

BRIEF

CHAPTER 1 NATURAL VENTILATED train station



1. Introduction

BRIEF chapter HATFIELD STATION 1

Gauteng is the powerhouse of the South African economy. The Province covers less than 2% of South Africa's surface area, but it generates more than 36% of the country's GDP, and more than 25% of the GDP of all the countries in Southern Africa. (South African Government.2001. Gautrans rapid rail link.)

The proposed Hatfield Station is located in a cut along north of the existing Metro rail reserve, between the existing Rissik and Hartbeesspruit Stations, both of which form part of the Pretoria Ring Rail system. From a vehicular perspective the station is located between Park Street and School Lane and between Grosvenor and Duncan Streets on Portion 1 of Erf 656 Hatfield and Remainder of Erf 717 Hatfield. It is therefore; north of the existing rail line but falls within the Hatfield business area uniquely located in an area of prime development. The Gautrans is a Blue IQ initiative and forms part of ten other Spatial Development initiatives (SDI)

The N1 highway between Pretoria and Johannesburg has a carrying load of 150 000 motorists per day and has an annual growth of 7% of motorists. This is indicative that an alternative means of transport is needed to ease the carry load on this road network. One solution will be the rapid rail system between these two cities.

The area between Johannesburg and Pretoria - two major cities in South Africa - is recording the fastest rate of economic development in southern Africa. The Gautrain Rapid Rail Link will be a new rail-bound mass transit system to serve the Johannesburg-Pretoria corridor as well as a link between Sandton and Johannesburg International Airport. Apart from the convenience, the project will provide economic and social development along Gauteng's north-south axis with associated population and related concentrations.



The 80 km network line will link Johannesburg, Sandton, Pretoria and Johannesburg International Airport and will have 10 stations. The distance between Pretoria Central and Johannesburg will be covered in less than 35 minutes at speeds of 160 km/h or more. It will be served by dedicated road-based feeder and distribution systems and park-and-ride facilities at the station nodes. The trains will operate 18 hours a day, this will lead to a nodal interchange that must cater for functional activities for the duration of the time visitors and passengers will spend there. The time lapse between trains will be initially 10- 15minutes. This time will vary at specific times of the day to cater for the passenger loads.

Safety will be a key factor to the success of the train system

1.1 (Proposed Gautrans rail line links).

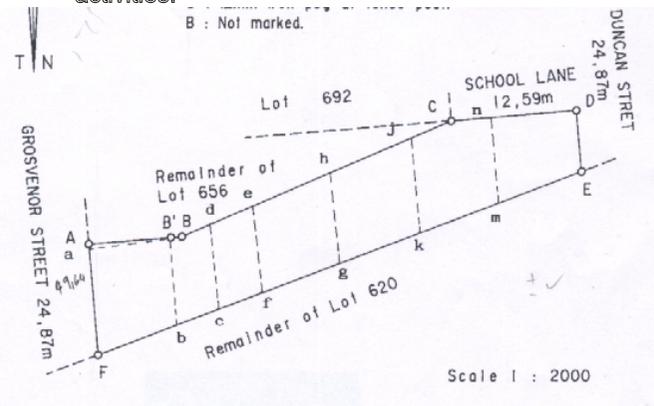
Safety will be a key factor to the success of the train system. The safety will be in terms of commuter safety on trains, on the waiting platforms, at the park and ride system and at night in and around the stations. It is Government's stated policy to promote public transport and to give it priority over private transport. The new **National Land Transport Transition Act, Act 22 of 2000**, places an obligation on Gautrans to actively implement this policy.

This initiative will be more convenient for people traveling not just between work and home, but also for tourists, business people and holidaymakers to Johannesburg International airport. The shuttle services, public transport system and the taxi services at the end of the line will also provide job opportunities, convenience for travelers and ease of movement through the visiting areas.

Less carbon dioxide emissions will lead to a cleaner environment and will be healthier, for the train will be powered electrically. Reliability, safety and security, comfort and short travel times are important requirements. A new attractive image is required. It must be able to attract motorcar users out of their cars into the train system. It must therefore be an attractive, cheaper and realistic alternative for the motorcar user. It must be predictable, particularly also for the airport user.

1.1. The site

The railroad tracks are currently owned by the SARCC, (Remainder of lot 620). The site adjacent to the railroad tracks is the proposed Gautrans site and is currently owned by the Municipal of Pretoria and the site, Lot 692 is owned by SAGE investments. Different land-use rights occur on the three sites, due to different zonings and functional requirements. Lot 620 is reserved for the metro rail system and it's relevant functional activities.



1.2 (LG diagram of proposed site).

