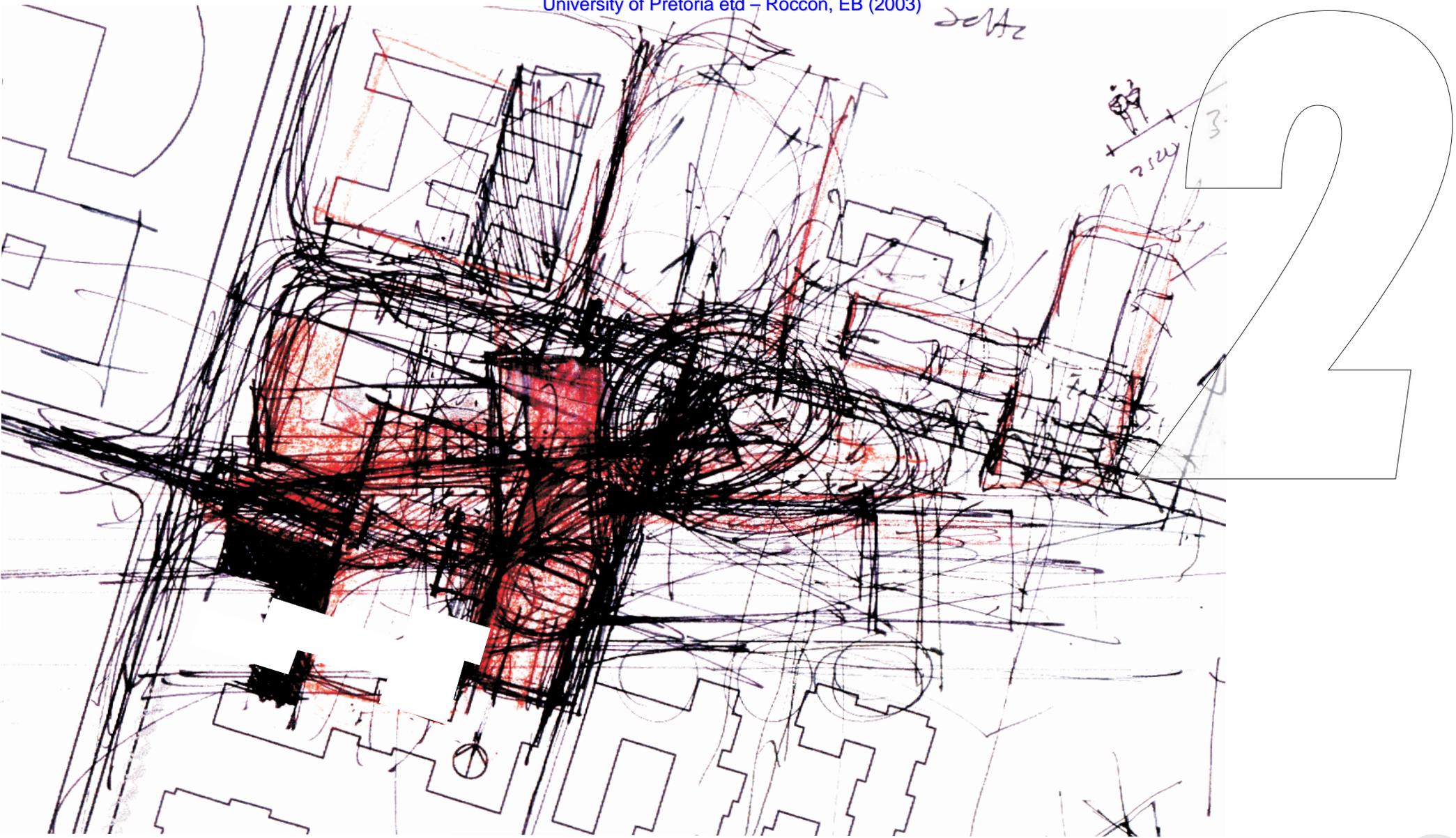


2012



BASELINE

CHAPTER 2

NATURAL VENTILATED

train station

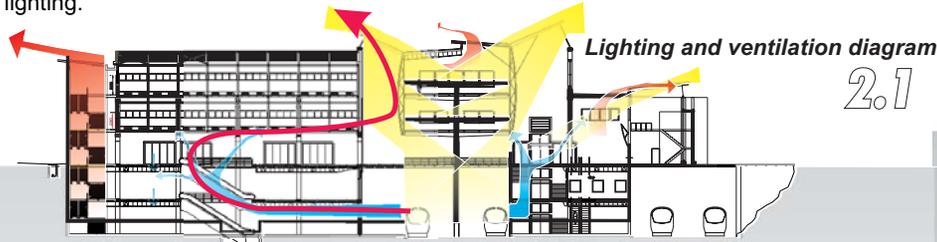


1.1) Occupant Comfort

The comfort of people in and around the building is the reason for good design. It will create a place with spaces within a space, where ease and comfort of movement will enhance the functional activities. People of South Africa enjoy sunshine. We thrive, as a country to function outside, between the buildings, with our environment.

1.1.1) Lighting and ventilation:

The building, will predominantly be orientated east/west. To avoid direct sun penetration on these facades, vertical sunscreen devices (designed to retain heat in winter and ventilate heat during summer) must be implemented and therefore, minimize natural lighting penetration during the day. The more natural light that penetrates the building will ensure less artificial lighting. This means less electrical energy used and less heat within the building, generated by the electrical heat through lighting.



Lighting

The natural lighting will penetrate the lower levels (platforms), by means of double volumes. The double volume will introduce ventilation from the platform level, to create airflow, air changes per hour and ventilation for the structure. The ventilation will transfer warm air or will ventilate and extract warm air as required, to keep the internal temperature at desirable temperatures.

