7.1 Introduction

The aim of this section is to explain how the technology is used to reinforce the conceptual idea. In order to explain this relationship three questions are answered. The first is the answer to the question of a structural system and a technological system promoting the conceptual idea. The second is a question about materiality and the use of materials with some related to the context and some in contrast with existing materials. A third question explores possible responses to environmental systems in the form of natural systems, artificial systems, and hybrid systems.
A - Canopy: Solar energy converter (photosynthesis)
• Photovoltaic panels
• Water distribution
• Solar water heating
• Solar control
• Spatial configuration
• Rain cover

Sustainability component
electricity for night illumination
stormwater down pipes to storage facility.
(kitchens and ablution)
socially sustainable interior spaces
diffused light
shade away rain visibly

Performance:
increase distance between columns by 4m
Hidden within structural components
ambiguous relationship between inside and outside
plasticity of structure – organic in form

decrease in size to top
square indicative of circulation round - gathering
housed within columns

B - Branches
• Structural support for canopy
• Service runs downpipes etc.
• Spatial definition
• Organic nature while ordered

Performance:
increase distance between columns by 4m
Hidden within structural components
ambiguous relationship between inside and out
plasticity of structure – organic in form

C - Trunk
• Main structural element
• Spatial definition
• Vertical service runs

Performance:

D - Base
• Edge definition: Gathering edge vs. Movement edge

Connection of column to ground

E - Roots
• Foundations
• Horizontal service runs
• Water, electricity.

Rooting the structure to the earth
provision for service runs
7.2 Composition

7.2.1 Materiality

According to the conceptual programme the proposed intervention must generate spatial configurations that are very different from the ordinary everyday classroom. The intervention responds to a modern environment with solid load bearing buildings featuring very specific wall to window relationships. These buildings define inside and outside by only a door sill or opening in the wall.

The new social classroom contradicts and questions these issues by a light tectonic response.

Fig. 7.5-7.23: Existing materials used on campus.
creating an ambiguous inside-outside relationship. This will be achieved by the use of a light organic skin wrapped over a stereotomic edifice. This edifice grows out of a plinth and becomes lighter and more tectonic up to the point where skin meets structure. The lightness of construction give the building its industrial character and is exploited down to service delivery by exposing service runs and the use of off-shutter concrete.

Slabs were thickened to avoid the use of down-stand beams in order to allow service runs the freedom of the ceiling. In some instances materials from the surrounding are used in the construction in order to facilitate a character relationship.

When viewed in relation to existing buildings the proposed intervention will read very different but uses the surrounding buildings as backdrop for this newly prepared, characterized and programmed environment.
The structural system can be described as a system ranging from a highly stereotomic character up to a delicate tectonic disposition. Conceptually derived from the tree as analogy, the structure consists of a few different tree-like columns primarily there to make the building structurally sound but fulfilling a host of other important functions. On plan the columns are formally indicative of either movement (rectangular shape) or of a space dedicated for a programme that allows gathering at that point. Column sizes range from 500mm dia. (ground floor) to 400mm dia. (1st floor) down to 300mm dia. on the top floor.

The structural grid has been designed at 8m c/c in an east-west orientation due to the buildings filter function from north to south. The spacings over the north south axis has been established at an economical 5.5m allowing a floor slab, with integrated beams, of a nominal 425mm thickness. This arrangement allows the services to be attached to a flat ceiling and exploit the freedom thereof in order to compliment the industrial character of the proposed building. This slab thickness also accommodates a crucial cantilevering possibility of 2.5 to 3m.

