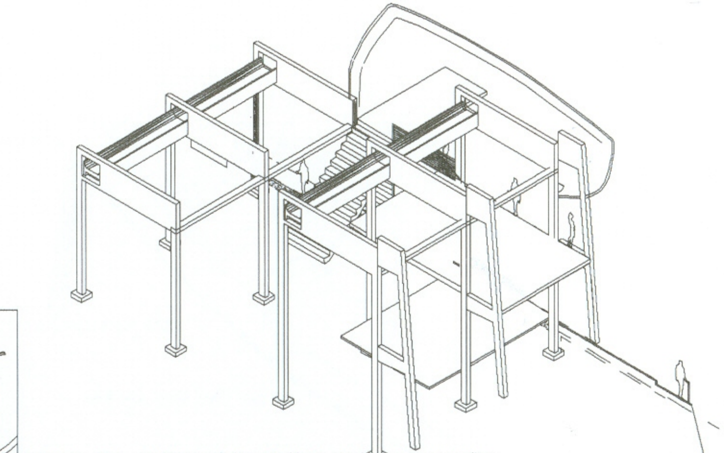
THE INNOVATION HUB - LOCATED ON THE AGRICULTURAL RESEARCH FARM, UNIVERSITY OF PRETORIA



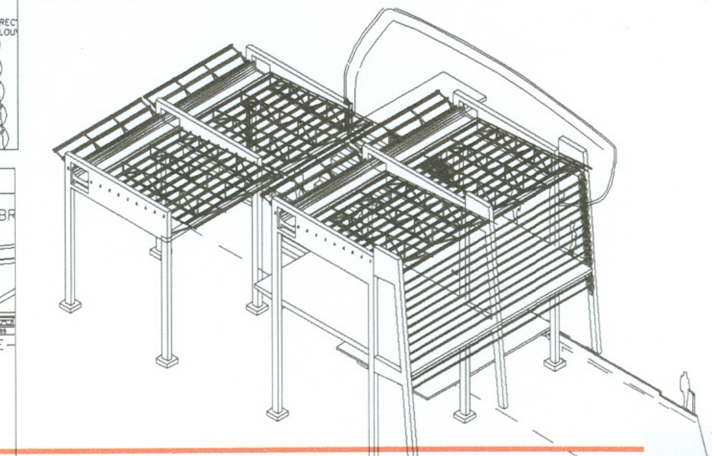
Phase 4: The addition of modules and the atria roof system



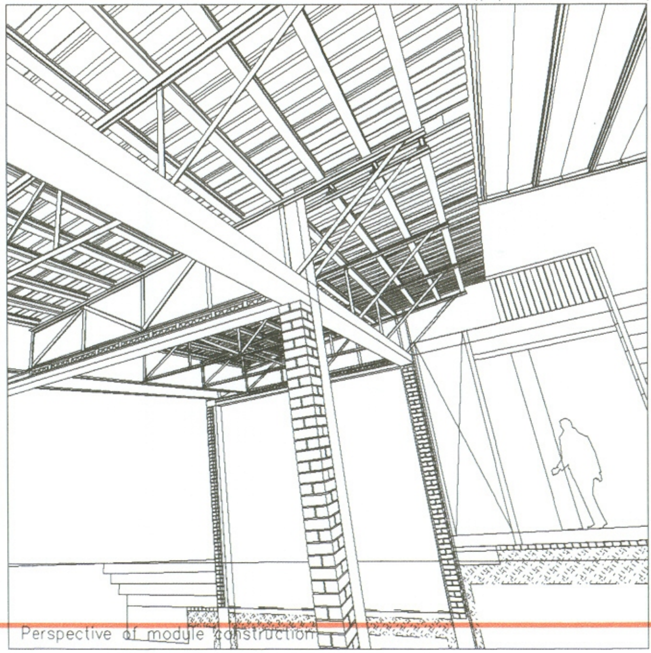
Phase 1: The structure extends east-west



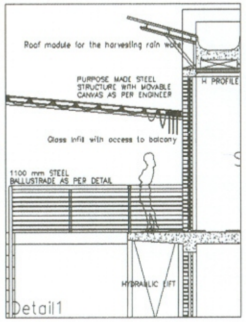
Phase 2: The addition of the gutters and the louvre fins