The platforms and pedestrianised areas must be well lit to ensure a safer environment. Lighting can also be used to enhance the visual and functional clarity of the different circulation routes, entrances, fare-vending areas, platforms and building facades. It can also be used for information graphics to inform people and passer-byes of train arrival and departure times.

The passive cooling and heating system will not act as a single heating and cooling ventilation system but assist the air condition system and therefore the air conditioning system, will use less conventional energy for operation. The system can even be switched off if the passive system is sufficient enough.

The lighting should not obstruct free movement of pedestrians or motor cars. The glare must be at a comfortable level and placed to enhance and create a safe environment.

(Exterior Locations	Foot-candles
Station Shelter	15 minimum
Interior Locations	Foot-candles
Station Platforms	10 minimum
Fare Vending Area	12 minimum
Station Platforms, Uncovered	10 minimum

(Table 1: lighting requirements)

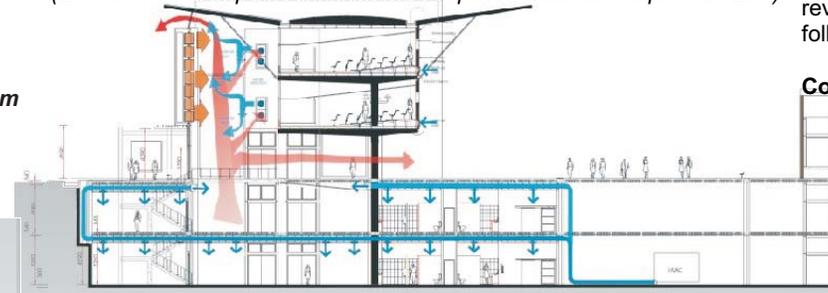
Toilets	10 l/s per sq.m
Offices	15 l/s per sq.m
Arrival and departure	20 l/s per sq.m
Shops (retail)	10 l/s per sq.m
Platforms	20 l/s per sq.m
Staircase	Pressurization -fire req
Equipment rooms	As per functional req

(Table 2: ventilation requirements)

1.1.2) Noise:

Period of Day (T) (dBA), LAeq,T(dBA)Lamax
 •06h00 – 22h00 (daytime/evening) 60- 85(dBA)
 •22h00 – 06h00 (night-time) 50- 85(dBA)

(Environmental Impact Assessment: Proposed Gautrain Rapid Rail Link)



Ventilation

All aspects of the potential construction modes, based on the most likely scenario as anticipated by the civil engineering consultants were reviewed. These included the following noise attributes:

Construction techniques.

Location of construction camps, ancillary plant sites borrow-pits and dumpsites
 Construction material delivery routes.
 Work program.

(Environmental Impact Assessment: Proposed Gautrain Rapid Rail Link)

Other specific noise situations related to the train operations:

The noise at stations.

The noise generated from ancillary equipment related to the rail system (tunnel ventilation, pressure relief and dewatering pump systems, traction stations, etc.).

The interior noise in the passenger cars.

Problems related to marshalling yards and workshops.

Potential noise problems from track maintenance operations.

1.1.3). Views:

It is important for working people within a structure, to feel part of the outside and not isolated. At least a third of a person's day will be spent working and people work within the confined spaces of a structure. If a building can be an extension of the outside, people will feel more "free" and part of the activities that passes them by, while working. They will feel part of the movement infrastructure.

The passing trains can be used as a viewport to the outside, if the movement can be exposed to the people. The pedestrians and commuters will also be exposed to the working people in the structure. To further enhance the viewpoints of working people and commuters, a greenhouse, will act as the linking space or foyer, between the inside and outside.

VIEWS

The viewports and greenery will both be used, not just as an aesthetic component, but as a natural ventilation mechanism and a microclimate establisher to minimize the use of artificial heating and cooling to acquire the desirable temperature for the functional activities.

The access roads (pedestrian and vehicular) will form view lines towards the departure and arrival platform areas. This will promote access to the station. Access to and from the station is the most important point to create a fluid movement pattern, avoid confusion and promote sufficient usage of the station and its related functional activities.

The arrival platform will lead people to the point where they can choose the next functional activity. As the commuters arrive on this point, they will have access to retail and commercial facilities to satisfy their daily requirements or appointments. The commuters can travel further in the form of bus and taxi travel or make use of the Gautrain mini-busses. The open air market, job center and hotel will also be directly viewed from this point.

The views at this point, will be crucial, for this will be the point of decision making, planning and then moving towards or away from and influence the movement on the site. This will also be valid for commuters, arriving for departure from the station. They will have access to the same activities, but will access these facilities through and with other view lines and line connection activities.

1.1.4) access to green outside

The outside area will consist of public open spaces that will bridge the railway lines and reserves. The implementation of green open spaces will be coupled to extreme expenses and construction difficulties. The greenhouse will not only be used as a microclimate establisher, but will reduce radiant heat to the building on the northern façade. The greenhouse will also provide access to greenery, in the form of a green courtyard.

The building's façade will open towards the green courtyard to allow cross ventilation and as a climate control element. Trees will form a fundamental constructor of pedestrian paths and pedestrian orientated streets.

1.2.) Inclusive environment.

Hatfield station will be a specifically designed building for its function. The building must accommodate 1500 people at peak travelling hours per platform. This will cause vacant open spaces at certain times (minimum of 1500 sqm) during non-peak hours. To create a sense of activity and occupancy, commercial, retail and overnight space will be introduced as shared volumes, but not as shared usable spaces. The building's function will be a train station, for as long as the railway commuters will use train travel as transport medium.

