Chapter 8
Technical detail

8.1Site information

The proposed site for the new Gautrain Station, Hatfield invulves a cut along the north of the already existing railway line between Hartbees Spruit and Rissik Station.It will take up the remainder of Erf 717Hatfield and portion 1 of Erf 656 Furthermore it was decided that portion one and two of Erf 717 be included for the purpose of this thesis.

Major site interventions would include demolition of Barloworld delta and the recently built SAAB motor vehicle showrooms. *(vide 4.14)*

There is a fall of 3,5 metres from Grosvenor Street to Duncan Road to the east.

Major excavations will be needed for the construction of a super basement(At least 20 meters).

The site was previously a school playground , thus the need for trees to be removed will be sparse.

8.2Technical motivation

Elevators

According to lectures by Mr Paul Allen, director of Associated lifts, on elevators and escalators(13 August 2003),worldwide the elevator industry has experienced tremendous change over the last twenty years.
The biggest by far were the development of elevators utilising machinery incorporated into the lift shaft; with no motor room on top to clutter the skyline of lower rise buildings.

The proposed new Gautrain Station would have to use this technology, as one of the main premises of the design from an urban point of view is the respect for vertical scale predominant in Hatfield.

Having certain design limitations to the capacity of the lifts, the maximum amount of people the lifts can safely transport is 15 persons or 300kg. (14 persons EN-81)
Coupled with this the amount of people then catered for would be 15 persons per lift times six, as the lift banks cater for six lifts. (Allen2003)
The speeds at which they travel are 2.0 metres per second, generating enough speed to service the needs of the people occupying the areas of the building serviced by lifts.

The building would be serviced in one area with passenger lifts, only in the areas where disabled persons and office workers need to travel from the maximum point of the first level of the “super basement” to the fist floor offices or lobby area respectively.

It would thus be correct in assuming that the allowable area per person would be 15m².

The assumption would also be correct that 15% of the population would travel to the ground floor, and of this percentage some will use the stairs to the first floor , the unit would also be expected to stop at 70% of the floors at any one trip.

AnImportant aspect to remember here is that people in modern day society do not want to be inconvenienced in travelling form point A to B. People find waiting for lifts extremely frustrating. If the building is a low rise one, where the conflict can arise if it would indeed be quicker to take the stairs, this however in this building does not reflect the whole extent of the dilemma as the lifts are predominantly placed for the use of disabled people and persons travelling from the basement where no direct staircase link exists this is a fire safety aspect.

A traffic study by law requires the elevators to handle certain volumes in a specified period and research have determined acceptable waiting times and availability from the main lobby level. Important targets to achieve are as follows:

1. Lift system should be able to fill building in at least 30 Minutes.
2. The handling capasity should not be less than five minutes
3. Waiting time should be less than 30 seconds
4. The waiting interval should be less than 55 seconds, based on a lift available to dispatch from the main lobby during a peak periods.
5. The number of cars selected should not be less than the number of cars required.
6. handling capacity in 5 minutes should be more than 30 persons (Allen 13 August 2002)

By using these parameters , it was thus ascertained that the building only needed five lifts of the 15 person capacity tolerance, but due to the design symmetry called for in the lift lobby and the possibility of unusually large peak periods, it was decided to keep the initial gut-feel design of six lifts, three per side.

The basement area would be serviced by escalators for pedestrian travel in the major circulatory areas, and with a lift bank of six 12 person lifts leading exclusively from the first basement level to the main vertical circulation space of the station and further to the Gaurail Offices situated on the First Floor of the above ground building.

Escalators

The design of the escalators in the courtyard area and the two symmetrical entrances alongside the axis defining canopy north if the building, needed to be approached with diligence and care, as they not only represent a crucial aspect of the ultimate success or failure of the building from a people movement standpoint, but also in that they serve as an important expression of how dynamic the “building as a machine” must be.

Practical considerations about sheltering moving elements from the elements also needed to be addressed although there do exist escalators that can be operated in the open.
The consideration in this instance rests harder on the fact that in order to facilitate the movement of people in large numbers on these machinery, there cannot be any chance left open for accidents due to slipping, or miss-stepping due to glare, as these could lead to compensatory claims.