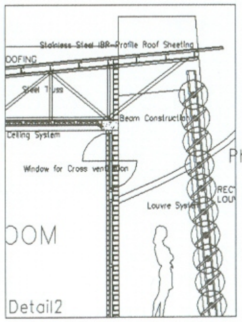
Phase 3: The addition of the roof modules and the louvre system



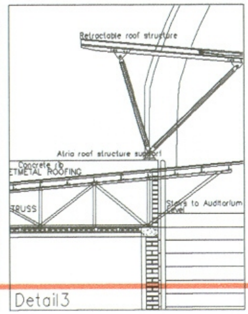
Perspective of module construction



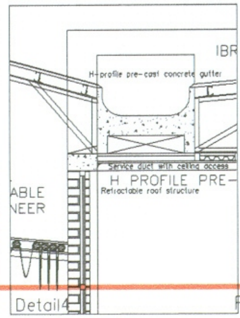
Detail1



Detail2



Detail3



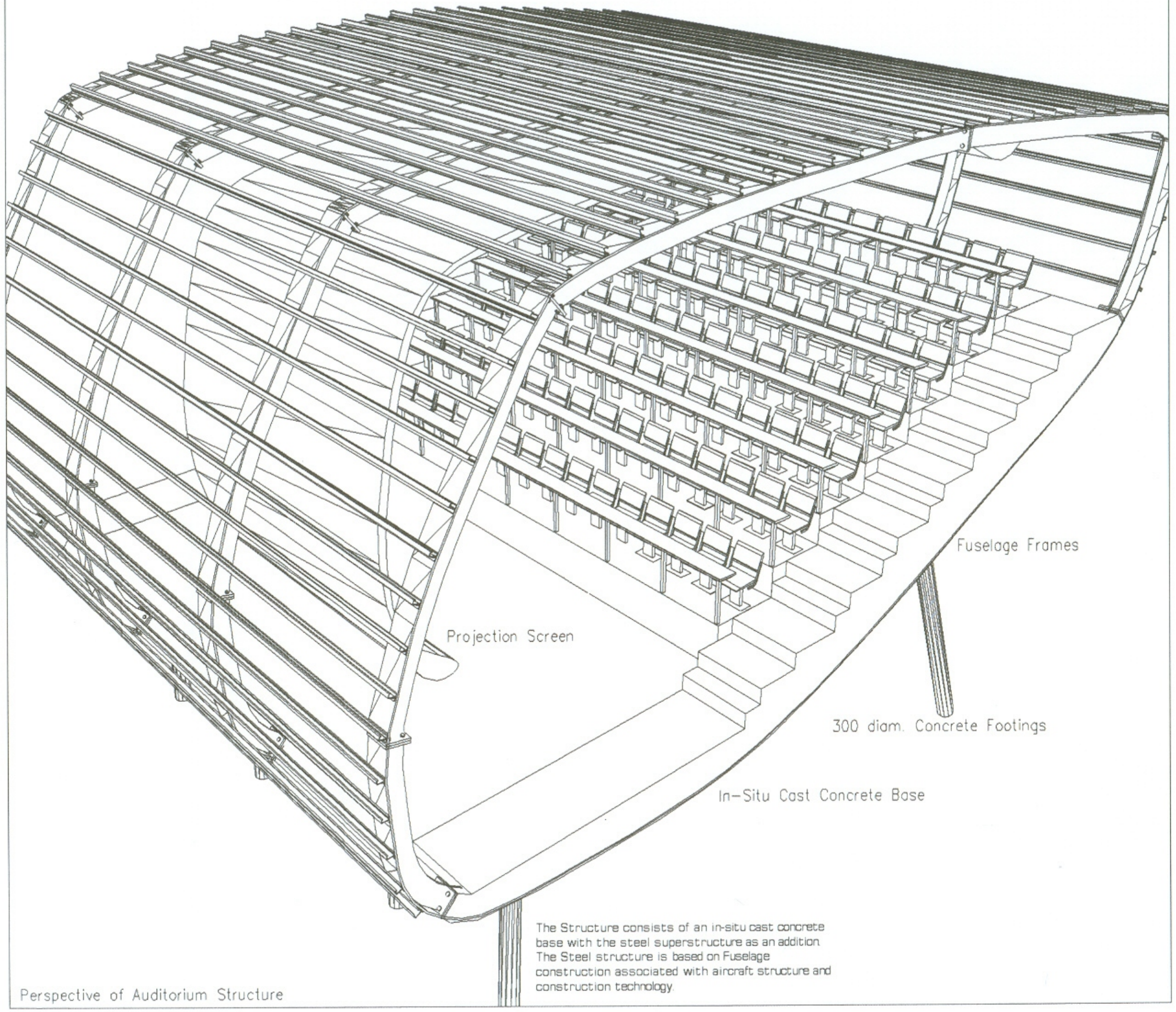
Detail4

HENALEDI3DVRFACTORY 7-8

THE INNOVATION HUB - LOCATED ON THE AGRICULTURAL RESEARCH FARM, UNIVERSITY OF PRETORIA