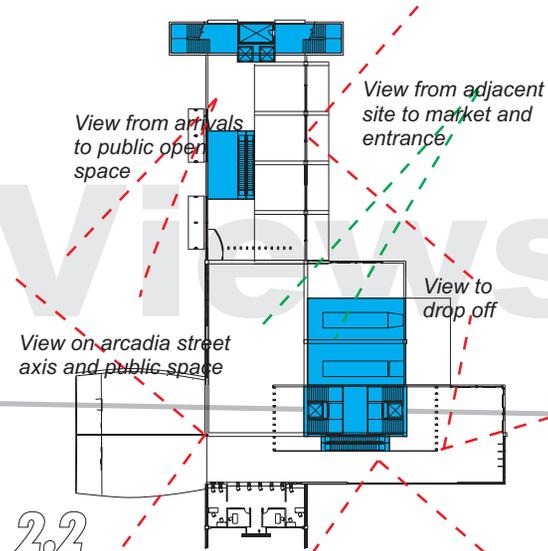
The surrounding structures that form part of the station precinct, must be flexible designed, to adopt different functional activities for changing times. The environment must therefore also be designed for the building to function.

1.2.1) Public transport and routes:

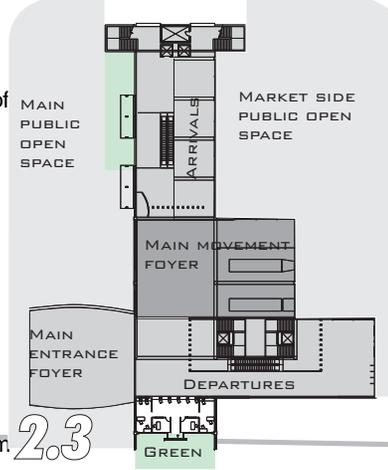
Public transport will form the main access medium, with pedestrian routes, for the departure and arrival areas on the station building. A primary access route that runs north/ south across the site will be used as a service route, drop-off zone and pick-up area for arriving and departing passengers.

A bus depot will be located within 50m of the arrival platform and the Gautrain mini-bus service will be available to transport passengers to nodal activity areas (Brooklyn, Hatfield and Menlyn). A ring road system (Schoeman St, Duncan St, Burnett St and Festival St), that will be serviced by mini busses and the municipal bus service, will be within walking distance from the station, to the north and the university, to the south, to reduce travel time within the Hatfield precinct.

As described in the urban design principals, Schoeman Street and Duncan Street will be hard edges. These streets are not pedestrianized but will have mini-bus and municipal bus stations for pick up and drop off. These waiting shelters will be adequately transparent to minimize vandalism and provide adequate surveillance of the station and enhance a sense of security and openness. Festival Street and Burnett Street will be pedestrianized and Grossvenor Street, will be an extension of Burnett, linking the station public open space with the pedestrian route from Burnett Street.



2.2
(Plan explaining views and vertical circ.)



2.3
(Plan illustrating green areas)

A station building that will form an extension of our environment, but still keep the identity and functional requirements of a train station, within the context of the site and neighborhood.



2.4
(plan showing public transportation on site).

1.2.3) Toilets:

Bus criteria:

- Buses should be as close as possible to the train station.
- Promote fast efficient movement with no obstructions (e.g.: crossing railway tracks).
- Provide emergency services for railway line failure.
- Separate bus and motor car access.
- Minimize conflicts between buses, motorcars, pedestrians, cyclists and train.
- One bus bay with 3,5m x 20m with 15m tapers on each side.

(LRT Design Criteria Manual. Revise October 2000).

Pedestrian movement and circulation to, from and across train platforms is essential for the smooth operation and functioning of a train station. Movement patterns must be as simple, obvious and comfortable as possible.

The Implementation of color, texture, patterns and clear signage will enhance the movement of pedestrians to the functional activities. Elevators, escalators, ramps and stairways will achieve changes in level. These circulation elements must be placed on the pedestrian routes but must not obstruct movement.

1.2.2). Circulation zones: (edges)

- A *Through Zone* is an unobstructed area void of above-grade utility boxes, vertical elements, furnishings, etc. that provides free flow of pedestrian movement.
- A *Curb Zone* is an unobstructed area void of utility boxes, vertical elements, furnishings, etc. that provides space for loading and unloading of vehicles.
- A *Furniture Zone* is an area where furnishings, utility boxes, light and sign poles, newsstands, trash receptacles, shelters, platform equipment, etc. are located.
- A *Guideway Zone* is the horizontal train movement area that corresponds with the vehicular dynamic envelope.
- A *Bus Zone* is an area where buses transition in and out of the station and stop for passenger loading and unloading.
- A *Building Frontage Zone* is an area between a building line and the through zone where passengers might lean, window shop, or avoid because of building obstructions such as window ledges, columns, etc.
- A *Drop-off Zone* is an area generally associated with kiss-and-ride where automobiles drop-off and pick-up passengers.
- A *Taxi Zone* is an area designated for taxi drop-off and pick-up.
- A *Clear Zone* is an area at the corner of an intersection that is void of utility boxes, vertical elements, signs, newsstands, trash receptacles, etc. to allow adequate sight distances.
- A *Pedestrian Crosswalk Zone* is an area designated for pedestrians that cross a street and that is clearly marked by paving or paint.

(LRT Design Criteria Manual. Revise October 2000).

Movement patterns must be as simple, obvious and comfortable as possible.