The slab thickness stays the same for both hanging floors and roof slab and to adhere to the concept slabs will be tectonically adjusted to be visually thinner and lighter. The 1st floor slab is presented as much thicker by using an up-stand beam while this also connects the two buildings in character across the square.
Fig. 7.30

Laundromat

Rentable Office

Perdeby Newspaper Office

Monolithic coloured cement screed reinforced with 100x100mm steel mesh on 425mm reinforced concrete slab on concrete columns as to detail

Reinforced concrete footing

Offshutter concrete finish with exposed (surface mounted) service runs

Monolithic coloured cement screed reinforced with 100x100mm steel mesh on 425mm reinforced concrete slab on concrete columns as to detail

300mm dia. reinforced concrete column

400mm dia. reinforced concrete column

500mm dia. reinforced concrete column

Monolithic coloured cement screed reinforced with 100x100mm steel mesh on 425mm reinforced concrete slab on concrete columns as to detail (see tree detail 01)

400mm dia. reinforced concrete column

300mm dia. reinforced concrete column

Trees detail 01 (main building) 1:50

Fig. 7.30

Pages 59 & 60
400mm dia. reinforced concrete column
opening with safety glass
monolithic coloured cement screed reinforced with 100x100mm steel mesh on 425mm reinforced concrete slab on concrete columns as to detail

15mm thick galv mild steel sleeve casted into slab, sleeve resting on column shoulder

500mm dia. reinforced concrete column

10mm safety glass
allan key fixing
monolithic floor screed
neoprene gasket
purpose made 4mm thick frame rawbolted to slab
floor slab

Fig. 7.3 1

tree detail 01  1:20
(column-slab connection)
roof construction:
inverted kliplok 700 roof sheeting at 1.5 degrees fall on
100x50mm steel purlins @ 1200mm ccs on
127x64mm channels @ 2000mm ccs on 150x150x5mm
square tubing @ 4000mm ccs.

monolithic coloured cement screed
reinforced with 100x100mm steel
mesh on 425mm reinforced
cement slab on concrete columns
as to detail

derbigum waterproofing on
cement screed reinforced
with 100x100mm steel
mesh to fall towards
fullbores on 425mm reinforced
cement slab on concrete columns
as to detail

detachable waterproofing on
cement screed reinforced
with 100x100mm steel
mesh on 170mm reinforced
concrete slab on sandfill
as to detail

cashiers
monolithic coloured cement screed
reinforced with 100x100mm steel
mesh on 170mm reinforced
cement slab on sandfill
as to detail

rentable offices
monolithic coloured cement screed
reinforced with 100x100mm steel
mesh on 425mm reinforced
cement slab on concrete columns
as to detail

jool office
monolithic coloured cement screed
reinforced with 100x100mm steel
mesh on 425mm reinforced
cement slab on concrete columns
as to detail

access hatch to service area
service area

offshutter concrete finish
with exposed (surface mounted) service runs

Fig. 7.32
100x75mm jakarta handrail

50x50x3mm steel square tubing welded to 10mm uprights

double sandwiched 10mm thick uprights chemical anchored to concrete slab

140x140x10mm baseplate welded to 80x80x4mm square tubing branch.

140x140x10mm baseplate welded to 80x80x4mm square tubing, bolted to branch baseplate

10mm steel baseplate casted into concrete slab on spacers

170x85mm ipe bolted to baseplate

150x38mm aluminium sections bolted to flanges welded to 150x150x5mm rafters

200x100mm cannel section bolted to 170x85mm ipe

kliplok 700 (white) @ minimum fall on 170x85mm ipe @ 1500mm ccs

170x85mm ipe bolted to baseplate

tree detail 02  1:20
(canopy & balustrade)

Fig. 7.33 Fig. 7.34

Fig. 7.33: (above right) Branch/canopy detail
Fig. 7.34: (above right) Branch/canopy detail
Fig. 7.35: (right) Branch/trunk detail
tree detail 03 (eating area) 1:60

- 10mm safety glass bolted to angles
- light fitting in galv. mild steel housing
- 50x50mm shadow line to fix waterproofing
- 500mm dia. reinforced concrete column

Ceiling board cut-out around steel tubing 500mm dia. with translucent roofsheeting over.

- 200x100mm channel supported by 100mm dia. 4mm thick tubing @ 4000mm intervals.
- Day time lighting
- Indirect night time lighting

Fig. 7.32
150x150x5mm square tubing upright branches, with cut out to facilitate bolt fixing to purpose made bracket.

150x150x5mm square tubing horizontal branches, with cut out to facilitate bolt fixing to flanges welded to upright branches.

Expanded metal mesh bolted to 25x25mm angles welded to 150x150x5mm square tubing.

