Chapter 8: Technical Report

8.0.1 TECHNICAL RESOLUTION

The ethos of the dissertation’s lies in allowing the users of the building to create their own spatial and tectonic appropriate solution to their needs, economic limits and technological capability.

The challenge lies in how much control the designer holds and allows for within the architectural systems applied. This dissertation seeks to achieve that balance through an in-depth process of engagement with the physical and social context.

Chapter 8 explores technical aspects of the proposal at the level from which an architect could enter into the dialogue with the self-build. The tectonics are drawn from the various research exercises and aim to work with the contextual processes.

8.0.2 THE UNIT OF GROWTH

The unit of growth (see Illus: 120, on page 90) is designed to be a flexible and adaptable piece of urban Infra-Tecture. The manufacturing and construction details are explained in further detail.

8.0.3 THE UNIT MANIFESTED IN CONTEXT

A building system is detailed, chosen for its contextual appropriate tectonic while demonstrating a possible alternative system. (see Illus: 125, on page 94)

8.0.4 THE ELEMENT OF UNIFICATION - THE ROOF

The roof becomes the strongest architectural symbol and is designed to be built within the ethos of the self-build processes. (see Illus: 138, on page 122)
Illus: 176  Unit of Growth technical resolution - Site Plan (Author, 2011)
8.1 THE UNIT OF GROWTH

The unit is intended to provide structural and service support for the retailer network of street vendors while using the infrastructural energy and materials of the typical lamppost. (see Illus: 123 , on page 92)

Infraset is one of the largest pre-cast concrete manufactures in the South Africa (Infraset, 2011: 45) and have several products in their various production facilities that were used in the design. Most importantly the pre-cast concrete lamp post provided the basis from which to design the unit of growth based on the durability in application, transport and maintenance.

In order to allow the unit to perform its additional social role, (see Illus: 127 , on page 96) in addition to lighting, the design was modified with the input of Infraset’s production engineer and constrained by manufacturing and transport factors.

The unit is designed to use current structural and service technologies while allowing for the incorporation of possible future technologies.

THE ECOBEAM

EcoBeam, a composite open web joist made from timber chord and mild steel webbing are one of the most efficient span to weight ratio structural member available today. (see Illus: 185)-D) Used contemporarily in Mopethi Morajala’s 10 x 10 housing in the Western Cape, the Ecobeam has a contextual background in developing areas.

The major benefits of Ecobeams:

- Can be manufactured at any location with minimum facilities.
- Adjustments to Ecobeam lengths are easily made.
- Ecobeams are easy to handle and economical to transport.
- All Ecobeams are straight and uniform in size, despite variations in timber size, because they are manufactured on a straight edge jig.
- Easy joining makes it possible to produce any length.
- The use of Ecobeams typically saves two thirds of the timber used in a classic timber frame construction.

(www.eco-technologies.co.za, 2011)

The size of the Ecobeams was determined by the weight that the unit and a single retailer can lift

POLAR VOLTACIC

The Solar Light Energy Fund has provided solar powered lamp posts to developing communities all over the world, and have a large success factor in South Africa.

These same thin film silicon cells provide the most cost effective polar voltaic cells, and have been employed in the units. (see Illus: 185)-B)

MICROTURBINE

Motorwind is a Port Elizabeth company, which has been pioneering micro-wind turbine technology in South Africa. (see Illus: 185)-A)

The microturbines are made from re-cycled plastic and work in parallel series panel that, by being connected in series, work at highly efficient rate in even low wind speed conditions.

The micro turbine work in extremely low wind speed areas, above 2m/s, where conventional wind turbine’s work at wind speeds between 10m/s and 25m/s.
8.1 The Unit of Growth

Social Role of Lamp Post
Re-Investigated

Timber and Steel Composite Eco-Beam Chosen Due to Weight and Ease of Fixing

Electrical Supply in Micro Wind Turbine

Electrical Supply in Solar PV Cell

Illus: 178  Unit Axonometric (Author, 2011)
Illus: 179  Technical Detailing of the Unit of Growth - Not to Scale (Author, 2011)
8.2.2 Material Selection & Structural Diagram

**Primary Structure: Pole**

- Galvanized Steel Turnbuckle
- Galvanized Steel Eye Rod
- Purpose made 40mm Inner Diameter Openings to OHTE Specifications
- 15mm diameter high-grade tensile steel cable reinforcing
- 600m² pre-stressed concrete
- 45/32mm x 45/32mm section profile
- Reinforced hangers for secondary structure connection