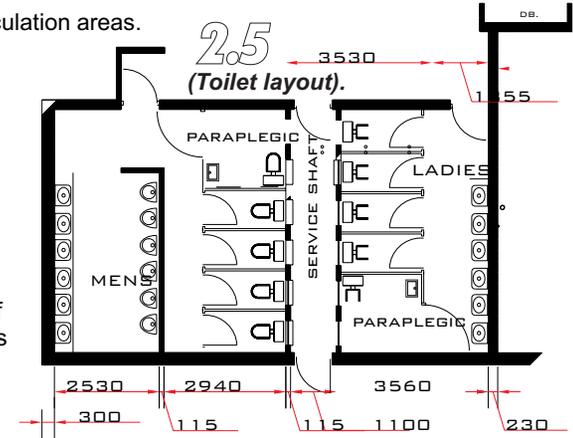
Each level that will be associated with the arrival and departure platforms will be equipped with public toilet facilities. These facilities will be situated near vertical circulation areas.

Men: at least 5 wash hand basins, 5 WC's and 5 urinals.

Women: 10WC's and 10 wash hand basins.

1.3.) Access to facilities.

Daily living and working activities require access to daily necessities and requirements of a range of services. By providing these services to people, it will increase the efficiency of the building's function and reduce impacts on the environment.



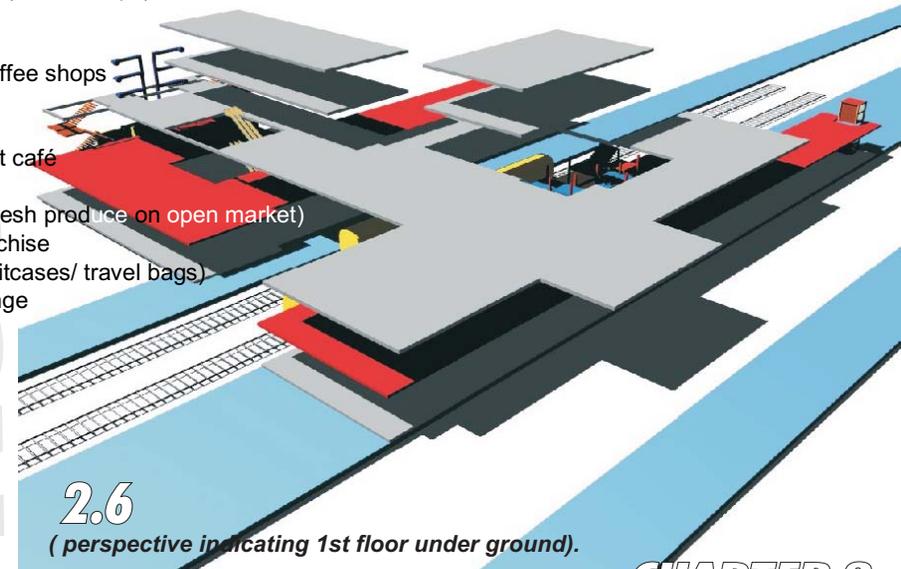
1.3.1) Banking:

Banking facilities will occur in the station building and on the public open spaces. Public telephones and ATM's will be grouped together, to form a functional unit and add to security precautions, for it will be placed where there will be sufficient surveillance and on movement axis.

1.3.2). Retail:

Retail will be in the form of daily requirements. The retail component will form an extension of the arrival platform of the station and a lengthen activity line of the open-air market. Retail will include the following:

- Stationary shop (150-200sqm)
- Chemist
- Doctor/ Dentist
- Street cafés/ coffee shops
- Restaurants
- Take away
- Post office/ I-net café
- Bank
- Supermarket (fresh produce on open market)
- Cell phone franchise
- Travel shop (suitcases/ travel bags)
- Bureau de change

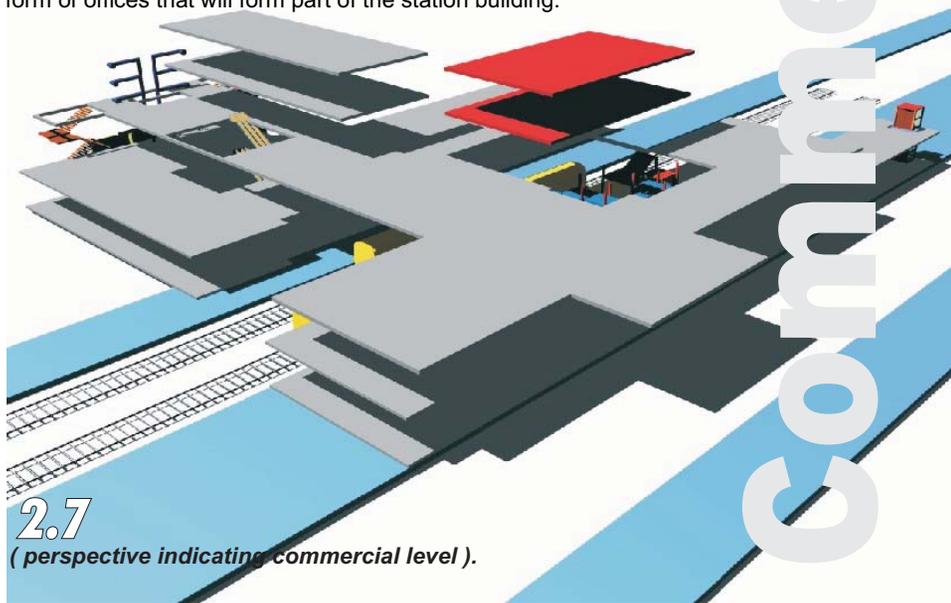


1.3.3. Residential:

The existing building to the south of the public open square, will be converted into a hotel. The existing building to the north of the site is currently being used as a hotel school. As a job creation opportunity and a functional requirement, the students and trainees can be utilized as staff members for the proposed hotel. Overnight accommodation, as a cheaper form of accommodation will be available at the arrival platform area. There are sufficient accommodation facilities within a 12-km radius from the station, for the site is situated in a residential area. Student accommodation for the hotel school staff and students will be proposed on the adjacent site to be developed as well as accommodation for the proposed job center.