“With EN115 regulatory requirements once an escalator exceeds 6 metres in rise then on entry and exit at least 3 flat steps are required. Lower rises will have 2 flat steps. Furthermore the use of 35° units are not permitted over 6 metre rises, due to the sensation the angle creates on decent that the general public find uncomfortable” (Allen 2003)
For this reason the 30° angle have been used as these have no restriction on the amount of rise it can accommodate, as long as it is structurally possible.

Although it is structurally possible to push the envelope, the design have been kept to within floor-to-ceiling heights a s to stay within the

The escalator step width has been decided upon is 1000mm as this is the most commonly used spacing, and the widest available in the South African market.
The handrails would consist of illuminated safety glass balustrades, which will help, in the illumination of the treads in nighttime, as well as helping to clearly identify the vertical routes in and out of the “Super Basement”.

The system then decided upon is the Escalator Type JS-LE, Glass-panel Balustrades with illuminations by Mitsubishi Electric.

Fire escape

The design of the fire escape system serving the “super basement” had the be re-thought as the SABS 0400: do not permit escalators, even ones disabled from mechanical movement and thus serving as a stationary staircase to be deemed as being sufficient fire escapes.

For this reason the emergency escape stairwells have been designed to sit at the periphery of the “super basement” edges where anybody can access the sealed off wells and egress from the basement and were numbered to be at least three.

“In any building not classified as D4 or H4 (low fire load) any storey below the ground storey shall be served by not fewer than two separate emergency route stairways: Provided that where such storey is used for the parking of motor vehicles one such emergency route stairway may be replaced by a motor vehicle ramp.” (SABS 0400-1990: 186)

A nominal size according to sport stadium design have been assigned to Fire escapes to accept a flow of people of no less than 190 persons: thus making the minimum width 1800mm.
It further states that no individual escape route shall be designed to handle more than 190 persons egressing from it at one time.
(Table 9 width of escape routes, SABS 0400-1990: 185)

In the building above ground the application of two 1600mm wide escape routes would be sufficient as the maximum distance any office occupant would need to travel to reach an escape would only be 45 metres.

The Supermarket and Restaurant areas would both receive emergency stairways no less than 1800mm wide to also accommodate the possibility of persons waiting for the trains to arrive, also using them. The easiest access routes away from the platforms would be down the rail cutting and away from the building, this however is unacceptable for the danger involved electrocution. For this reason people will be directed to escape routes leading from the platform to the north to the landscaped garden area.

Ventilation

Aeration of the “Super basement' would be achieved in a number of ways overlapping to make the system redundant, in order to prevent failure of one to jeopardise the successful working of the building.

The high speed trains departing and arriving into the confined space designed for it underneath the dominating Architectural canopy typifying the structure, pushes in front of it a substantial amount of air, creating air pressure which is then utilised to act like a piston to push air through the basement areas. The air, which contains large amounts of oxygen, dispels the stale air, which settles at the lower areas of the basement to the top of the landscaped garden area.

The Carbon Monoxide gas dispelled in the Landscaped garden is then immediately re-circulated into the ecology, as the vegetation need these gasses in order to grow.
The grating vents to the landscaped garden is designed in such a fashion that it blends in with the garden furniture and design of the building elements.

These grated vents also houses the supplementary redundant system of extractor fans which job it would be to kick-start the circulatory system by using the stack effect to ventilate the spaces underneath.

The “Super Basement” would then in a further aspect also ventilate by means of the cross-flow of air created by the openings for vehicles situated on opposite ends of the site right in the path of the prevailing wind direction, aiding the extraction of noxious gasses.

The design of the super basement also incorporates a cavity wall and extractor fans on top, permitting ventilation by means of the stack effect.

Cross ventilation and passive temperatures control is possible in the office space due to its oversized shaded windows and high roof space. The air pocket under the roof serve as insulator.

Elements and Materials

Traditional elements

Coming back to the traditions of railway architecture, where steel is respected as a symbol of strength. Full utilisation of this aspect is made by the extensive use of “over designed” splice joints and other typifying elements to 'tip the hat' to previous generations. These elements come particularly strong to the fore in the interior architecture, where these elements were used in the design of not only the door fittings, but also the sanitary ware accommodated in the ablution facilities have a strong rail connection with Stainless steel units being used throughout.