In order for the Gautrans to function as an intermodal, multi-functional site, the land use rights and zoning of the site must accommodate the proposed usages. The Gautrain station and platform will be erected on lot 656 and the remainder. The owner, Municipal of Pretoria, will be the owner and client. Lot 692 will be developed by SAGE investments, according to the draft document, as a multi functional development. These activities will range from retail, informal and formal, commercial and living units.

These activities proposed for this site will have to interlink and connect with the layout and planning of the station to form a unity and vibrancy on an 18-hour time scale. The remainder of lot 620 will still belong to Metro rail and the platforms will be "shared" with the Gautrans. The Gautrain will operate on separate rail tracks.

According to the Gauteng Transportation Infrastructure Act, the current land use rights must be disowned, to give rise to a different and new land use right. The new sites must be re-proclaimed, to give new rights to the site and after this has been achieved, can the re-zoning of the site be achieved for future use. The Gautrans site will undergo a concession agreement with three groups of people

The design and construction team (principle agent, construction companies, contractors)

The operations team (operating company for the Gautrain relevant functions)

1.2 Climate

Pretoria has a moderate climate with hot summers and mild to cold winters and lies in a summer rainfall region of South Africa. To utilize the moderate to warm climate of the region, it can commonly be acknowledged to create buildings as an extension of the environment and create shaded areas, as movement lines and functional spaces as part or through the constructed area. As evident from the UVB index, the mid afternoon is the time for maximum protection against the sun.

In summer, Pretoria has 60% of its days as sunshine days and in wintertime 80% of its days are filled with sunshine, but with less heat intensity. In September, Pretoria will have an average of 9,4 hours of sunshine per day. The use and functional application for sun control devices are thus a necessity, for this will be the time the site will be most occupied with visitors and residents. Summer sun should be shaded and winter sun should be allowed to penetrate the structure and to heat the structure, to utilize the re-radiant heat within the building at night.

Thermal mass is effective for half of the under heated period and the whole of the over heated period. Massive floors, roofs and internal partitions may provide it. Lightweight insulated roofs are feasible in this region, provided that the walls and floors supply sufficient thermal mass.

Solar angles at 12:00 for Pretoria (UVB intensity at its optimum).

22 December. 87 deg.

21 March\ 23 September 64 deg

22 June 41 deg.

As illustrated, the degree of shadow cast by the afternoon summer sun, can be calculated and incorporated into the design, to form pathways, rest areas, open spaces and sheltered areas for the pedestrian and vehicle.

Pretoria use the following coordinates for sun angle calculations:

25 degrees south- latitude.

28 degrees east- longitude.

Pretoria is in a Highveld region and is 1362m above sea level.

1.3. History of the old Arcadia Primary School.

Hatfield Township was established in 1904. The suburb name is derived from Hatfield town and Hatfield house in Herefordshire, England, to commemorate the arrival of Lord Selborne to Pretoria.