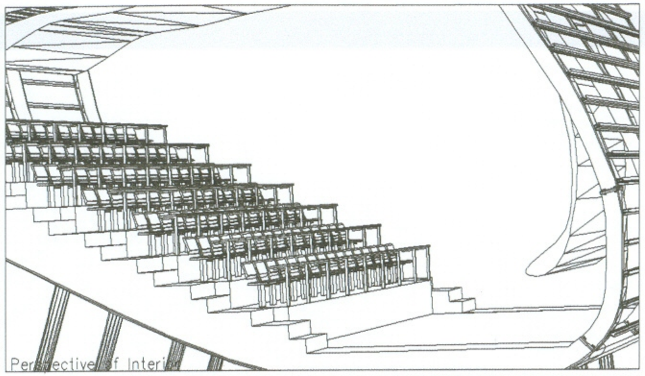
CAD LAYOUTS

University of Pretoria - Bergh, F. S., 2003

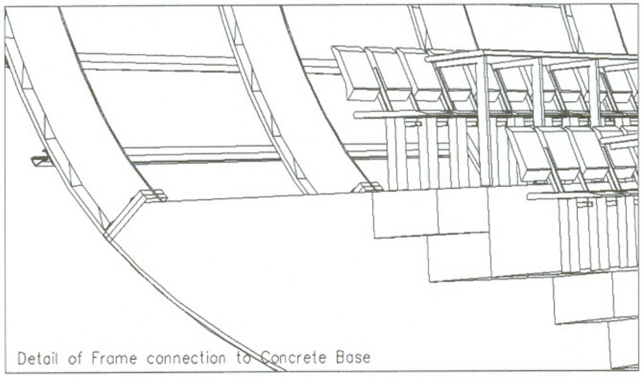


The Structure consists of an in-situ cast concrete base with the steel superstructure as an addition. The Steel structure is based on Fuselage construction associated with aircraft structure and construction technology.