Balustrades, much the same as would be the case in a semi workshop like environment of the stations of yesteryear, comprises of pre-fabricated proprietary units with customary ball-and stanchion constructions bolted to the floors by means of chemical anchoring threaded bars.

Materials

The construction of the main Station building and other structures on the site would mainly be in reinforced concrete.This reasoning is tempered with the firm economical in mind as the embodied energy of concrete in South Africa and the labour required to erect the structure need to take precedent in the choice of material.

The mere construction of the “Super Basement” can only be economically attained by the use of this material.

The secondary use of 300W structural steel elements comes closer in the ideal of creating an architecture relating to the rail heritage we enjoy in this country than any other material, and it is for this reason that the material is then used.

Roof

The most controversial material choice in the entire structure would be the use of Copper Roof Sheeting.

The Copper Roof Sheeting used, as roofing materials as well as a cladding material in certain areas need to be used as the uneven curve of the roof necessitates it. The organic shape of the roof also derived from the more natural / humane theme of this vast building is what drives the material choice.

A further reason not readily evident is in the inherent qualities of copper as a roofing material and as a historical roofing material.

As a hypoallergenic metal, which has the properties of destroying pathogens, it was used throughout the ages by kings as drinking challises. For precisely this reason one can safely use the rainwater harvested from such a roof in irrigation where possible human contact may be envisaged as in this instance.The tanked water don, however, does not represent a potable water supply, it merely suggests that the addition of chemicals to the water isn't imperative to prevent bacterial outbreak.

As a historical roofing metal the importance of this roofing material is however more desirable. Throughout the ages in Europe and other developed countries, the use of copper had had as a result the “patina effect” where prestigious building built up a layer of esteem by means of the “green” roofs they posses. It is this green patina that a prestigious building such as the Gautrain Station would like to aspire to, and its Government backers.

On the Office level the roof structure have been exaggerated to the extent that it concurs with the overall design scale of the building, yet it is sympathetic to the surrounding built fabric in vertical dimension. The services have been accommodated under foot in the coffered slab where the relatively new, but essential aspect of data transfer facilities take precedence.

Overhead the clear space lends itself perfectly to enhance the thermal performance of the building where the airspace acts as an insulation material. Mobiles can be added to accentuate the continuous flow of air through this space the workings of which can be understood in the analogy that Renzo Piano used in the design of Chep Lap Kok Airport Terminal in Japan in 1995, where huge funnels came from below to aerate the airspace under roofing material.

As for the construction of the Roof over the Office Area the Specification can be read as follows:

- Industrial Copper Roofing Sheets with in-situ bonded seamless bonds in an 385x40mm Proprietary Ribbed Pattern on;
- Proprietary clamps shot-fixed to the underlying purlins at the recommended spacing as specified by the manufacturer on;
- IPEAA 100 I-section 300W Mild Steel purlins, spaced at 1800mm ccs on;
- 305x165x41 I-section Main truss members at 5200mm ccs
- Trusses to be connected to underlying building structure by means of pre-drilled holes filled with a Proprietary chemical anchoring system, threaded bars, comprising of M16 four bolt configuration as specified by the structural engineer.

The construction of the composite truss to be referred to the pertinent detail drawing in Section E-E.
Herewith follows the specification:

- 305x165x41 I-section main arched member Radii to differ for every truss, as well as the size with,
- IPE200 I-section corner support unit comprising twin sets of IPE200 I-sections and,
    - IPEAA 100 I-section 300W Mild Steel, web stiffeners and Tie-beams with,
    - Jakob® Inoxline Proprietary Stainless steel cabling Stiffening members of size and fixing procedure specified by the manufacturer.

The construction of the truss system to be pre-manufactured completely in a factory environment where the member strengths can be monitored and evaluated as well as factory primed for durability. Assembly on site would merely comprise the craning into place and bolting together of members to specification.

The roofing material chosen for in the Canopy, (the area covering the rail tracks and which also serves as the piston area to the ventilation of the basement has been decided as a factory coated, continuous metal profiled roofing sheet with seamless bonding. The colour would thus also correlate with the ultimate hue of the copper roof sheeting used elsewhere.

