Chapter 9

Technical resolution

Introduction

The following section investigates the decisions and motives that drive the technical level of the proposed project. As such, this section should be read in conjunction with the accompanying set of drawings. The objective of the investigation is to establish an appropriate strategy to achieve effective technical resolution of the proposed building structures. With this in mind, aspects such as a historical study, in conjunction with a technical investigation, informed the design decisions.

With the growing environmental concerns, both locally and internationally, as well as the recent energy shortage in South Africa, the implementation of sustainable principles are elementary. It should however be kept in mind that sustainable design encompasses a myriad of aspects ranging from issues such as passive systems, material sourcing, and construction processes. For this reason, the proposed project seeks to focus on solar shading and cooling. The object is to enable energy-independent occupant comfort as far as possible.

Historical study

This section of the technical investigation examines the materials used in South African railway architecture as can be found in the old Transvaal Province and as was constructed by the NZASM. According to De Jong, Van der Waal & Heydenrych (1988:85) those old NZASM station buildings are characterised by three distinctive features. Firstly, they draw inspiration from the railway architecture in Europe, and in particular that of the Netherlands. This influence is clearly observed in the use of red brick and white sandstone which reflects the ornamental language of the Dutch Renaissance. Attention is deliberately drawn to the central part of the building. However, they lack the impression of height that their European counterparts achieve. Secondly, the station buildings reflect an adaptation to local circumstances. As such, many of the station buildings were constructed using locally available stone (sandstone, hornstone (dolomite) and hornstone (“flybrick”). Brick was used where it is either more readily available or cheaper. Corrugated iron was used as roofing material as opposed to the tiled roofs of their European counterparts. A third distinctive feature is the use of verandahs, and particularly so on smaller station buildings. This local weather conditions play a large part as it allows for the free movement of passengers (De Jong, Van der Waal & Heydenrych 1988:85).
Considerations

Building mass

The investigation on the building mass was conducted on two levels. Firstly, at a mass level, resulting from the identification of public open spaces located in front of the station building and the two internal courtyards on the southern side of the proposed building. The latter two spaces are identified as problem areas due to these spaces being shaded throughout the day in mid-winter. Secondly, each individual unit level was investigated in terms of its indoor light quality, both on the northern facade of the retail and office complex and the eastern facade of the station concourse.

On a mass level, the investigation informs bulk massing, the position of voids, and the height of roofs in order to improve the thermal and natural light quality, as well as to address the street facade in the broader urban schema.

Orientation

The proposed buildings orientation is a direct result of its response to its urban context. As such, the building is aligned to the two streets in front of it, and is thus orientated 5 degrees west of True North. This configuration results in the retail and office complex's main facade predominantly facing northwards, while the main facades of the station concourse primarily faces east.

While the northern and eastern orientation is advantageous for natural light and dominant northwestern summer wind for ventilation purposes, the southern side of the building, which opens onto internal courtyards, is exposed to the direction of prevailing wind and rain.

Form

The shallow depth of the proposed building, being informed by its urban context, allows for good natural cross ventilation and natural light penetration into the interior spaces. As such, it is suited for office and other uses.

The south-facing courtyards are open and allows for ventilation of the building interior spaces. The primary circulation bridge to the south of the building is exposed to the direction of prevailing winds and rain, and will need to provide protection from these.

Scale

The 3-storey large structure of the proposed building requires that elements be introduced to have to the building respond to the human scale. This is achieved with the introduction of horizontal elements. On the northern facade, this translates into a large overhang that provides both shelter from natural elements, shading from the sun, and defines the circulation space.

Natural ventilation

The proposed building is designed to make use of natural ventilation. This is achieved through windows and doors on the northern facade. The station concourse is a green structure and therefore allows for ample natural ventilation.

Storm water

Storm water is drained off the roofs and connects with the storm water drainage system that currently exists in the site. Currently, this system drains to the railway line.

Fire protection

Fire protection of the proposed building is achieved through the installation of fire hoses on each of the floor levels, along with fire extinguishers. This is done in compliance with Table 2 of Part T of the SABS 0400, which requires one fire hose per 500m² and one fire extinguisher per 200m². These are accommodated in a vertical shaft on the southern facade.

In addition, the Multi-service Chilled Beam System (MSCS) that is discussed later in this chapter, has to capacity to house sprinkler systems in their design.

Facilities for the disabled

Facilities for the disabled are provided by the provision of elevators that allow for easy access to both the platforms at the railway line. Elevators are also provided to gain access to the offices on the first and second floor levels. All ablution facilities also provide facilities for the disabled.