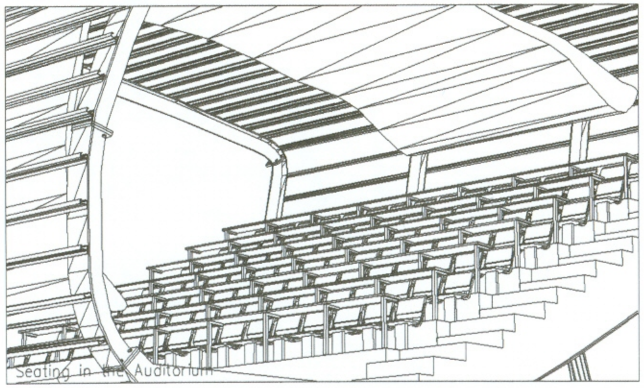
Perspective of Auditorium Structure



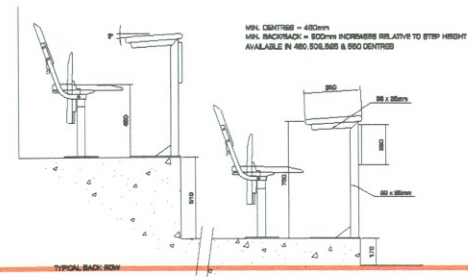
Perspective of Interior



Detail of Frame connection to Concrete Base

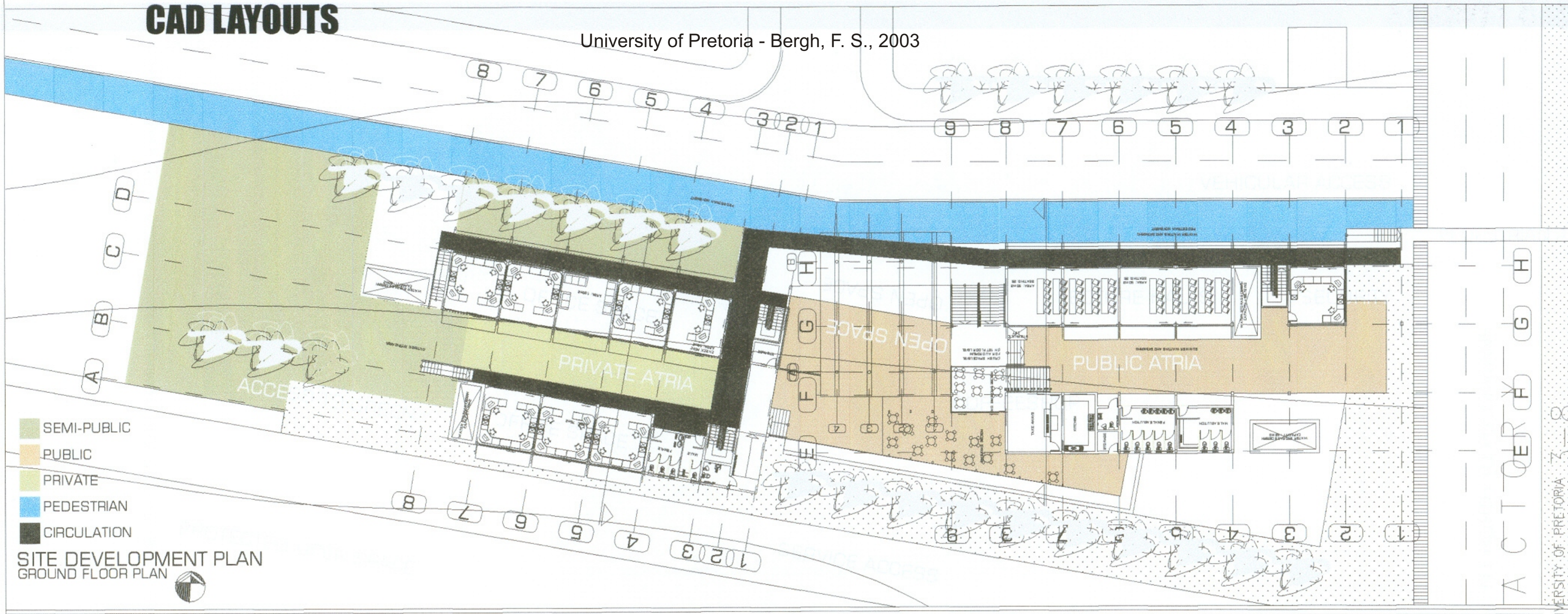