Structural Steel in Canopy

The canopy would house the hidden plant paraphernalia of the building such as the air conditioning units to service the Gautrain Restaurant and Supermarket on the concrete slab roof space.
The canopy as stated earlier would then be comprised of curved I-Section members as main supporting members with progressively smaller leading sectional members as web stiffeners and tie-members, as determined by a structural Engineer.

All radii designed according to the specifications lain down on the relevant Sections.

Main truss spacing to be at 9500mm ccs with twin truss supported on a shared plinth (two trusses forks down to rest on one base)

Purlin spacing to be 1800mm ccs with the metal roof sheets comprising the thickest gauge accommodated by the manufacturer 1.8mm.

Infill panels between the trusses to be of 6.0mm Safety Glass panels suspended from their bearer frame by means of proprietary hangers and fixing systems, with aluminium louvred panels as facing material.
Ventilation of the canopy structure to be dealt with, with alternating infill panel containing remotely open able window sections.

The canopy shields which are a predominating feature on the building façade to the south comprises of Smoke Extractors of a proprietary nature to be triggered in the event of a catastrophic fire to open and release hot gasses away from the building.

The secondary function would definitely be the ingress of natural light into the canopy to limit the amount of artificial light required.

Aluminium

Further material use in the form of sunscreens and window- and door frames is Aluminium.
Aluminium represents a relatively high embodied energy level, but cancelled out by the advantages of solar radiation reduction and the resultant lowering of cooling costs to the building interiors, makes the choice a sensible one. The envisaged time span of the building is also seen as more than 30 years and for that reason we would need building materials of a high grade to facilitate longevity.

Landscaping

Monolithic Concrete blocks with delicately case fine grain concrete and chamfered edges.
These would be placed as a sacrificial element at strategic areas in the garden spaces. Their function is quite out of the ordinary.

Placed in such a way as to be no threat as a possible hiding place for muggers

Public spaces where the local community may lend their input is very rarely vandalised they would act as a lightning rod for these activities. They further provide a forum to the community to express themselves through art. An important building element in our modern television depraved society.

Floor covering

The choice of floor covering materials in the offices, restaurant and office areas have been predominantly one of economical viability and the ease of changing with the fashion trends envisaged to occur over the lifetime of the building.

Offices

For this reason the offices for example would contain carpet tiles in the main office area to ease access to the under floor trunking utilised there and to ease the replacement of carpeting as the wear and tear factor comes into play.
The formal meeting cubicles have mote durable floating wood proprietary floor panels to suggest a more expensive flooring system, yet keep the appearance to the visitor as very upmarket.

Cirlculation spaces

Main circulation spaces have the local artist "Terrazzo Cement Art " interlaced with high impact slate tile flooring.

The slate tile motif is also taken straight into the lift floors as they comply with the general pattern of the lift lobby where they stop, causing a seamless departure from lift lobby to lift.

Restaurant

The floor coverings in this area of the building would have to comply with the safety standards and specifications surrounding hygiene.

Kitchens

In the kitchen spaces and areas of food preparation the use of non-porous flooring materials, which are non-slip, needs to be adhered to.

While in the seating areas a easily cleanable carpet tile can be used.

Supermarket

The flooring in the supermarket would be of a proprietary nature with the company insisting on using Porcelain Tiles manufactures to fit their corporate image.To be utilised in both the public and non-public areas, while Granno will be used in the store room areas.

Refrigeration facilities would have the same porcelain tiles as used in the rest of the Supermarket.

Change

Of most importance is the need to have the building and its finishes open for changing use in the areas, which may be expected, such as the offices, restaurant and supermarket.

The design was thus approached from an open-ended scenario to have the spaces easily converted from use.
Thus what are now offices may one day be the talk of the town Art Gallery of Pretoria. The onus however lies on the anchor tenant, in this case the Gaurail Authority offices to use the building, in this way promoting its use.

To facilitate this feature of easy change the building has the load bearing members situated at the furthest extremes of the built envelope, with vast open spaces both vertically and horizontally to accommodate any design changes in future.

Cobbled Stone vehicle driveways

The importance of community involvement in the creation of a public building cannot be overseen. A community who helps to create a building tend to endorse it.