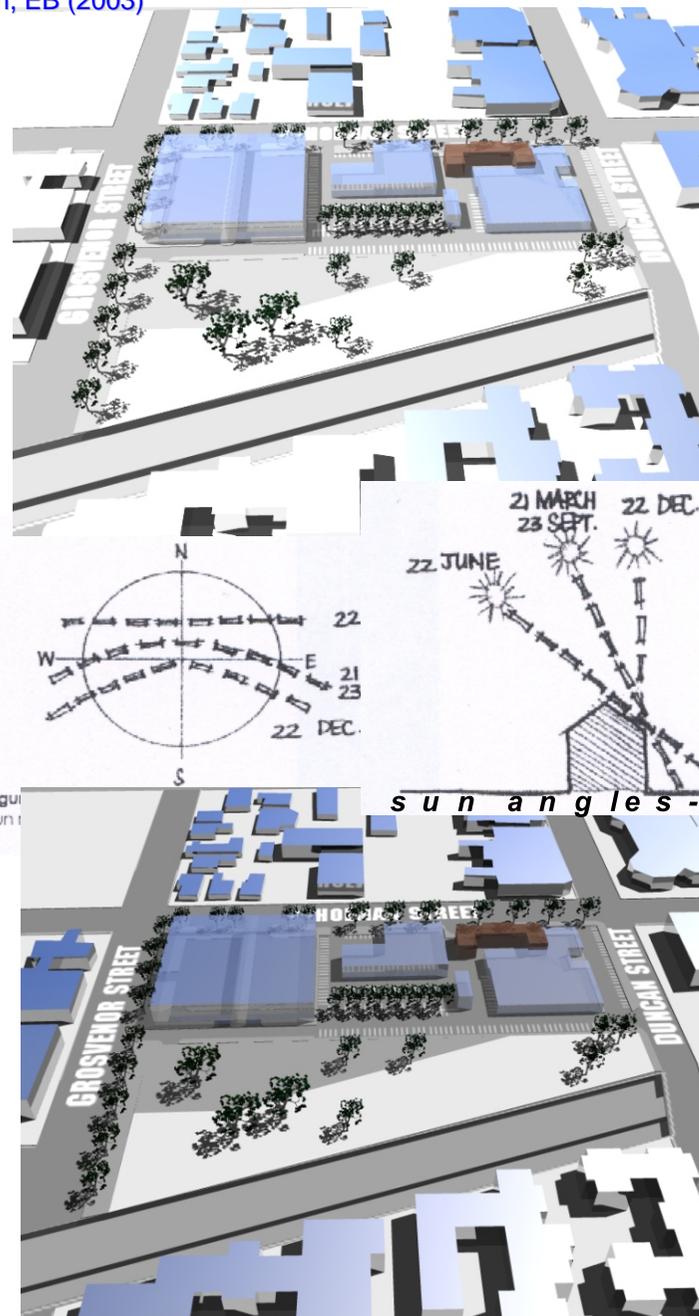


Figure 1.3

sun angles - diagram

1.3 (sun angle diagram and analysis).

Arcadia Primary School was established to serve the 159 families within the borders of Hatfield and serve those 'outlying areas' of Pretoria. Arcadia Primary School admitted its first pupils on 10 October 1916. The school building evolved with the changing times and through the introduction of different individuals in charge of decisions over the school. Since the initial planning of the school in 1913, to the opening in 1916 and up and to the sale of the school in 1994, the addition of new elements and upgrading of others, were according to what the different principles felt appropriate for the school to further develop, giving the pupils the best education possible.



1.4 (photos of the old school structure).

1.4. Precedents.

Johannesburg International Airport

The sites that were visited were Johannesburg International Airport, the domestic arrival and departure terminals and Metro rail Intermodal interchange, also in Johannesburg, Newtown.



Photo no:2

Advertising and information boards are easily visible by placing them above circulation nodes. Double volumes around the circ nodes-visibility to lower levels

Convenience, efficiency and mobility have become synonymous with airport travel. The terminal itself is user friendly, easy to read and very functional. The interacting play of the triple volume entrance space is not over whelming on entry and the three-leveled functional spaces, adjacent, are convenient to move in and human scaled. Escalators and lifts are placed within movement patterns and easily accessible for handicapped people, even from the car park. The entrance from the car park though is not well defined and the direction to move to, from your vehicle is not legible.



Photo no:3

On-route information cubicles and rest area seating is provided for passengers and visitors. These will occur on the axis of the vertical circulation nodes. The scale of the ceiling volume suggest an area of informality .

The terminals are divided into three strategic levels. The triple volume ground floor acts as arrival point for departures, with vast open movement spaces. This space is connected by the check-in points for the different airlines to be used for your travels. The structure comprises of large, central concrete column structures that supports the roof. The triple volume entrance area is clad by external glass paneling in a steel column structure.

The terminal itself is extremely spacious but never loses its intensity as a vibrant movement line. It's scale and proportion is on a humane level and a feeling of comfort and relaxation promotes free movement through the different levels of transition. The entrance to the terminal could have been better defined and expressed and to find the entrance from entering the site was difficult. Signage on its own will not replace defined routes.



Photo no:1

Photo showing the large volume of movement space and glazed facades to improve and enhance the view to the outside activities, weather cond and to maximize natural light to enter the structure. External sun control devices to control sun entry.

An airport is a place where people arrive from and depart to a destination. It's a place where millions of people pass through per year. It's a place with functional activities 24-hour a day and must accommodate large groups of people periodically before and after arrivals and departures.

Photo no:4



The first floor acts as food court and retail area, where the visitor can relax, look out on the people and keep busy by the various shops and rest areas. The second floor acts as arrival point.

Photo no:5



The concrete columns also houses the air condition outlets and has been utilized as an aesthetic featured, representing the jet propelled engines of a Boeing. Air circulation at roof level has been enhanced, by air movement in a curved form, as represented by the ceiling form.

Metro Mall

The Metro Mall is an urban renewal initiative for Newtown in Johannesburg. The site stretches over two land parcels, for a total site area of 2,6 hectares. This urban renewal project is important because it links Braamfontein, to the north of Johannesburg, with Newtown to the south. The project catered for the street vending\ trading and for the huge volume of mini-bus taxis, to provide an area of opportunity for both pedestrian and road traveler.

The Metro Mall accommodates 25 bus ranks that serve 35 different routes and an area for 2000 mini-bus taxis. The spaces for each taxi association have been allocated, to minimize the risk of taxi association conflicts. The site also provides sufficient space for the 800 formal and informal traders.

Theory around proposed development. (As illustrated and set out in the urban design document-annexure 5)

Statement 1:

" Spaces around transportation terminals are places of considerable economic potential. This potential is reinforced where there is a coincidence of different modes of transport". (Dewar,D., and Uytenbogaardt, RS. 1991. South African Cities: A Manifesto for Change, Cape Town).