Fig. 7.37: (above left) Branch/ceiling detail
Fig. 7.38: (middle left) Branch/trunk detail
Fig. 7.39: (left) Trunk/floor detail
Fig. 7.40: (above right) Branch/trunk detail
Fig. 7.41: (above middle) Branch/trunk detail
Fig. 7.42: (above right) Branch/trunk detail
Fig. 7.43: (right) Expanded mesh detail

Fig. 7.37
Fig. 7.38
Fig. 7.39
Fig. 7.40
Fig. 7.41
Fig. 7.42
Fig. 7.43
Fig. 7.44: (above) Structural model
Fig. 7.45: (below) Column/floor detail
Fig. 7.46-7.50: (right) Details

Hand drawn concept details
7.3 Environmental systems

7.3.1 Natural systems

Sun Study and Shading Devices

7.3.1.1 The east-west orientation of the building provides the ideal opportunity to make use of passive solar control. The sunscreen on the northern side is clad with a Mentis product (see: tree detail 04) that has angled blade sections. This expanded metal mesh is treated with a mat textured epoxy coat to avoid any glare during summertime. The device eliminates direct summer sun, only allowing reflected light to enter the building while winter sun is allowed entry. The south facing side enjoys south light ideal for office practice and usually glare free. The east and western facades of the building is limited to minimal surface areas and openings are treated with vertical louvers (east & west).
88.06 degrees: summer solar angle

41.06 degrees: winter solar angle

south light: glare free

area provided for aircon units, split system

area provided for photovoltaic panels and solar water heating

Fig. 7.51
The following twelve images forms part of an annual sun study. This study was undertaken in order to make decisions as to the optimization of microclimate with focus on the external space between the buildings. The square has been designed to provide choice as to sunny spaces and shaded spaces. A 200x200mm by 50mm thick cobble paving will provide heat during night time by means of radiation. The study was undertaken at the 21st of each month @12:00pm.
7.3.1.2 Rainwater harvesting and storage

stormwater lay-out plan (scale 1:550)
Due to this natural supply of fresh water, the proposed building is adapted to make use of stored rainwater and use most surfaces to collect stormwater. The hard surfaces (i.e. the student square) are serviced by stormwater catch pits while all other surfaces are permeable to allow for ground penetration.

Stormwater is collected in a holding tank below ground level on the western side of the building. When this 35,64 cubic metre tank reaches two thirds of its capacity a fully submersible pump (driven by solar energy) pumps the water into a storage tank situated directly above. This tank forms a tower that provides the necessary head pressure and doubles up as a landmark and orientation beacon.

After passing through a filter system the stormwater will service all water closets and refuse rooms while being used in an evaporative cooling system (fine spray over entertainment areas) during peak summer times. Surplus water will be used to water the greenery around the intervention while during heavy showers an overflow is provided to the municipal stormwater system to prevent flooding. The storage tank is connected to municipal water supply in order to discharge daily demands.

**Rainwater calculations**

- **Roof areas**
  - Main building: 1363 sqm
  - Fast food building: 800 sqm
  - Eating area: 542 sqm
  - Total catchment area: 2705 sqm

- **Tank sizes**
  - Holding tank: 35,640 l
  - Storage tank: 108,500 l
  - Total storage potential: 144,140 l

Capacity design population +/- 3000 persons/day

Wc usage: 2650x8 l = 21,200 l x 20(weekdays) = 424,000 l

Precipitation:

Max monthly (January): 136 mm = 0.136 x 2705 = 367880 l x 0.85 (15% evaporation) = 312,698 l

Min monthly (July): 3 mm = 0.003 x 2705 = 8115 l x 0.85 (15% evaporation) = 6897 l

Thus @ maximum rainfall there is a shortfall of 111,302 l

@ minimum rainfall there is a shortfall of 417,103 l

**Rainwater storage**

---

**Table: Temperature and Precipitation**

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<th>Highest Recorded</th>
<th>Average Daily Maximum</th>
<th>Average Daily Minimum</th>
<th>Lowest Recorded</th>
<th>Average Monthly (mm)</th>
<th>Average Number of days with &gt;= 1 mm</th>
<th>Highest 24 Hour Rainfall (mm)</th>
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Fig. 7.65 Thirty year ave. as per South African Weather Service.
7.3.2 Artificial systems