Seating in the Auditorium

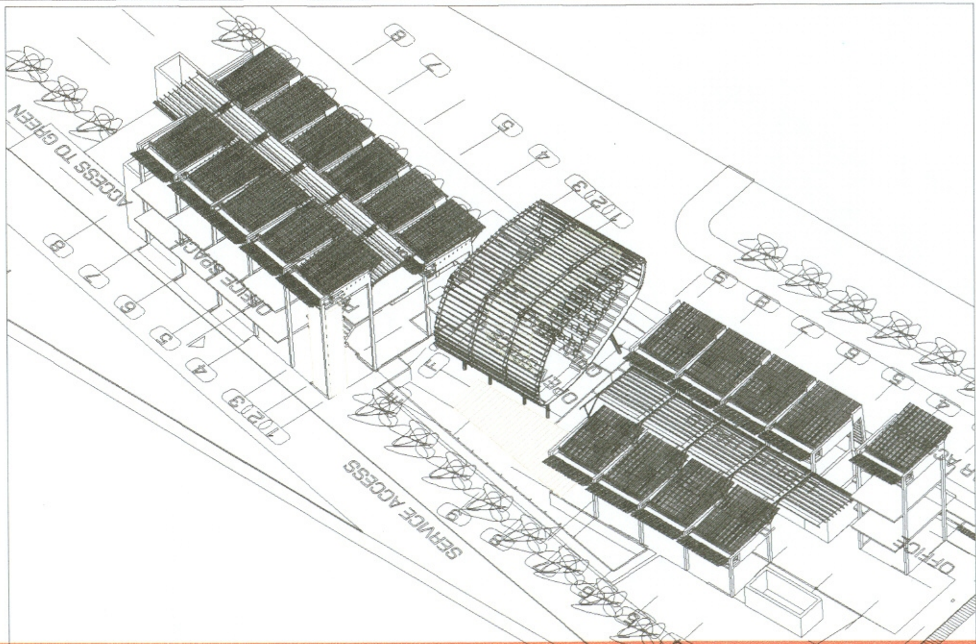


Section of Seats

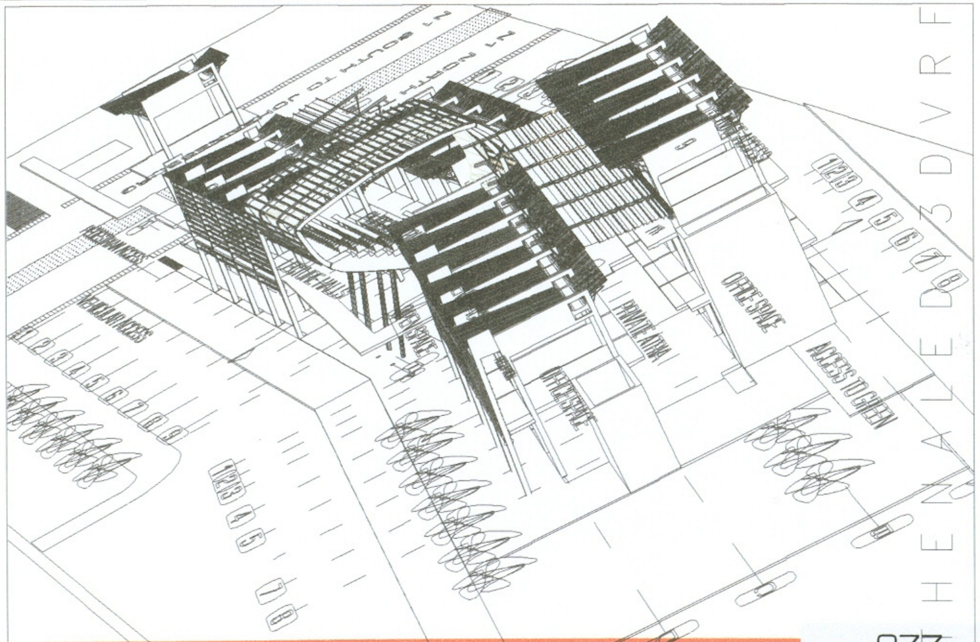
CAD LAYOUTS



SITE DEVELOPMENT PLAN
GROUND FLOOR PLAN

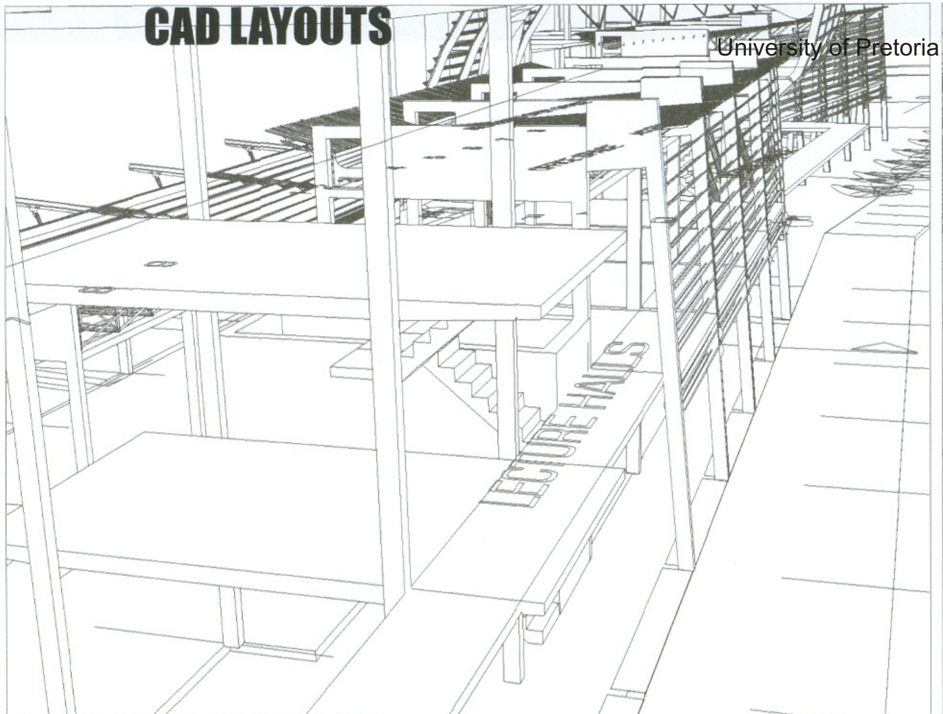