As was evident at the Metro Mall intermodal interchange, the passengers that travel are the primary source of business for the informal street markets that line the streets and the formal shop keepers benefited from the clients, but to a lesser degree. The development comprises of a central covered multi story parking lot that is surrounded by informal and formal arcades. On a secondary level, passers by can also penetrate the arcades and use the informal market as a shopper. The business also provide for a sense of vibrancy through the cultural music that fills the compacted informal market lanes and the food courts that provide the smells and tastes of a home cooked meal. The site is vibrant for the time people travel to and from the site, this will usually be normal working hours of the 6:00 to 18:00.

The domestic airport terminal had a different feel around its circulation spaces. The terminal comprises of three stories, where the first floor level consists of the formal shops and the food court. The ground floor level is for departures and the second floor is for arrivals. The terminal will be functional 24 hours a day, for flights will commence on a 24-hour schedule.

Both these sites are economic nodes within their urban infrastructure. It is a place of convenience for their users and not for the people in its urban structure, for it does not act as a shopping mall for every one, but only for its users, the travelers.

Statement 2:

"Daily requirements to be accessible within walking distance. Public transport should provide access at a larger scale." (Dewar,D., and Uytenbogaardt, RS. 1991. South African Cities: A Manifesto for Change, Cape Town).

The JHB domestic terminal cater for a large scale of daily requirements needed when arriving from or leaving for your destination. The functional activities are aimed at the passenger and to cater for their needs. The Metro Mall site also caters for daily necessities, but aims for a larger market group, the travelers and the passers by, thus linking the site with its neighboring sites. By using the informal market within a streetscape, the activities attract a larger group of people, adding to the social interaction and to the community construction. The transportation service acts as central attraction function.

The airport terminal has access to public transport in the form of vehicular taxis, situated at the entrance to the terminal. A dedicated national bus service, also cater for the tourist and is not easily accessible from the terminals. The access is not direct, the information and route to the bus services are vague and in descriptive. Tourists should be given direction from a central point of arrival and not routed and re-routed to a destination. The incorporation and functional integration of the transport modes at the airport terminal is lacking coherency.

Statement 3

"Linkage is simply the glue of the city. It is the act by which we unite the different layers of activity and resulting physical form of the city."

These two precedents are two different linkage systems. The Metro Mall is situated within a city block, to form a nodal function and the airport terminal act as a node on its own. A network of transport systems links both. The routes or access to the two sites must be readable and easily accessible. The Metro rail is on a smaller scale and is accessible on foot or by vehicular movement. The airport can only be accessed by vehicular movement, and the signage and movement pattern to identify the desired destination is not read easily.

Visual linkages through the sidewalks and arcades and the airport link the Metro Mall by the vehicular roads leading to the parking or drop-off areas. Internally, the buildings are linked linearly and the departures and arrival terminals are very easy to understand and accessed.

Statement 4

“Legibility. The quality, which makes a place comprehensible. This is important at two levels: physical form (landmarks) and activity patterns (nodes).” (The Architectural Press, London , Responsive Environments,1985 .Bentley et al.)

Its contemporary design features can identify both the Metro Mall and the airport terminal node. The scale and proportion of the Metro Mall fits in with its surroundings. The construction methods and materials used are very much the same, but the techniques and applications of the different materials differ. The corner treatments, with its triple volume entrance halls, are decorated with rusted irregular strung sheet metal panels will invite the visitors to the functional activities. The floating concrete roofs with its abnormal large, thin overhangs are evident of the changing application of reinforced concrete. The building is shaded with galvanized sun controlling louvers and the poly carbonate sheeting on the galvanized I-beams speaks of low maintenance, long life-span, but not low cost. This treatment of external elements is a contemporary application of external elements, as is evident in Melrose Arch and also JHB airport. Its external features and construction elements can thus identify the building.

The JHB airport will be recognized and identified on approach by the aircraft lined along the terminals. The routes and direction to travel is clear and legible but as soon as the buildings are approached, the functions or building destined for becomes vague. Signage, information boards and staff members are needed to direct first time users. As soon as the destined buildings are entered, the legibility and movement are readable and easily understandable.

2. Purpose and strategic objectives.

As it is an SDI project, the Gautrain project must promote and stimulate economic growth, development and employment creation in the future. The system must bring a realization amongst users to travel on foot to nearby functional activities, to walk from the station to work, past buzzing activities. This can be achieved by creating walking streets, open public spaces, (hard and soft), multi functional buildings, movement corridors and a safe, convenient environment to move in. The related activities and functions will vary from station to station and create a rich experience to see and experience different cultures and people from region to region.