1.3.4) Commercial:

Commercial and retail facilities have been introduced to the area over the last 10 years. The commercial component will further lend to the multi functional development in the form of offices that will form part of the station building.



1.4.) Participation and control.

Occupants that participate and help to decide in the functioning of their environment they work in, will enable the users to manage and control their environment. Control over aspects of their environment will enable personal comfort control and satisfaction.

1.4.1) Environmental control:

Users of buildings have reasonable control over their environment. Except for the building management system to be implemented, occupants can participate in the climatic control of their environment, to adjust their own comfort levels, by opening and closing louvers and windows for cross ventilation and airflow and the adjustment of blinds. The implementation of the passive airflow system and the trombe wall system can educate people in different applications of these construction techniques.

1.4.2) User adaptation:

The occupants must have the freedom to utilize the space, as they desire. This calls for areas that allow different uses over time. Flexibility of the spaces created, is the design principle that must be achieved. This includes the design, manufacture and implementation of a modular partition system.

Social spaces:

Social spaces in the building and on public open spaces and pedestrian routes are important for the interaction between people. This can range from informal to formal spaces. Street furniture can be used to create seating areas along a pedestrian route and promote interactions and rest areas. These spaces in buildings can be the restaurants or coffee cafes on the platforms, the tearooms in the commercial offices and the arcade in front of retail shops.

Community involvement

The station will act as a part of the Hatfield prescient. The community will use the station as a transport medium to reach their destination. The university and surrounding schools can utilize the station for field or day trip excursions. The metro rail can utilize the central platform for deliveries for the open-air market. The job center can provide the necessary day-to-day job opportunities. The part of the departure platform that will not be used for commuters can be used as a capital generator, where space can be rent for storage. An overhead crane can be used to distribute heavy loads and a service lift for smaller particles.

1.5.) Education, Health and Safety.

1.5.1) Education

We live in a technological age. Information in our respective fields is important for us to keep up with daily advances in our professions. Information comes in a wide range of mediums. Access to newspapers, newsmagazines, Internet and people in the same fields of interests are important to keep up with what passes us by. Seminar rooms can be used as function rooms, education rooms and lecture rooms, to educate and inform the community. The community can use the room(s) as a community hall, as a church or for discussions, relevant on the community.

1.5.2) Security:

Security in this area is important for the use of the station. If the station is labeled as an unsafe and dangerous place, commuters will return to their more expensive way of travelling and visitors will stay away. Access routes (pedestrian and vehicular) must be well lit during the nighttime. Activities must overlook the pedestrian routes and buildings (commercial, residential and retail) must be placed along these routes.

The implementation of the passive airflow system and the trombe wall system can educate people in different applications of these construction techniques.

2.1.) Local economy.

Hatfield station and the related development that will impact the site will hold enormous economic benefits for local contractors and development in the region. The local economy of the area can grow by utilizing local resources, skills and workers. There are enormous amounts of jobless people on the streets of Hatfield and can be trained and educated in the construction, management and distribution skills of building construction, road construction, bridge construction, train related aspects, commercial, retail and education. The proposed job center can already start to promote, recruit, train, educate and advertise through the planning phases of the project.

2.1.1) Local contractors:

The principal agent, employer, contractor and tender document must try and promote 80% of the construction be carried out by contractors based within a 40km radius from the site. By using local contractors and sub-contractors, the local economy will grow. From an ethical and judicial point of view, the tender document, experience and quality of work must also be considered before appointing. The aim is not to be partial to the local community but to uplift, educate and train people from the local area. If a tender of better quality is accepted, local unskilled laborers must try to be incorporated into the contractor's team.

2.1.2) Local building material supply:

An estimate has been set to use 80% of building construction material, manufactured and produced within 200km of the site. These include pre-manufactured components. A building system or separate building component (e.g. wall unit, passive cooling device component).

2.1.3) Outsource opportunities:

Small emerging businesses can be given a chance to establish a reputation, by providing an opportunity for them in the development, planning, construction and maintenance phases of the project. These provisions include the education and training emerging businesses, outsourcing catering, cleaning services, security and to create space and opportunities for business to use space for retail and education during the phases of the development. The maintenance of the building and site can be through self-developed and trained staff or outsource to companies within 50km of the site.

2.2.) Efficiency of use.

The efficiency of buildings occupied and used by people can be unsustainable if the planned spaces are not used to its full potential. Spaces within a structure can be used for different function during the day. This means to utilize the same space for different functional activities during different times of the day. This will promote a longer occupancy during the day to reach the 18-hour day functional activities.

2.2.1) Usable space:

Non-usable (non-rentable) spaces (toilet facilities, plant rooms, communication rooms, etc) must be in the right proportional relation to usable (rentable) spaces. A train station has arriving and departure platforms that can not be utilized as capital generators. To accommodate and utilize these non-usable spaces, retail can be incorporated on the path towards the platforms, to generate income, to accommodate specific daily requirements and needs. The non-usable spaces, must not be more than 20% of the total building area.

2.2.2) Occupancy:

The station and surrounding buildings must be occupied for at least 30 hours per week. The introduction of retail, housing, commercial and open-air market activities with a train station, will produce functional daily activities for at least 18 hours per day.

2.2.3) Space use:

The optimum management of spaces during different times of the day will intensify the functional activities during the day.

2.2.4) Use of technology:

Technology in communications will reduce the necessity for extra space required for conference facilities. Video conferencing and Internet access will be incorporated and assist the surrounding commercial companies to reduce travelling time and expenses.

Technology in construction will be introduced in the greenhouse structure, to regulate and control the microclimate. A louvered roof structure will open to allow ventilation from the platform levels and close to heat the air. The roof will open when there are too much moisture or heat within the green house. Thermostat and moisture sensors will trigger the opening of the roof. A computer management system will regulate the dry bulb, wet bulb and relative humidity inside the greenhouse and allow for evaporative cooling (cross ventilation) or heating (heat pump) to allow for a comfortable environment.