7.3.2.1 Refuse

Due to the absence of a basement level, shops are provided with small temporary refuse rooms cleaned every morning before business commences. These refuse are gathered and kept in the main refuse area where it is removed twice weekly. Refuse rooms are all supplied with floor traps and taps while the doors are rodent proof.
main pick up point: old duxbury road

refuse pick up route

Fig. 7.68 Refuse strategy plan 1:550
7.3.2.2 Fire protection:

The following will form part of section 3 in compliance with SANS 0400 Part T:

The proposed building is non-smoking and no smoking will be permitted even on balcony areas. Safety distances to other buildings: Western side: 15 400mm Eastern side: 16 300mm Structural members to have a fire rating of 120 minutes with all structural steel treated with min. 38mm Pearlite spray on plaster to comply with Part TT7.

Emergency route lighting to be 0.3 to 0.5 lux.

The building is provided with an alarm system that can be manually operated and automatic smoke detector alarms.
fire hydrants
portable extinguishers
escape routes
hose reels

Fig. 7.70: Fire plan (1st floor 1:550)
7.3.2.3 Drainage
Fig. 7.72: drainage lay-out
Fig. 7.73: drainage lay-out (1st floor 1:550)
Fig. 7.74: drainage lay-out (Upper floor 1:550)
The term "hybrid systems" refer to systems that make use of natural conditions to supply artificial systems. Systems like photovoltaic panels and solar water heating are discussed.
The chosen photovoltaic system is a “Dual Axis Photovoltaic-Grid Intertie”. This system makes use of an array of panels 1000x2200mm (capable of converting 170W) that is manually set to one of two settings. The first is flat on the roof of the main building (@3 degrees) as a summer setting and at 48.94% normal to the rays of the winter sun.

The panels are mounted on the roof structure of the main building between every second bay to allow sun to heat up the roof slab underneath to provide the top floor of the building with passive heating. This arrangement allows for about 100 panels. Where 18 panels is sufficient to supply a medium-sized house, 100 panels are equivalent to about 5.5 medium-sized houses (Ryker, 2007:55).

The use of a battery bank was considered but due to its limited lifespan and high maintenance costs it was decided to use the municipal grid as a storage device. This means that the energy converted by the panels will always be placed back into the grid and energy used will only be provided by the grid (Ryker, 2007:55).

The energy generated will mainly be applied to drive the pumps filling the storm water tanks and night lighting, which is very important considering a socially sustainable intervention.
Fig. 7.77: Roofplan (position of Solar Panels) 1:550

Fig. 7.78: Night lighting: Student Square

Fig. 7.79: Night lighting: Northern side.
This energy conversion method is the most cost effective and successful up to date. (Ryker, 2007:71)

It is proposed to use a Direct Active System where water is pumped using a solar powered pump. Due to heat loss it is also proposed that the system span the length of the main building roof (northern side) in order to establish different tapping points close to the areas where it is needed. The system is therefore treated as a storage system in itself although hot water heaters can be installed in line as the demand grows.

The roofs over the spectator area to the south will also be used to provide hot water to the kitchens below.

Fig. 7.80: Direct active system
7.4 Technical Precedent
This example portrays the technological mimicking of a tree and its branched in an abstract way. Attention was also given to the detailing of the connections between branch and trunk.

In this project the designers explored skin as a separate membrane with many different functions. The perforations investigate shading patterns while the skin hide randomly placed openings behind it. Openings are cut into the skin allowing views and direct sunlight. The project is a frontrunner of skinned buildings in the South African context, build with profound budget constraints.
Nashua Kopano Head Office, Woodmead North Office Park, Johannesburg By: Paragon Architects.

This precedent was chosen only for its intricate detailing. Column details were considered.

Proud Heritage Clothing Campus, Durban By SoundSpaceDesign Architects

These two projects questioned the paradigm of an assembled architecture and came up with two buildings taking the industrial character to new heights. The use of materials forms and the play between solid and light were studied.

Fig. 791

Fig. 790

Fig. 792