The following strategic objectives have been identified by the Gautrans initiative:

- The Gautrain Rapid Rail Link (Gautrain) must *facilitate development* in the Province.
- The project must contribute directly and indirectly to *job creation*.
- It must assist in unlocking the *economic development* potential of the Gauteng SDI projects and *strengthen existing development nodes* in Gauteng.
- It must *improve accessibility and mobility* in this development corridor.
- It must *promote the use of public transport*.
- It must *develop an integrated public transport system*, through the use of feeder and distribution systems.
- It must *integrate land-use* and transportation planning in the corridor.

It must assist in *improving the image* of public transport.
(*Integrated station functional area guidelines, Draft 3. September, 2002.*)

- Create or reinforce densities, to promote rider ship (getting feet to the station);
 - Establish different land uses to generate different trip volumes at different times of the day;
 - Ensure correct mix of land uses, thus, land uses that generate frequent trips and not extensive land uses where population density is low; and
 - Establish new urban form that embraces the train system.
- (*South African government.2001. Gautrans rapid rail link.*)

2.1. Concept

In concept the network consists of two lines. One line connecting Pretoria and Johannesburg and the second line, to link with Johannesburg international airport. There will be three anchor stations: Pretoria station, Johannesburg station and Johannesburg International station. Further more there will be seven satellite stations.

This initiative is expandable as the population develops, resettle and grow. There will be extensive feeder and distribution services at each station, of which a part will be dedicated and under the control of the Gautrain operator. There will also be a park and ride systems at various stations for comfort and ease of movement. At stations, provision will be made for commercial, retail and other development opportunities, to add value and provide additional income. Densification around stations is also very important.

This project is aimed at economic development, growth and job creation. If these objectives are reached, the local economy can grow and a better standard of living can be achieved. The number of joblessness will be reduced, skilled labor will increase and people will be able to sustain their own way of living.

3. A Public Transport Project

The Hatfield station will rise to the forefront as economic-, social-, and transportation node of the Hatfield precinct. The station will, with its presence, bring large volumes of people to a central activity node. To help transport the different people to their destinations, a carefully planned distribution route system has to be in place. As evident in the urban design proposal (annexure 1) Schoeman Street, Duncan Street, Burnett Street and Festival Street, will be the primary public and private vehicle distribution veins. At every cross street and corridor (these streets will be more pedestrian orientated), there will be taxi stops for the pedestrian traveling on foot.

The Gautrain will act as the central activity node and within a 500m radius, public transport has to be accessible for the pedestrian. Within this radius, the metro rail train stations are situated, to enhance and strengthen the public transportation system. (a transportation facility in reach within five minutes on foot.) Passengers traveling to and from Hatfield Station will use private vehicles for park-and-ride purposes. Based on the results of the demand modeling process, these passengers will mainly originate from the northern and eastern suburbs of Pretoria. It is estimated that the following will have to be provided at this station to accommodate passengers accessing the system by means of private vehicles:

A socio-economic impact analysis determined the potential benefit of the project with regard to matters such as job creation, economic growth and a wide range of other benefits far outweighs the cost of the project for the present and also has benefits that will influence economic growth for the future.

The socio-economic impact analysis showed that the Gautrain could have the following economic benefits (year 2000 Rand values):

Potentially 43 000 job opportunities will be created during the construction phase of the project.

The business activities related to the construction of the system could be worth R3, 6 billion per year.

Result in an increase of between 0,7% and 1,0% in the GGP over the implementation period.

1 200 people will be employed to operate and maintain the rapid rail system.

The business related to the operation and maintenance of the system could be worth R325 million per year.

Up to 40 000 jobs can be created as a result of the other economic activities related to the project leading to additional business of up to R3, 6 billion.

(Integrated station functional area guidelines, Draft 3. September, 2002.)

Similarly, the economic analysis indicated that the main quantifiable transport benefits are (year 2000 Rand values):

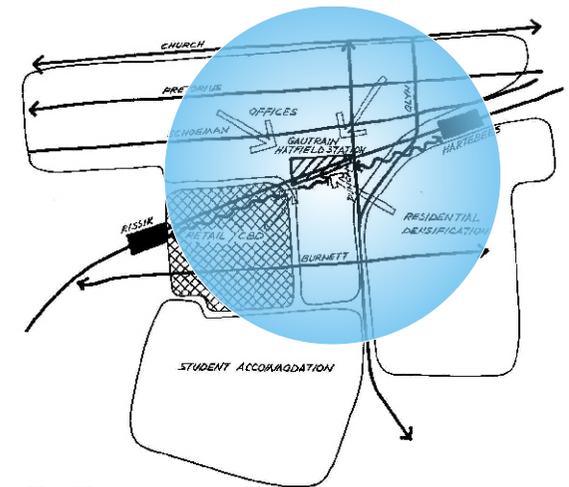
Saving in the cost of time of R933 million per year.

