CHAPTER EIGHT
TECHNICAL INVESTIGATION

DESIGN SYSTEMS

PASSIVE SYSTEMS

MATERIAL STUDY
CHAPTER 8- TECHNICAL INVESTIGATION

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CHAPTER 8 - TECHNICAL INVESTIGATION

Services, Circulation, Ducts and floor area

- Floor Area
- Foyer Space
- Service Rooms
- Vertical Circulation
- Water Storage/catchment
- Service Ducts

FIG 152 - Basement Plan
FIG 153 - Ground Floor

GROUND FLOOR
BASEMENT LEVEL
CHAPTER 8 - TECHNICAL INVESTIGATION

FIG 156 - Roof Level

FIG 157 - WATER DRAINAGE
WATER SYSTEMS

Rainwater harvesting
Output: Roof Area X average rainfall
= 4615m2 X 0.674m (Weathersa, 2009)
=3110.5m3

Comments: The basement structure is fitted with two water storage compartments which are attached to a pump system, thus the collected water could be used for two purposes.
1). The water could be pumped to a filtration system and used in the ablution facilities
   o Dual flush system uses 3l (light setting) or 6l (heavier setting)
   o Conventional toilets use 11-15l per flush
2). The unfiltered water could further be used to irrigate the site and adjacent buildings in time of plenty.

Water Storage
The water harvested from the roof will be stored in two storage rooms in the basement. The storage tanks (hydraulics nel range) will be joined together by an underground gravity pipe, in order to regulate the levels of both tanks. The tanks will further have a pump system, attached to a filtration systems, that will pump the water to the needed areas, (ablutions, irrigation).

<table>
<thead>
<tr>
<th>Rainwater harvesting</th>
<th>Building usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>Type</td>
</tr>
<tr>
<td>14 000 L</td>
<td>Water</td>
</tr>
<tr>
<td>Estimated usage</td>
<td>= 71040 L/ month</td>
</tr>
<tr>
<td>Average hot water consumption:</td>
<td>1mm of rain x 1m2 of roof surface</td>
</tr>
<tr>
<td>Hand basin 1 liters</td>
<td>= 1 liter</td>
</tr>
<tr>
<td>Kitchen sink (per wash-up) 6 liters</td>
<td>4615m2 X 674mm (weather SA)</td>
</tr>
<tr>
<td>Dishwasher 14 liters</td>
<td>=3,110,510 L (potential collection/ year)</td>
</tr>
<tr>
<td>1 person + household 120l</td>
<td>3,110,510/ 12 months</td>
</tr>
<tr>
<td>Washing of floors/sores: 50l</td>
<td>=259,209 L/month</td>
</tr>
<tr>
<td>Toilet: 8L per flush.</td>
<td>The basement has sufficient space to hold 12 14000L storage tanks, with total storage capacity of 168000 L per month</td>
</tr>
<tr>
<td>Showers: 36l per person</td>
<td></td>
</tr>
</tbody>
</table>
Radiant cooling

Radian cooling systems are energy and material efficient systems (Cunniff, G, 2009). Compared with air systems, radiant-cooling hydronic systems use approximately half the horsepower and materials to move heating and cooling energy within a building. The system consists of Low-flow injection-pumps, which deliver heating and cooling energy to terminal units.

Pros:
- Radiant chilled ceilings consist of metal panels with hydronic tubing attached, where chilled water is circulated through the panels to produce radiant and convective cooling. (Cunniff, G, 2009).
- Approximately 50 to 60 percent of the heat transfer from a radiant chilled panel is radiant, while 40 to 50 percent is convective.

COOLING

From a central pump system, cold water is pumped through coils to the top of the ceiling panel. The underside of the ceiling panel is cooled which in turn cools the air against it. The panels then absorb the heat, which radiates from the room. The air above the panel is cooled and cool air moves around the edges to the rest of the room.

HEATING

The warm water that is pumped through copper coils to the top of the ceiling panels enables the ceiling sail to act as a radiant heater. The panels heat the air above and below the panels, and circulate it around the room. The system is very effective over large areas, and thus reduces heating and cooling energy consumption.
Sun Control

The building uses a series of cantilevers from the roof, to the slab, in order to minimize direct sun penetration into the building. Recessing the building facades on the lower floors compounds this system, as it takes into consideration the sun angles during summer months.

GKD steel mesh is used in the exterior and interior of the building for a number of reasons. These include: its excellent corrosion resistance, long-term durability, high fire resistance, and low maintenance. The material also works well as a sunscreen device as it is able to keep out harmful UV rays depending on the density of its weave. While keeping out harmful rays, it also enables an unhindered view out of the building.
PASSIVE SYSTEMS

The public component of the building uses passive heating, cooling, and ventilation systems to regulate its climate. The following principals are adopted in the design.

Thermal mass:
The building design exposes the hard mass of its structure in order to increase heat gain during the day, and radiate it off during winter, and at night.

Recessed façade:
The faced sits under an extended roofline, in order to protect it against harsh north light, but allows for heat penetration in winter due to its lower angle of entry

Natural ventilation:
The south façade is open to the courtyard where wind is able to permeate and move through the building

High floors:
The design uses high floor to ceiling ratios, in order to allow all the warm air to collect above head height, and thus disperse through openings

Insulation:
The building envelope is insulated to reduce drastic heat gain and loss
CLIMATIC SYSTEMS

**THERMAL MASS**
The building uses thermal mass to radiate off heat on cold winter days, the depth and thickness of the slab help in heat retention.