Evaporative cooling will be in the form of a fine spray with gray water from the building. The spray will also provide the necessary moisture for the plants.

2.3.) Adaptability and flexibility

As mentioned, the structure must be flexible to accommodate future functional changes during the building's life span.

2.3.1.) Vertical dimension:

A minimum of 3 meters from the floor level to the underside of the floor slab must be achieved. As a passive cooling system will be implemented in the design, access for ducting must be provided. Access floors and hung-ceilings will provide adequate space for ventilation ducts, piping and electrical conduits. To achieve optimum flexibility and adaptability a minimum of 4,2m will be adequate to allow the required space for access floors hung ceilings and enough internal space. The height of 4,2m min can later be divided into two 2,1m levels min for extra usage and flexibility. The use of brickwork and a desirable height of 4,420m will be adequate. All levels do not have to adhere to this flexible height.

2.3.7.) Insurance/ water/ energy/ sewerage:

A managed plan to ensure that water usage can be reduced will be implemented. Low flush toilets and urinals can be used. Water from wash hand basins, sinks and drinking fountains can be filtered and reused as gray water for the gray water system (greenhouse watering and evaporative cooling). Using low energy light bulbs can reduce energy usage and the use of natural daylighting during the day can also reduce energy usage. A light filter automatic timer can be used to switch lights on at different times of the year in and around the building. The measuring and management of water and energy usage can be determined by the management system to control and check for inconsistencies during usage.

2.3.8.) Disruption and “downtime”:

The operating, management, communications, HVAC and back-up systems will be accessible by a service lift and near a service entrance on the southern side of the building. This area will function on its own and will not be accessible by the commuters or public. A separate controlled access point will allow entry for staff and service staff.

2.4.) Capital costs.

The site has the ability to bridge the gap between low income and high-income living standards and conditions. An open-air market and informal trading can co-exist and compete with affluent commercial and retail activities. The dirt and grime point of view perception can be eliminated if the situation and environment are pleasant and safe enough to be used.

2.4.1.) Build ability:

The station building will be placed on the site to maximize its orientation sun and view advantages. It must also fit into context and into the existing building placement and existing building fabric. The building will be a simple U-shaped structure that will provide access from the main public open space on the western side of the building (departure platform) and link with the market on the northern side of the building (arrival platform).

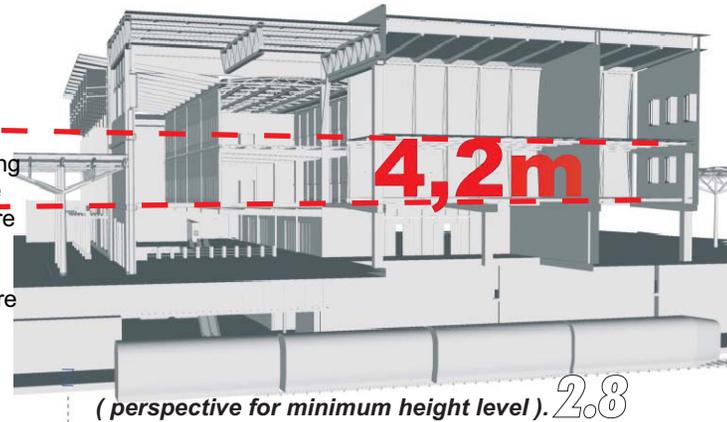
There will be replication of components on the building and in the building in the form of load bearing columns and cladding components. This will reduce construction and manufacturing costs establish a standardized component, to reduce wastage (cut-off).

2.4.2.) Construction:

The site will be developed in phases as the need for functional activity increase with commuter usage of the train station. The planning of the project is essential in the success of the planning and construction phases. The first phase of the development will be the most important or the anchor of the development. In this case the train station and platforms will be the first phase of construction. If the station is safe and operational for use, the functions to support the station can start with construction.

The retail and overnight accommodation will therefore be the second phase. The commercial building to relocate the proposed hotel structure (currently commercial) will be the first to start construction with the retail. The third phase will be the rest of the proposed commercial structures.

The buildings should be constructed as a shell (load bearing elements e.g. columns and slabs) and then the facades, finishes and secondary elements (ventilation installations, electrical installations, toilets, basins etc.)



(perspective for minimum height level). 2.8

2.3.2) Running costs.

Buildings must be an investment. It must generate more income than expenses. If running costs per month can be kept to a minimum, there are more capital left at the beginning of each month. This means more profit and a sound investment.

2.3.3.) Maintenance:

A low maintenance building will ensure lower running costs per annum. Materials that will be used must be of high quality and the application of materials must ensure a long life span for its intended use. The structure to bridge the railway lines can not be of heavy mass, for the point load on the bridge structure will mean a higher construction cost of the bridge itself.

2.3.4.) Internal partitions.

The load bearing structure must be designed in such a way that internal load bearing structures are not required. This will allow for internal partitions to be erected at any place to utilize every area to its full potential.

The partition panels can be designed to fit in with increments of the load bearing structure grid and will enhance the flexibility.

2.3.5.) Services.

The service shafts and service ducts must be easily accessible and can also lend its weight to structural stability, ventilation and service routes. Well-planned service entrances will mean an easier way of maintenance and service providing.

A lightweight structure on the bridge grid will mean a structure of timber, steel, pre-cast concrete elements and non-load bearing brickwork and stonework. Heat retention advantages from heavy mass structures will therefore be a problem with lightweight structures.

This in itself will mean carefully planned and design sun protection elements for the building to utilize stored heat energy during night and protection from the sun during the day.

