The walkways are threefold demonstrations of this permeable and legible precept:

**University facade, public facade 1 & 2**

**University facade:**
Cladded by polycarbonate sheet, mirrors the small dwelling sheeted shack context in colour with natural ventilation up flow draughts. Becoming a skin for green architecture and symbol for context.

**Public facade:**
1. Open corridors, light weight steel structure with laser cut steel balustrades designed by artists in the community colored to mark the legibility of each floor.
2. Deep corridors for large load of people, open air walkway with roof coverage, cutaway slab to allow vegetation to infiltrate the space, adding new life to finished products and material. A building wrapping the space creating a public civic square, that becomes legible and accessible, while simultaneously morphing in roof form creating a unity of simple tectonics. As Norberg Shultz explains:

> “A meaningful relationship between horizontals and verticals also depends on the form of the roof.”

Hence there no intention to dehumanize the change in vertical space and horizontal space, but rather to find an eloquent relationship between proportion and mass on open space with green felt, figure 121.

The three levels of floors are planes supported on columns divided in function. They are seen as layers, horizontally starting at basic need, finishing in furthering yourself in education and uplifting your community across the site, so it runs vertically starting at basic civic requirements for most access, to less access but more specific needs at the top.

In the words of Mies van Der Rohe *“We call a shack a shack and not a structure....”*

We find the image of structure and totality of building as equally required and appropriate in symbolism of theory as this dissertations community engagement facilitatory vision. Honest in form and honest in material. To reflect honestly that which is inside to those that intend to use it. Steel, concrete, Brickwork and corrugated sheeting.

**Public facade:**
1. Open corridors, light weight steel structure with laser cut steel balustrades designed by artists in the community colored to mark the legibility of each floor,
2. Deep corridors for large load of people, open air walkway with roof coverage, cutaway slab to allow vegetation to infiltrate the space, adding new live to finished products and material.

Note: All structural calculations for beams, columns: steel, concrete and timber on technical drawings.
Concrete beam & columns

Steel beam & columns

Concrete slab & walkway

Figure 112
3d image of total structural system of proposed CEF facility

Figure 112 a - c
Structural elements

Concrete
Walkways & stairs
Steel
Ventilation systems
Service areas

Total structural model
Figure 113a
3d2 image of structural system of proposed CEF facility

Concrete
Walkways & stairs
Steel
Ventilation systems
Service areas

South elevational structural image
Concrete Walkways & stairs Steel Ventilation systems Service areas

South elevational campus perspective Structural image Bent H-BEAMS-polycarbonate sheeting over

Public square, concrete base, Steel columns
Prominent visibility of walkways Structure close up Structure in campus context
7.2.1.

**SYSTEMS AND SERVICES: A SUSTAINABLE APPROACH**

**SYSTEMS:**

**PASSIVE VENTILATION:**

Flank A+B; figures. 114

The building is not holistically attempting to claim a green building status, however it was with intent that the use of a passive ventilation system was designed. For purposes of dissertation Flank B and subsequently Flank A is similarly in design was used for calculation purposes.

These flanks are mechanically assisted to passively ventilate the buildings.

The usable space are centralised with corridors at the edge, allowing for reduced heat gain, but resulting in reduced ventilation by natural means.

A series of development has taken place of which the final product as seen in Section Z-Z chapter has been the answer.

The placement of two shafts running 1st floor to roof top slab, 4sqm each with a cat-lader fixed internally and turbo extractor fan overhead, extracting all air in building 8x per day. More than the regulation requirement of converted 5x per day. This does not cool the air as in air-conditioning but recycles the air, replacing warm latent air with fresh; hence cooler air. (See calculation on dwg.)

The system is powered by voltaic cells placed over curved roof edge, allowing enough energy collection to run the extractors as well the smaller jet motors for the louver systems.

The extractor and louvres motors start & stop simultaneously 8 times per day and or when the thermometer drops and or reaches a certain temperature.

The allocated space for the shafts are sized for future changed ability with sufficient space on roof top for future plant requirements.

The excess voltaic energy is used for lighting in public ablution and corridor lighting during night time, in the attempt to reduce the electrical bill. Even if only by a fraction.

Flank C; figures. 115

Flank C face majority western sun hence heating up immensely, while the opposite public corridors face east collecting Eastern morning sun. The proposal to deal with this predicament is to recess the corridors and use vegetation to cool the space. Simultaneously using the thermal flywheel, or heat stack system on the western side. This will allow the air to be drawn across the offices from east to west in the afternoons when the offices should theoretically heat-up.