**RADIANT COOLING**
Radiant cooling is used in the ceilings of the office areas and in the floors of the rentable offices. It is used to cool down the building instead of the air.

**CROSS VENTILATION AND STACK EFFECT**
Cross ventilation is used in conjunction with radiant cooling for climate control. The stack effect also helps in air circulation and replenishment.
Typology and Durability

In light of the precedence and typology, study conducted throughout the body of this thesis, the materiality of the building should not only be indicative of the taxi industry, it should also be adaptable enough to express all three facets of the industry. In consequence, to the identity of the industry being formulated by the articulation of both formal and informal attributes of the industry, there is a need for the use of a combination of materials. This will ensure that both parties receive their thermal, acoustic and durability requirements. The intention however is not to create a cacophony of materiality, but rather to have base materials that are expressive of the industry which are in part complimented by a second layer of materials that supplement their function.
In light of existing typologies associated with the taxi industry, the base structure will compromise primarily of concrete columns, beams and composite concrete floors. Secondly and in response to the conceptual notion of transport architecture being articulated as primarily roof and floor architecture, the roof structure will also be part of the primary structure. The material to be used for this will primarily be constructed of steel, with steel support structures.

A steel frame structure will be attached on to the base concrete structure, and will serve as the secondary structural system. This system is indented to represent the fluidity and lightweight nature of the public facet of the industry. The incorporation of both systems is intended to further represent the existing typologies, thus further instill the sense of identity. A third layer of materials will be used in the office component of the structure, and in order to respect, the formal conditions need to run an office appropriately.
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Concrete with a screed finish is commonly used in the construction of most transport structures, for its durability and low maintenance properties. It is for this reason that the material will be used in the construction of this structure. It will form part of the primary structure as to further enforce the notion of typology and thus play into the creation of identity. By in large the concrete will be exposed, as a truth to materiality is an important facet to maintaining the perception of fluid architecture.

In Staying, true the concept of truth to materiality, exposed brick, or face brick will also be used in the construction of the building. The fact that no plaster or paint is required to finish of the product also adds to its sustainability and low construction costs. Other advantages include: low water absorption, naturally fire-resistant, excellent acoustic properties, superior thermal insulation, Environmentally friendly, (low carbon footprint), (www.ocon.co.za: 2010)

### Slab and column

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### Structural infill

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### Specification

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick Strength</td>
<td>Average 30 MPa</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>Approximately 11%</td>
</tr>
<tr>
<td>Efflorescence</td>
<td>Nil to slight</td>
</tr>
<tr>
<td>Dimensions</td>
<td>220mm x 100mm x 70mm</td>
</tr>
<tr>
<td>Mass</td>
<td>Average 2.6 kg</td>
</tr>
</tbody>
</table>

FIG 173-Concrete Frame

FIG 174- Concrete Structure

FIG 175- Colonial Red
MATERIAL STUDY

Steel

A steel frame structure will be attached on to the base concrete structure, and will serve as the secondary structural system. This system is intended to represent the fluidity and lightweight nature of the public facet of the industry. The incorporation of both systems is intended to further represent the existing typologies, thus further instill the sense of identity. A third layer of materials will be used in the office component of the structure, and in order to respect, the formal conditions need to run an office appropriately.

Steel I sections are used in the construction of the walkways and pergola areas; they are also compliment by GKD mesh, which is used as a screening device, as well as a media screen. As the usage is primarily in the square area, the device could be used to supplement the income of the building. The I beams are coated with a fire proof paint, and further with a dark grey paint, as to reduce heat gain.

In parts of the design, steel is used as floor covering and as a shading device. For this purpose, steel grating is used, in order to give of the sense of a floating lighter structure. Other advantages are that the it is permeable allowing for visual, air and light penetration. Because it only allows partial light in, it can also be used as a screening device.
INTERIOR MATERIALS

Metal mesh
Not only will the mesh be used outside due to its sun shading - reducing heat load, cooling requirements and ultimately energy consumption. But will also be used in the interior of the building. The mesh will be used as cladding on the walls and as part of the ceiling. The aim is to create a robust industrial feel, which is synonymous with the transport industry. Cambridge Solucent metal fabrics deliver striking visual appeal, increased comfort, and most importantly, energy savings. (Archiexpo, 2010)

Polished screed
Benefits:
- Smooth finish
- Durable material
- Thermal properties

UV RESISTANT GLASS
Smartglass Solarshield is a glass with a metallic coating and a clear or tinted PVB (polyvinyl butyral) interlayer that is designed to reduce solar heat gain. This glass type also prevents up to 99% of harmful UV radiation from entering the building. Solarshield is a laminated safety glass that is widely used in sky/roof-light applications. Its U-value is 5.8 in all available colours. Heat gain can be further prevented by applying a white perforated film layer to the glass, which allows light to permeate through the penetrations while reflecting the rest of the light.
**MATERIAL STUDY**

**Granite finish**

Granite will be used in the courtyard area, due to its durable nature.

**Standard Sizes:** 600x300, 800x400, 900x450, 400x400

**Standard Thicknesses:** From 15 to 80 depending on requirements

**Finishes:** Sawn, Flamed, Honed, Bush Hammered, Antique, Polished, Split

IBR sheet metal roofing is the primary material used as roof covering. This is due to its flexible and lightweight nature. The material enables the design to manifest its concept of having a lightweight structure flowing over the building, unifying all elements of the building.

- Pitch 1.5 degrees
- Made of zincalume or Calvanised coated steel
- Klip lock profile

**SANDBLASTED CONCRETE**

Sand blasted concrete is also used in the outdoor spaces, for its decorative and durable properties.