Aerial View of Public Open Space

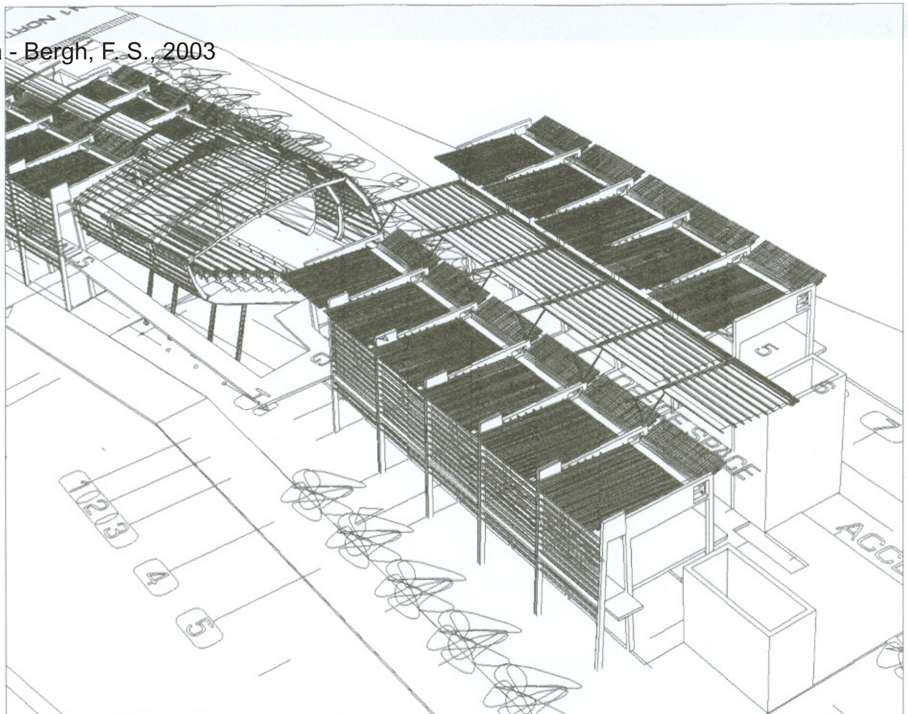


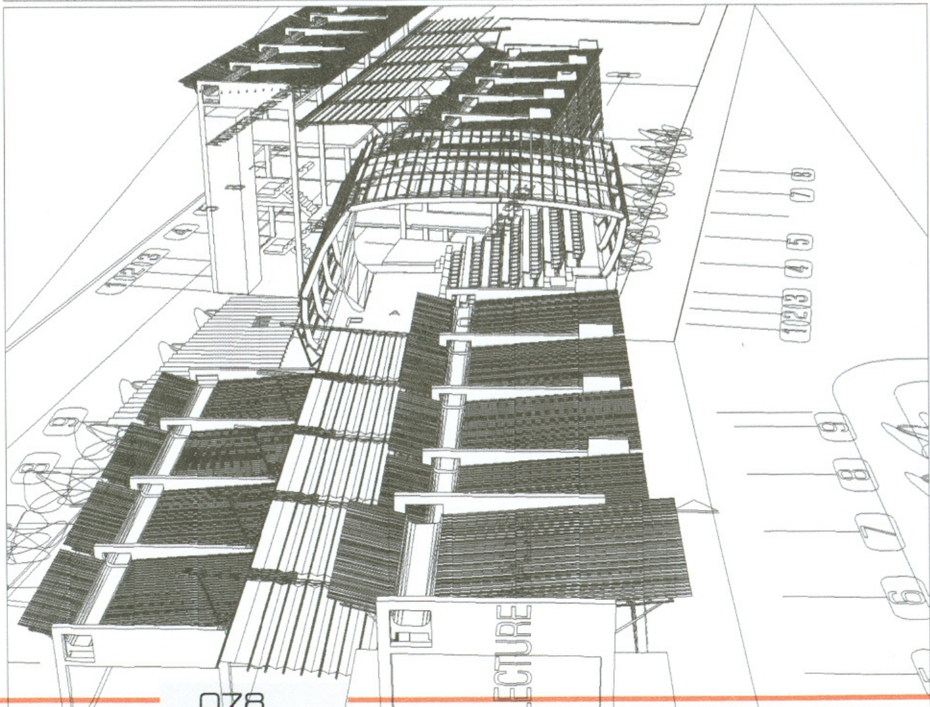
Perspective of Private Atria

THE INNOVATION HUB - LOCATED ON THE AGRICULTURAL RESEARCH FARM, UNIVERSITY OF PRETORIA