The chimneys, are cladded with corrugated sheeting to add to the heating effect, with a small top vent opening. They serve as service shaft for cable trays and

**7.2.2.**

**PHOTO VOLTAIC: AS NOTED AND MENTIONED**

**2X KEY SECURITY SYSTEM PER ORGANISATION OR COMPANY**

**SERVICE:**

The in-house servicing is run from Flank C, ground floor being delivery yard and first floor being administration and communication.

The facility is run by a private management and maintenance company. Service lift connecting to all floors.

Major tenants have fixed storage bays on lvl 1.

All ablution facilities are connected by service shafts, leading to access doors, all at external sides of building. Flank A at Northern edge. Flank C at western edge in vent shaft.

Existing service yards for lecture halls are removed and repositioned as noted on dwg’s. New yard caters for existing and increased size air conditioning units for lecture halls, new power supply to building, back-up generator as well as transistors are required.

Connecting to existing sewer mains, by means of six new manholes. Existing fire points to be reused and additional added as per regulation. See technical drawings chapter 8.

Storm water off site drained to existing storm water channel. Water tanks act as holding tanks with overflows into storm water channel.

Roof access by cat-ladder fixed to vent shaft at flank C. Flank A to be accessed from rooftop at conference centre.
FLANK A&B
Passive ventilation process sketch design and detailing

Ventilation design & morphology scale, public
Architecture - large civic building
CALCULATIONS

PASSIVE VENTILATION CALCULATIONS _ Flank A; B SECTION Z-Z

Note: proposal to make use of extractor fans to replace the air in the building 8 times per day (working hours), every hour, in doing so removing all warm air and replacing with fresh air, working on green building principles. Outcome results in the omission of an air-conditioning system, and the extractor system function on free energy basis, running of the solar voltaics as noted in photo voltaic calculations.

The louvers and extractor are linked and the motors start simultaneously opening and closing 8 times per day, with a thermostat connected to the MiBus, if the air temperature does pass over a set temperature the system starts up, if the temperature drop below a set temperature the system does not start up. The system works only during daylight hours as it is powered by voltaics, but can be used at night on stored battery power, consideration was taken that none or very few employees will be at of fice after dark.

The two required shafts are over-specified by 2m² each, to allow for future users to change the system to air-conditioning, as all users do not find comfort in a energy efficient and co² free environments.

**CALCULATION:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Calculation</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total building flank b air intake openings as seen in section z-z</td>
<td>2700mm x 380mm = 1.026m² x 8 openings = 8.208m³ for 3 l/hs/rooms excluding ground floor = 8.208m³ x 3</td>
<td>24.624m³</td>
</tr>
<tr>
<td>Total building flank b extract openings as seen in section z-z</td>
<td>1560mm x 380mm = 0.5926m² x 3 openings x 2 shafts</td>
<td>3.56m² per floor</td>
</tr>
<tr>
<td>Total air volume required to transfer in flank b as seen in section z-z</td>
<td>24680mm x 10200mm = 251.736m³ - 8m³ for shaft space</td>
<td>243.736m³ x 3200mm height = 779.95m³ per floor</td>
</tr>
<tr>
<td>In order to specify the correct extractor one needs to calculate the speed required to transfer the air. In the calculation of air volume, one needs to check that no draft or internal wind is created inside the room.</td>
<td></td>
<td>32.6m²</td>
</tr>
</tbody>
</table>

Thus:

Fan required for volume replacement in flank b as seen in section z-z = 2339.86m³ / 8 (time per day replaced) = 18718.88m³ total volume of air to be changed thereby = 779.95m³/h of air every hour:

26.72kw x 7hrs = 187.04kw/h maximum 26.72kw x 9.91hrs = 264.8kw/h

Thus in both cases one has 171.88kw/h per day left for store for public facilities and corridor lighting.