For this reason the cobbles will be laid by members of the local community in a community participation and job creation scheme. As an added bonus this also falls into the stipulation from Government that local communities that were previously disadvantaged should be given participatory roles.

Garden Furniture

Furniture pieces such as litter bins; benches and canopies would be of the same architectural language as the roofs in the building. The enclosed sheltering feel created by the canopies is what the design tried to achieve as were used in the Holyhead Ferry terminal, in Holyhead, Great Britain. The added advantage of “system Building” the elements to the same specifications as the roofs made the addition of relatively large quantities of these furniture pieces possible.

Benches

Pre-cast concrete benches according to the design details have a very fine abrasion resistant concrete aggregate of 7.0mm in dispersed with steel filings to create a very robust finish that would weather over time into an oxide finish complementing the building design.

The technology of steel filings in the screeds of factory floors have been around for numerous years and help to maintain good traction in high risk areas, as well as to enhance the abrasion durability of such flooring applications much the same as would be called for in this instance

Pedestrian High Traffic Areas

Terrazzo Cement Art. The art pieces by up-and coming artists would enhance the community ownership of the building, as well as give the artists a leg up in life.

Garden Areas

The garden areas would be laid out by qualified Landscape Architects with predominantly indigenous flora to be used, where possible enhancing the species diversification necessary to have the garden grow.

Wall Surfaces

Ticketing hall

Wall Surfaces inside the main ticketing hall are covered with ceramic mosaic designs by local artists.

Funnel area where the train arrives and departs

Baked enamel panels with designs of indigenous artists along a technological theme.
Factory made panels consist of 1.5mm thick mild steel panels of 1500x1500mm with hidden vandal proof fixing screws, painted with the artists' design and baked.

This method have been successful utilised in countries like England and Japan, with the added advantage that spray
paint graffiti tend to easily removable if attempted to be defaced at all.

Water

Potable water

Potable water distribution system to comprise of a proprietary copper system situated in services zones as indicated on plan.
Access via removable screen panels to be incorporated into the general design and finish of the interiors as specified and designed by an Interior Architect.

Ground water

Ground water conditions in Hatfield are notoriously severe. Ground water, and a lot of it, is present at depths as low as 1.0m below ground.

For this reason the basement would be of a double hull construction with sumps situated every 25m². These sumps would be serviced by sump-pumps triggered by a water level fangle automatically switching the machinery on and off as the level rises. The natural fall of Hatfield to the West enables the discharge of ground water build-up to be safely achieved into the rail cutting.

Stormwater

The handling of rain / storm water is for an entirely different scenario.

The storm water is prevented from ingress into the basement on levels three and two, but the first level is dealt with as a open air level, even as this level is sub-terrainean. Water ingress in this area is dissipated by means of storm water channels covered with grated materials leading to a catch pit area from where the water is directed to fall into the rail cutting and municipal drainage systems provided for this.

In the northwestern edge of the basement the storm water would be incorporated into a separate system working along the same lines as the ground water system, with the distinction that the high-speed pumps will be of much greater capacity.

Sewerage

The sewer system is accommodated in the headroom structures of the basement.
Main sewer lines consists of 160mmØ Marley Twin Wall ® uPVC pipes or similar approved product.
Secondary branches consists of 110mmØ Marley Twin Wall ® pipes.
Fall and hydrostatic loads to be approved by mechanic engineers.
Site sewerage discharge in municipality sewer lines as indicated on plan

Lighting

Lighting systems to compose of ambient deflected light source systems where the artificial light sources would only be utilised as an enhancement to the natural deflected light utilised.
Because of the large overhangs, (1250mm); and the solar azimuth and incidence for Pretoria over the year, the only direct light to fall into the building would be highly weakened afternoon and morning rays, which could not significantly contribute glare or heat build-up in the building.
Yet the diffusion of light into the office spaces and public circulation areas would be sufficient to ensure the building would be well lit.

The extensive use of “floating” roofs can be seen not only as a very strong thermal design element, but also as an imposing element in night time as the massive copper roofs would be seemingly floating in mid air above the more grounded elements of the building enhancing the important monumentality aspect searched for in the building design.

Natural light also pours in from rooflights used in the canopy. This way track an platform areas get illuminated

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