Saving in accident costs of R15 million per year.

Reduction of 70 000 tons of CO2 emissions per year.

(South African government.2001. Gautrans rapid rail link.)

The land required for a rapid rail system is far less in comparison to a road system that can move the same amount of people per hour a day.



1.5 (Diagram illustrating densification towards the station).

5.3. Land uses

The land use composition of Hatfield's functional area is very diverse accommodating a whole range of activities. The main land use characteristics are summarised below: Retail forms the centre of the area, consisting of Hatfield Plaza and Hatfield Square as well as associated uses located along Burnett Street; (refer to **annexure 1** and urban design proposal to compare current situation to proposed situation and distribution of land uses.)

There is a significant concentration of offices north of the railway line and particularly around the proposed station. The offices vary in type some being newly developed office blocks and parks, others converted homes into offices, and still some being a mix of home and office space;

The areas of highest residential concentration are located east of Duncan Road in Hatfield Village and south of Prospect Street including the student accommodation. Where Hatfield Village is concerned the area comprises low-density single dwelling per erf typology while the student accommodation is a mix of high-rise blocks and low-density alone standing units.

6. Development framework.

The core area should accommodate mixed-use development, retail and offices, office and residential or retail, office and residential to enforce the core as primary business area and to achieve desirable densification. It is proposed that all high-density residential development be located along the periphery of the residential zone between the offices and the low-density residential area to act as a point of transition.

An ever-increasing demand for student accommodation is placing pressure on further eastward expansion to define the spine and in support of the Gautrain residential densification along this road is proposed.

Diversity of land uses / variety of opportunities

Linear pedestrianisation and access to development along the railway line, connecting Loftus Station, Rissik Station, proposed Gautrain station and Hartbeesspruit Station.

The development that has occurred in Hatfield has generally been of a low density and includes extensive uses such as motor showrooms which de-density concentrations.

Linking with Hartbeesspruit station as part of the Tshwane Ring Rail system and proposed extension of the Hatfield Centre. Increased traffic congestion into the city will make the station less accessible.

The coverage is estimated at 45% due to the potential for densification and availability of vacant land, especially in Hatfield village near Hartbeesspruit station.

Present residential: @200m²/unit there is 472 units in the node.

Densification in this node will mainly be through high-density developments.

To attain a density of 25du/ha - need to attain 2500 units. If it is accepted that there are 472 units in the 100ha area an additional 2028 units will be required.

The expected economic profile of the future residents in the study area is middle-income families with none or one vehicle per family and young and upcoming professionals. On average an area of 60m² per residential unit is accepted.

Taking parking and landscaping requirements into account, coverage of 50% and a height of 4 storeys is accepted for residential buildings. Therefore, 6ha is required in addition to the existing high-density residential facilities.

The parking requirements of the station have been calculated as 1500 @25m² per parking space. Parking facilities will be provided over three storeys. Since residential densification should take place there should be an increase in community facilities, such as crèches, schools and clinics. The area surrounding the station is well served by schools and other community facilities. The provision of more localised facilities should be incorporated into the areas where densification is planned.

Open space will have to be provided as part of the high-density residential developments.

In the core area surrounding the station it is proposed that an additional 30 000m² of retail be provided at ground level, with four levels of offices above the retail and penthouse residential units above that. Accepting coverage of 60% for this land uses an additional 4,8ha of land is required.

No additional hotel development is foreseen in this node, since there is adequate provision.

Where Hatfield becomes a tourist destination (both for local and foreign visitors) incorporating entertainment, educational and sport facilities,

(Integrated station functional area guidelines, Draft 3. September, 2002.)

7. Accommodation list

Platform screens and doors.

There has been a trend recently in modern metro systems towards incorporating glazed screens along platform edges. This is only possible where sliding powered doors are available on trains and where the location of these doors is always consistent, which is why screen doors do not appear on main line railways. There are a number of interesting points to remember when considering platform screen doors.

Climate control was the reason why doors were introduced for underground stations in Singapore when its metro system was started in 1989. On most lines equipped with platform screen doors, the space between the sliding doors has emergency doors that can be pushed open onto the platform, so if the train stops out of position, there is still emergency access to the platform. There are also local station door controls provided at the platform ends, in case the automatic system fails.

Against the provision of platform doors must be the cost of maintenance. Train doors account for more than half the rolling stock failures of most metro and suburban railways and the same sort of designs are used for platform doors. Any system, which uses such doors, must ensure that adequate provision for maintenance is made and that any savings in heating or ventilation costs is not outweighed by failures

Entrances and exits.

Station entrances and exits must be designed to allow for the numbers of passengers passing through them, both under normal and emergency conditions. Specific emergency exit requirements are outlined in many countries as part of safety legislation or to standards set down by the railways or other organizations.