2.3.6.) Cleaning:

The construction elements and choice of materials to be used must be of such a nature to be cleaned easily and maintained longer. The use of tiles instead of carpets as an example. The cleaning of windows, will it be easily reachable.

3.1.) Water:

Water is a daily necessity to sustain life. Water has to be stored to accommodate the daily needs of the building and its occupants and take up large amounts of space. The cost of constructing the space required and the cost of conventional water supply, must be weight up against each other to work out the feasibility of each choice. To store water, will mean a more environmental and cost saving method of water usage. The reuse and re-distribution of water (gray water) will have cost saving implications.

3.1.1.) Rainwater and water use:

Rainwater will be collected and stored in basement tanks (50 kl). The water can be used with or separate from the gray water for evaporative cooling, flushing toilets and watering the greenhouse. Heat pumps can utilize solar heated water for heating in winter. The reverse effect can also be used to introduce cooler air during summer time. Water can still circulate the solar heaters during summer times and used from the geysers. Warmer water in the geyser means less energy to be added for the desired water use temperatures.

The water has to be filtered first before it is introduced into the geyser for use. During periods of little or no rain (winter times) water can be obtained from the conventional municipal connections.

3.1.2.) Run off:

Using steel grids in paved surfaces and paving with a fall towards channels can collect the run off. This water can also be stored in the storage tanks and then filtered for use.

3.1.3.) Planting:

Trees and soft landscaping will be used around the building as surface covering instead of hard paved areas. The soft landscaping on the western side of the structure will have less re-radiation properties than the paved surface. Deciduous trees will be planted on the eastern and western sides as sun control elements and as a natural environment element. The green planted areas will be on visual axis from within the building and on movement axis.

3.2.) Energy:

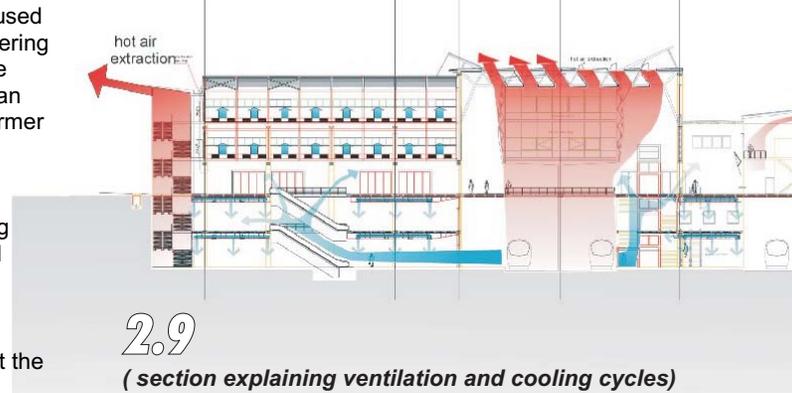
Buildings consume large amounts of energy (in the form of air-conditioning units, artificial lighting, electrical appliances etc), to operate on a daily basis. All electrical appliances and equipment need electricity from the national grid to operate. Conventional energy production contributes to the depletion of non-renewable resources and therefore damages the environment. This lead to a large environmental footprint (use more energy per day than nature can replace per day). The use of less conventional energy will leave a smaller ecological footprint and the use of renewable resources can lead to a controlled and manageable environmental resource usage.

3.2.1.) Location:

Commuters and visitors will use less energy, for the station is within walking distance from Hatfield, the University, schools and the residential suburbs. People will not need to use vehicular transport to visit or make use of the station presciecnet.

3.2.2.) Ventilation system:

The building will make use of a passive ventilation system for cross ventilation. Cooler air will be introduced through the platform level into the building by louvers in summer times. The louvers will be adjusted by a computer management system that will be connected to thermostats and pressure control sensors. The pressure sensors will ensure positive air pressure on the inside of the building and will open the outside façade, to introduce new air into the building every hour (depending on the space and the activity).



The air that will be in the building at this time will circulate through the heat pump, to cool the air down or heat the air, depending on the season and the air temperature, humidity in the air and the air quality.

Trombe walls on the western façade can further heat the internal air by opening the building's façade windows and closing the ventilation louvers of the wall. The trombe wall will be used to ventilate the hot air on the building's façade in summer time and will also be used as a vertical sun-screening device at this seasonal time.

In wintertime the reverse effect will take place. The ventilated air will be introduced into the building to heat the air.

The greenhouse will also absorb CO2 from the surrounding environment and through the microclimate, introduce fresh air as a "cleaner air supply".

Accommodation	Air changes per hour
Offices-above ground	2-6
Offices-below ground	10-20
kitchens	20-40
Public toilets	6-12
Plant room	10-15
Restaurants	10-15
Storage room	1-2
Assembly hall	3-6
Class room	3-4
Domestic habitable rooms	1

(J.Greeno.1998. Building services, technology and design.)

The natural ventilation system will assist the artificial cooling/heating system in controlling the internal environment's climate.

3.2.3.) Heating and cooling system:

Raw materials and new components used in buildings consume resources and energy in their manufacture and processes. Buildings accommodate activities that consume large amounts of resources and produce large amounts of waste. Reducing the use of new materials and components in buildings and in the activities accommodated and reducing waste by recycling and reuse supports sustainability by reducing the energy consumption and resource consumption. (J.Gibbert, 2002.Sustainable Building Assessment Tool.)

3.3.1.) Toxic waste:

Areas where dangerous and toxic materials will be discarded will need to be addressed, by providing the right precautionary measures to avoid accidental exposure to the waste material. The loading and transportation of the toxins must also be considered. These areas will include the service yards for the trains (oil, cleaning fluids etc.), the batteries for the photovoltaic cells, commercial companies and equipment used in offices, retail or household appliances.