**Connection Joints**

- Galvanized Steel threaded insert
- M18 stainless steel bolt
- 15mm diameter high-grade tensile steel cable reinforcing
- 7mm stainless steel hanger shoe
- 20mm opening for cable entry

**Secondary Structure: Composite Timber & Steel Truss**

- 4770 x 330 panel

**Unit of Growth technical resolution - Detail A - Not to scale (Author, 2011)**

**Unit of Growth technical resolution - Detail C - Not to scale (Author, 2011)**
8.2.2 Material Selection & Structural Diagram

**Illus: 183 Unit of Growth technical resolution - Detail B - Not to scale (Author, 2011)**

- 75 x 150 Timber Chord
- 75 x 150 Stainless Steel Nut & Bolt
- Mild Steel Stainless Steel 2 x 48mrs Parallel chord Support
- 3110 x 350 Parallel chord Support

**Illus: 184 Unit of Growth technical resolution - Detail D - Not to scale (Author, 2011)**

- 3110 x 350 Parallel Chord Support
- Mild Steel Stainless Steel Nut & Bolt
- 150 x 150 H Beam
- 40mm Galvanised Mild Steel 150 x 150 Angle
- 40mm Stainless Steel Expansion Bolt
- Grade 4.8 M20

**Illus: 185 Unit of Growth technical resolution - Spatial allocation (Author, 2011)**

- 52 sqm

**Illus: 186 Unit of Growth technical resolution - Detail E (Author, 2011)**

- Primary Structure
  - 15mm Diameter High-grade tendon steel cable rebar
  - Lightweight concrete
  - 150 x 150 H Beam engravings
  - 45mm Diameter PVC conduit pipe
  - 15mm diameter high-grade tendon steel cable rebar

- Connection Joint
  - M5 Stainless steel bolt
  - M16 x 350 parallel chord Support
  - Stainless steel hanger shoe
  - Threaded stainless steel insert
8.2 THE UNIT IN CONTEXT

To explore the manifestation of the unit in context, a hypothetical process of development was illustrated in Chapter Six. The focus of that hypothetical growth was the cement depot of the cement retailer network.

The focus of the dissertation is not in the design of a structure for the retailers, but in the architectural possibilities of the unit. The ArcelorMittal building system was chosen as a contextually appropriate building system as it is similar to contextual metal frame and cladding systems, but provide insulation and fire protection in addition.

Used in the Meetse-A-Bophela primary school in the adjacent neighborhood of Ext 14, the system is made of insulated pre-manufactured walling and roofing components. Joined by off the shelf flashing and connection units the system allows for quick and easy assembly and possible disassembly.

Flooring is dealt with by the use of Eva-Last recycled lumber decking was used for the flooring, as it too had the insulatory as well as recycled properties needed for the flexible building system.
Unit of Growth technical resolution -Callout A- Not to scale (Author, 2011)
8.2 the unit in Context

---

**Illustration 192** Eva-Last recycled plastic lumber
(Eva-Last, 2011)

**Illustration 193** Eva-Last plastic fastenings
(Eva-Last, 2011)

---

**Illustration 194** Eva-Last recycled plastic lumber joist
(Eva-Last, 2011)

---

**Illustration 195** Detail E - Not to scale (Author, 2011)
8.3 THE ARCHITECTURAL MANIFESTATION - THE ROOF

The roof is designed to be assembled from standard parts in order to be built affordably and with minimal extraneous structural supports.

The frame members are mild steel, treated L-profiles bolted together for easy assembly and dis-assembly. These members are then assembled to make an optimized truss system that rest on the main structural members of the concrete poles.

The size and weight of these members are designed to allow a single person to move individual pieces and a group to construct and move the assembled truss units.

The construction of the roof is intended to make use the units as temporary support struts during the process of assemblage. These temporary supports will be removed once the roof structure sits in balance. (see Illus: 197)

The roof itself is made from treated prefabricated IBR sheet metal, with translucent profiled polycarbonate sheeting in the deepest part of the section to allow for light.
8.3 THE ARCHITECTURAL MANIFESTATION - THE ROOF

Illus 200  The roof structure unit in its assembled form (Author, 2011)
8.4 ROOF SYSTEMS

The roof itself forms the spatial and systemic entity that unifies the cement retailer network under a single structural facility. Through water and energy collection the roof not only provides shelter, but access to services that will enable the cement retailers to enhance not only their business, but engage with the other retail networks in the context of Mamelodi.