The entrances to a station must be welcoming to the prospective passenger. Stations must also have sufficient entrances to cater for the different sides of the railway route but the number must also take into account the cost effectiveness of each entrance. The cost of staffing ticket offices can be very considerable and the numbers of ticket offices must be managed to suit the patronage offering. Consideration must be paid to issues like which way doors open.

Passenger information.

Information systems on stations are variously referred to as a Passenger Information System (sometimes referred to as PIS). There must be a reliable way of informing the passengers where the trains are going. Passenger information systems are essential for any railway. One of the most common complaints by passengers on railways is the lack of up to date and accurate information. When asking the staff for information, passengers expect an accurate and courteous response with the latest data. This means that staff must have access to the latest information and they must be trained to use it properly and to pass it on to passengers. Information displays mounted in public areas must be visible in all weather conditions and be updated regularly with accurate information. There are two types of information - *constant* and *instant*.

Constant information can be described as that which describes the services and fares available and which changes only a few times a year or less. This information can be displayed on posters and fixed notices. There also might be special offers, which can be posted from time to time.

Instant information is that which changes daily or minute-by-minute. This is better displayed electronically or mechanically - both systems can be seen around the world.

For instant systems, it can be assumed that passengers require knowing:

- Current time
- The destination and expected time of arrival of the next train
- The stations served by this train
- Major connections requiring boarding of this train
- The position of their car - if traveling with a reserved place
- Where the train will stop - for variable length trains
- Other destinations served from this station and from which platform

There are some information systems appearing with advertising in some form or other. This is a useful source of revenue or sponsorship but it must not be allowed to detract from the main aim of providing the passenger with train service information.

Some modernized lines are provided with bi-directional signaling. This allows trains to travel along either line at normal speeds and be fully under the control of fixed signals. This is a useful facility to have when engineering works have made one track unusable. Trains operating in either direction will then use the other track(s)

Ablution facilities.

Public toilets are regularly abused and vandalized in many countries and railway administrations end up paying large amounts to maintain and repair them. They can also often be used for illegal activities, such as drug related offences, sexual activities and for robberies.

An increase in the number of passengers relieving themselves in the public and sometimes in the prohibited areas of the railway, including cases where they have wandered onto the track and got themselves killed by passing trains. At the very least, these activities cause an odor and health risk nuisance.

Any railway operators responsible for stations will have to decide whether they are prepared to pay for the installation of toilets and, if they do so decide, they must be prepared for the management and maintenance of such facilities. Nowadays, it is considered good marketing to provide good restroom, baby changing and toilet facilities.

In spite of all the difficulties, toilets must be considered a requirement, if for no other reason than the public expect them. If they are installed, they must be designed to a high standard and then kept spotlessly clean throughout the day

Concessions.

Concessions on railway premises can be a lucrative source of income for a railway and the opportunity to provide for them should be taken wherever possible. The normal types of concessions are coffee shops, refreshment counters and small lunchrooms, plus pharmacies, dry cleaners, newspaper shops and flower shops

Some larger stations are able to provide space for so many shops that they are almost shopping malls in their own right. This is good for the railway, since it attracts customers and it provides a sense of community, which would otherwise be lacking.

Platform design

Side Platform Station.

On a railway, which requires passengers to be in possession of a valid ticket or "authority to travel" whilst on the property, the station area is divided into an "unpaid area" and a "paid area", to denote the parts where passengers should be in possession of a valid ticket. Of course, there are now many railway operators who have "open stations", which allow passenger to wander at will without a ticket. In these circumstances, in addition to a ticket office or ticket selling machines, tickets can be purchased on the train. The basic station design used for a double track railway line has two platforms, one for each direction of travel.

Where there is a high frequency service or for designs with high platforms, a footbridge usually connects the two platforms. In the case of a station where tickets are required to allow passengers to reach the platform, a "barrier" or, in the case of a metro with automatic fare collection, a "gate line", is provided to divide the "paid area" and "unpaid area". This design allows equal access for passengers approaching from either side of the station but it does require the provision of two ticket offices and therefore staffing for both of them. Sometimes, stations with two ticket offices will man only one full time. The other will be manned as required at peak hours.

Lifts and escalators

Vertical transportation at stations in city environments and on urban railways is almost as important as the horizontal transportation provided by the trains. Any station not easily accessible on the surface and which requires stairs, will nowadays, require lifts for the disabled.

Stations with a height difference between levels of more than 4 to 5 meters will probably need escalators as well - certainly in the up direction. Escalators are expensive, so the number of passengers using the facility must be at a sufficient level to make them worthwhile. Both lifts and escalators are high cost maintenance items and need to be kept in good condition.