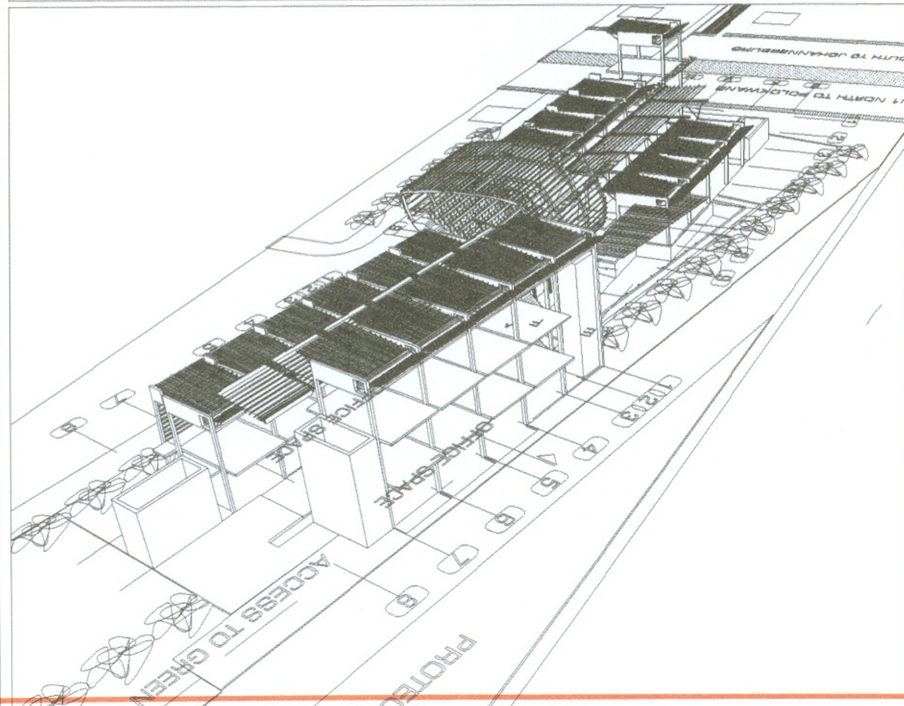


Perspective of Entrance from Pedestrian Bridge


Perspective of Office Units



Perspective of Atria Roof Structures



Perspective of Office Units and the Access to the Protected Green Space