3.3.2.) Inorganic waste:

There will always be waste products where there are people. The best way to accommodate for the recycling of waste materials is to design and create space for waste materials. Recycle waste areas can be designed for and arrangements for pick-up can be utilized at service entrance. The waste material can also be sold to recycle companies per load, kilogram or in other measurable formats.

3.3.3.) Construction waste:

During the construction phase of the project, arrangements have to be implemented for the clearing of waste material on site. Excavated earth can be used to fill uneven soil areas for building purposes, but should not be used to cover the existing topsoil, for that can destroy the existing micro-habitat of organisms and cut off the necessary sun, air and ventilation system needed for their survival. The added soil can also cause soil erosion (loose soil with no established root system).

Construction waste can also be sold to waste management companies. The waste materials can also be re-used (loose bricks as pavers). In the design process, standardized and modular elements can also be used and designed to minimize wastage.

3.4.) Site:

Buildings invade the natural environment and replace the natural fabric with a manmade structure that uses natural resources for the construction and running of the structure. The depletion of the natural fabric impacts on the environment we live in and need to survive and support life on earth. The building leaves a "footprint" and if the footprint uses non-renewable elements, too much energy in the construction and running of the building, the footprint can leave a permanent imprint on the earth's surface.

This is one reason to density the functional usage on the site in an ordered, coherent and planned form. The more multi functional activities on a site will mean less ground to be broken for more buildings. This will also have financial gain for investors and developers, for the more rentable floor area, means more capital gain. For the occupants and users can only benefit from the functional activities on the site.

Air changes will occur every hour during occupation times. The air that is introduced will then be heated or cooled through the heat pump. The "new" air will replace the "old air"(warm air rises to the roofline. Ventilation ducts open. Cold air from beneath will create airflow and replace the "old air". Electrical fans can assist in air distribution/ expulsion). The ventilation shafts close and traps the "new air". Blow fans on ground level will start air movement upwards, through the triple volume and extractor fans extract air on the other side through air ducts, where the heat pump will heat the air, add extract moisture or cool the air down.

Solar water heaters will introduce heat to the air (heat pump stage) and will also introduce warm water into the geysers. As mentioned, the trombe wall will also heat the air or ventilate the building's façade.

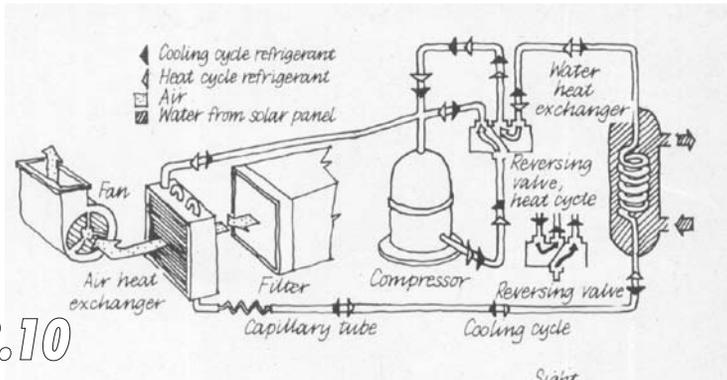
This passive heating/ cooling system will only act as a mechanism to reduce energy usage and time of usage of the air conditioning system. On extreme weather conditions during the different seasons, the air conditioning system will be more efficient.

3.2.4.) Appliances and fittings.

All water pipe fittings must be covered with insulation materials to reduce the loss off heat during water distribution and flow. Low energy light bulbs can be used and fluorescent tubes can be used to reduce the energy usage. The lighting can also operate on a timer mechanism for different seasons, as mentioned.

3.2.5.) Renewable energy:

Energy can be generated through photovoltaic cells. The generated energy can then be stored in the form of rechargeable batteries. Electrical lights can be operated during night from these batteries.



2.10
 (illustration of heat pump cycle for heating and cooling air)
 (energy conservation in hot climates: D.Holm, 1983)

3.4.1.) Brownfield site:

The Gautrans site was previously occupied by the Arcadia Primary School. It has since been divided into different portions and the proposed developed site, owned by the Sage Life Investment Company, forms part of the divided site

The station will form part of a new station public open area. The existing buildings were not planned to form a public open space for the train station. The facades of the existing building will be looked at and altered where necessary to form the desired building form and public open area.

3.4.2.) Neighboring buildings:

The buildings surrounding the site will only be altered where necessary and only the new part of the Delta Motor Corporation building will be broken down and construction elements reused where applicable. The new structures will be designed to allow maximum heat and natural sun light penetration and also placed for sufficient natural ventilation.

3.4.3.) Vegetation:

The existing vegetation on site will be retained where possible, to minimize impact on the natural environment. The greenhouse on the northern façade of the building will only use indigenous plants. A cultivated roof system can be implemented on the eastern roofs of the building for insulation purposes during the mornings and also on ground floor level on the eastern and western sides to minimize reflective and direct heat gain during the day.

3.5.2.) Manufacturing process:

The construction and manufacturing of the building components and elements must be manufactured with as little as possible impact on the environment (construction and manufacturing process).

3.5.3.) Recycled/ reused materials and components:

The sun control panels on the main entrance will be manufactured from recycled plastic elements. A plastic technologist will be incorporated, as sub-contractor, into the design and development of the panels. The reason for the use of plastic panels is to utilize the waste materials as a modular system. The properties of the plastic can be altered to take on new properties on molecular level. This can be achieved through nanotechnology. The plastic panels can absorb and store heat for more sufficient and efficient heat storage. The plastic will minimize direct sunlight penetration on the eastern and western facades and can thus act as a sunscreen device on its own. The plastic can also gather more dust and still be suitable due to the plastic's characteristics.