The siting of lifts and escalators is important. Passengers have to queue to board them so there must be space at the boarding point to accommodate a large number of people at busy times. Such areas must be kept free of obstructions and not be too close to platform edges. The number of stairways and escalators must be sufficient to allow a trainload of alighting passengers to clear a platform before the next trainload arrives. This may seem obvious, but it isn't always done. Most countries require an evacuation standard to be applied to the number and location of stairs and escalators.

Basic construction.

One other point to note. Escalators in the railway environment usually get a lot more use than those in commercial or retail. A railway, with a standard department store design escalator, may find it will quickly wear out and will need constant repairs.

The sub structure.

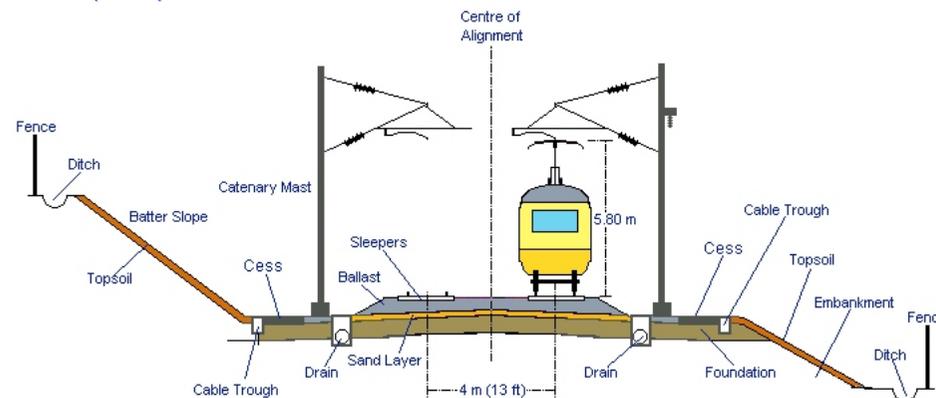
This part of the road consists of three main elements; the formation, the sub-ballast and the ballast. The formation is the ground upon which the track will be laid. It can be the natural ground level or "grade" or it can be an embankment or cutting. It is important that the formation is made of the right materials and is properly compacted to carry the loads of passing trains. The formation under the track has a "camber" rather like that seen on a roadway. This is to ensure ease of water run-off to the drains provided on each side of the line.

The track itself is supported on "ballast", made up of stones usually granite, below, which is a layer of sand, which separates it from the formation. For new or renewed formations, the sand is normally laid over some sort of geotextile screen or mesh to separate it from the foundation material below. In the past, asphalt or plastic sheeting has been used to prevent water seepage.

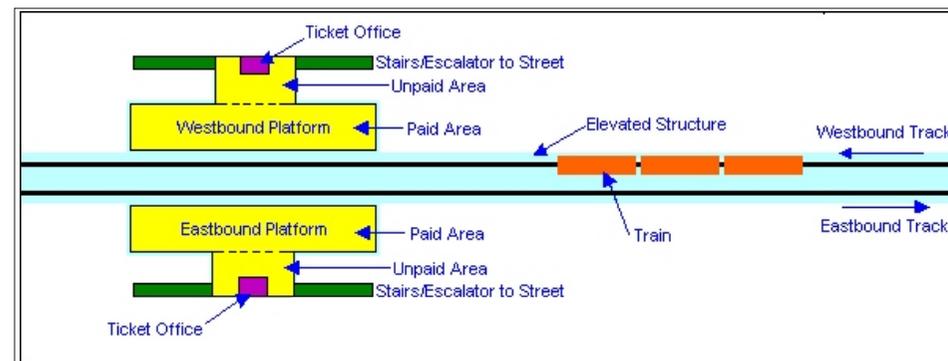
Catenary masts (if the line is electrified on the overhead system) are located outside the drains and, beyond them; there is a walkway area. This may just be a cleared path for staff to walk safely, avoiding passing trains or, on modernized routes, a properly constructed path. Next to this path will be a cable trough. These were originally concrete but are nowadays often made of plastic. A plastic tube, usually bright orange in the UK, protects Cables crossing the track.

Usually, the edge of the railway property is outside the pathway or cable runs. If the line is built through an area requiring an embankment or cutting, the slopes will be carefully designed to ensure that the angle of slope will not take an excessive width of land and allow proper drainage but without risking an earth slip. The slope angle depends on the type of soil available, the exposure, the climate and the vegetation in the area. Drainage ditches are often added along the edges of cuttings and embankments. In the UK, fences are always provided along the boundary line of the railway to protect the public from wandering onto the track. Even so, there are a few accidents every year when trespassers are killed or injured by trains or electric conductor rails.

(<http://www.trainconstructions.com>)



1.6 (Cross section of a typical rail road construction line).



1.7 (Diagram illustrating the principle for platform design).