Artificial light

Artificial light is to be introduced to ensure consistent lighting levels with increasing room depth. It is suggested that an automatic lighting and sensor system be installed.
Existing & new structures
Structural system

The primary reinforced concrete structure of the proposed building is based on a 4m x 8m grid. It consists of columns and beams, with lateral stability provided for by the service shafts and concrete floor slabs. This skeletal structure is informed by Le Corbusier’s "Domino Structure", and allows for flexibility within the building. As such, it accommodates future changes to the building programme.

Due to the adaptable nature of the proposed building and its variable functions, the building is designed to achieve flexibility. This is achieved by the bulk of interior walls consisting of dry-walling that can be easily moved to achieve any required spaces. This results in a reduction of the overall weight of the building and enables easy adaptation. In addition, dry-walling achieves the required acoustic levels and is reusable.

Similarly, services are provided for by means of vertical shafts. Floor to ceiling heights are 3.6m at ground floor level and 3.2m on the upper levels and allows for the accommodation of suspended ceilings should it be required for the effective distribution of services, or for reasons relating to acoustic treatment.
Vertical service ducts

Various services are housed in separate vertical ducts located on the southern facade. These include wet services, fire protection services, and electrical services.
Sun study

A SketchUp massing model of the proposed building was composed to examine the daylighting scenario. Natural lighting scenarios were examined for both the summer and winter solstices at 08:00, 12:00, and 16:00. From this investigation it becomes clear that the summer scenario differs greatly from the winter. In summer, the internal courtyards are exposed to sunlight for the bulk of the day, with minimal shade in the morning and afternoon. This is not the case during the winter solstice when the internal courtyards are primarily shaded for the entire day.

This sun study determines that large indigenous trees can be used to strategically provide shade during the summer months.
Solar control

Vertical solar shading on the eastern and western facades of the station concourse is achieved with the use of Colt Shadowglass Glazed Solar Shading System. This system provides a solution to low-energy building demands by maximizing natural daylight whilst controlling solar heat gain and glare. Shadowglass also affords a view outside, ensuring that occupants remain connected to the external environment (Colt International 2008:11). Solar control is achieved through the use of a TSH-Thermo-Shading system, which is self-powered by the sun using the heat generated to expand or contract fluid within a tube. This system requires no external power, as absorber tubes that are enclosed by a double-glazed tube forced air and force a hydraulic cylinder to open or close the louvers. "When absorber tube 1 gets hotter than tube 2, gas in the centre tube expands which hydraulically control the cylinder rod, the louvers will rotate until both tubes are in equal alignment with the sun" (Colt International 2008:15).

Office interior with Colt Shadow Glass Insulation (Source: Colt International 2008)
Colt source system 1 (Source: Colt International 2008)
Colt source system 2 (Source: Colt International 2008)
Solar control installation (Source: Colt International 2008)
Solar system on eastern facade
Cooling system

Passive Chilled Beams

Chilled Beams are a cooling system that offers an alternative to conventional mechanical ventilation systems. It was first introduced in 1965 and has been extensively used in both the UK and Australia over the past 15 years (Engerer Systems 2008).

Passive Chilled Beams use potable water as a heat transfer medium. The water is circulated through copper cooling pipes bonded in aluminium heat transfer fins, which enable the cooling of a large area through both natural convection and radiation (Engerer Systems 2008). As warm air rises, it is drawn to the chilled beam and cooled before returning downwards. This results in the system being quiet and draft free. The system can be fully integrated with a normal suspended ceiling, but will require perforated ceiling tiles immediately surrounding it to work effectively.

Multiservice Chilled Beam Systems (MSCB) offer the opportunity for even further incorporation of services such as cooling, uplighting and downlighting, condensation sensors and integrated control valves, fire alarms and sprinkler systems, as well as pipework, ducting and power or compartmental trunking. Passive Chilled Beams provide up to 400 W/m² (up to 159 W/m²) of cooling (Engerer Systems 2008).

The system requires low maintenance as it has no moving parts. The use of copper and aluminium mean that the system is both durable and recyclable. In addition, the system has a life cycle guarantee of up to 25 years (Engerer Systems 2008).
Demolishments

Structures that are demolished for the construction of the Gautrain project is illustrated by fig. 9.37.

The structures demolished within this proposed project is shown in fig. 9.38.
First floor plan
The proposed building is the consequence of a process that, from the beginning, had no clear image of the outcome. It is a process that was driven by rational, cumulative decisions taken within the bigger picture of development frameworks and historical references. This process was concerned with creating a place rather than an object or a preconceived outcome. Its aim was to re-generate a culture of “publicness”, of collective public ownership and responsibility for public space. Past and future is interwoven by retaining selective parts of the existing Rosa A Station building, and incorporating these into the proposed complex.