WATER HARVESTING

The cement retail depot itself does not require a high yield of water use, but provide access to service to its sub agents of control and its own ablution facility. The combined water use in services with the total water storage amount of 3.8 million liters a year requires that 6 x 5000 liter tanks are required. (see Illus: 201)

SOLAR ENERGY COLLECTION

The roof in addition to water collection collects solar energy to supplement the energy consumption of the building. These Polar Voltaic Cells, are required to be at an inclination of 10 degrees plus the degree of latitude, placing them at the required 35 degrees of the horizontal.

<table>
<thead>
<tr>
<th>Month</th>
<th>Average Monthly Precipitation (mm)</th>
<th>Run off Coefficient</th>
<th>Run off</th>
<th>Rainfall-B</th>
<th>Roof Area (sqm)</th>
<th>Runoff=A (Rainfall-B) x Roof Area</th>
<th>Demand Per Month</th>
<th>VT=VT1 + (Runoff-Demand)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>136</td>
<td>0.9</td>
<td>1557.4</td>
<td>134000</td>
<td>400</td>
<td>329600</td>
<td>320000</td>
<td>VT=VT1 + (Runoff-Demand)</td>
</tr>
<tr>
<td>Feb</td>
<td>75</td>
<td>0.9</td>
<td>1557.4</td>
<td>73000</td>
<td>400</td>
<td>402200</td>
<td>6</td>
<td>5000 x 6 = 30000</td>
</tr>
<tr>
<td>Mar</td>
<td>82</td>
<td>0.9</td>
<td>1557.4</td>
<td>80000</td>
<td>400</td>
<td>481800</td>
<td>6</td>
<td>5000 x 6 = 30000</td>
</tr>
<tr>
<td>Apr</td>
<td>51</td>
<td>0.9</td>
<td>1557.4</td>
<td>49000</td>
<td>400</td>
<td>530400</td>
<td>6</td>
<td>5000 x 6 = 30000</td>
</tr>
<tr>
<td>May</td>
<td>13</td>
<td>0.9</td>
<td>1557.4</td>
<td>11000</td>
<td>400</td>
<td>541000</td>
<td>6</td>
<td>5000 x 6 = 30000</td>
</tr>
<tr>
<td>Jun</td>
<td>7</td>
<td>0.9</td>
<td>1557.4</td>
<td>5000</td>
<td>400</td>
<td>545600</td>
<td>6</td>
<td>5000 x 6 = 30000</td>
</tr>
<tr>
<td>Jul</td>
<td>3</td>
<td>0.9</td>
<td>1557.4</td>
<td>1000</td>
<td>400</td>
<td>546200</td>
<td>6</td>
<td>5000 x 6 = 30000</td>
</tr>
<tr>
<td>Aug</td>
<td>6</td>
<td>0.9</td>
<td>1557.4</td>
<td>4000</td>
<td>400</td>
<td>3600</td>
<td>6</td>
<td>5000 x 6 = 30000</td>
</tr>
<tr>
<td>Sep</td>
<td>22</td>
<td>0.9</td>
<td>1557.4</td>
<td>20000</td>
<td>400</td>
<td>23200</td>
<td>6</td>
<td>5000 x 6 = 30000</td>
</tr>
<tr>
<td>Oct</td>
<td>71</td>
<td>0.9</td>
<td>1557.4</td>
<td>69000</td>
<td>400</td>
<td>91800</td>
<td>6</td>
<td>5000 x 6 = 30000</td>
</tr>
<tr>
<td>Nov</td>
<td>98</td>
<td>0.9</td>
<td>1557.4</td>
<td>96000</td>
<td>400</td>
<td>118400</td>
<td>6</td>
<td>60000 x 6 = 360000</td>
</tr>
<tr>
<td>Dec</td>
<td>11</td>
<td>0.9</td>
<td>1557.4</td>
<td>9000</td>
<td>400</td>
<td>72000</td>
<td>6</td>
<td>45000 x 6 = 270000</td>
</tr>
</tbody>
</table>

323233.3333 Litres a year
6 Tanks @ 5000 Litres a tank

Summer Rainfall

<table>
<thead>
<tr>
<th>Gutter Size Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise: Rainfall (mm)</td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
8.4 Roof Systems

Diagrammatic depiction of roof and sub-systems of resource harvesting (Author, 2011)