Photo voltaic energy harvest quantity:

Note photo voltaics are only mounted on flank a & b. **SEE CALCULATION IN CHAPTER 5**

**ELECTRICAL REQUIREMENT FOR EXTRACTOR FANS AND LOUVRE SYSTEM Flank A; B SECTION Z-Z**

Extractor turbo fan : 0.62kw x2 fan units x 12 hours = 14.88 kWhr per day

Fan Louvre jet: 0.1kw per motor, single motor = 3 louvers thus 42 louvers in take and exhaust vents / 3 = 14 motors

14 x 0.1kw = 1.4kw

14 motors @ 100w each @ 1min/h = 1400w

1400w / 60sec = 0.02kw/sec x 12 hours = 0.28kWhr per day

0.28 + 14.88 = 15.16kWhr per day

As noted previously the voltaic has capacity at minimum & maximum to generate minimum 26.72kw x 7hrs = 187.04kw/h maximum 26.72kw x 9.91hrs = 264.8kw/h

Thus both cases one has 171.88kw/h per day left for store for public facilities and corridor lighting 249.64kWhr per day left for store for public facilities and corridor lighting.

**Resultant air movement in room in flank b as seen in section z-z**

779.95m³ x 3 rooms = 2339.86m³ total volume per day

2339.86m³ / 12hours = 194.98m³/h max air movement area: 10200mm x 3200mm height = 32.6m² thus 194.98m³/h / 32.6m² =5.98m³/h, but to replace 8 times every 12 hours.

5.98m³/h / 8 x 12 = 9m²/h 9m² /3600sec = 0.003m³/sec air movement inside room for replacement of air 8 times per day

Note: one feels air only at 5m/s, thus no wind draft will be experienced, but total air replacement will occur 8 times per day, making it fully passive ventilated rooms

779.95m³/h / 3 floors = 253.32m³/h per floor

253.32m³/h / 32.6m² per floor = 7.77m/h

5.98m³/h / 8 x 12 = 9m²/h thus 9m² /3600sec = 0.003m³/sec air movement inside room for replacement of air 8 times per day
FLANK C
Passive ventilation process sketch design and detailing
5.3.7 SITE CALCULATIONS  
(SEE FIGURE 40 FOR AREA REFERENCE)  
CALCULATIONS AS NOTED ON DWG: SITE, SERVICES & STRUCTURE PLAN

5.3.7.1 PHOTO VOLTAIC ENERGY HARVEST QUANTITY: figure 42, indicated area in red.

NOTE PHOTO VOLTAICS ARE ONLY MOUNTED ON FLANK A & B.  
TOTAL VOLTAIC AREA FLANK A: 87.38m²  
TOTAL VOLTAIC AREA FLANK B: 87.38m²  
AS PER AMERICAN STANDARDS, 75% IS REQUIRED FOR 1kW of energy, thus 75% x 0.093m² = 6.54m² is required for 1kW of energy.

5.3.7.2 WATER CATCHMENT ROOF:  
FLANK B+C ROOF AREA: 1949.1m²  
FLANK A ROOF AREA: 530m²  
PARKING ROOF AREA: 259.1m²  
ALTERATION ROOF AREA: 144m²  
TOTAL AREA: 5214m²

MAX RAINFALL PAST 17 YEARS: 1546.3mm / 365 = 4.24mm per day average
MAX MONTHLY RAINFALL PAST 17 YEARS: 281.1mm / 365 = 0.79mm per day average

5.3.7.3 GUTTER SIZE REQUIREMENT:  
TOTAL ROOF AREA: 5214m²

5.3.7.4 DOWN PIPE SIZE REQUIREMENT:  
TOTAL ROOF AREA: 5214m²

100mm² / 1m², regulation standard  
5214m² x 100mm² = 5214000mm²  
5214000mm² / 15 proposed down pipes = 34760mm² per down pipe  
4/3 x 34760mm² = 185.44mm²: for 15 down pipes required, as per design intent the gutter water tank detail is to be expressed and thus size is correct for both architectural

5.3.7.5 WATER TANK SIZE REQUIREMENT:  
NOTE: Proposal for water harvest at current for irrigation purposes only any and all overflow and excess to be discharged into water-pipe under square into storm water channel, excess water at parking garage to be discharged into public park and retained and discharged by method of berms and large vegetation growth.

Water tanks detail  
2 x 4 stack (3&4.8m per stack) = 3325mm∅  
1 x 3 stack (3&4.8m per stack) = 1126mm∅  
7 x 3 stack (3&4.6m per stack) = 200mm∅

MAX RAINFALL PAST 17 YEARS: 1546.3mm / 365 = 4.24mm per day average
MAX MONTHLY RAINFALL PAST 17 YEARS: 281.1mm / 365 = 0.79mm per day average

291580.0 + 67586.4 = 117040.0L

GUTTER AREA REQUIRED = 0.109 saving per day

Note, energy harvest used primarily for passive ventilation system, connected to a temperature gauge. See passive ventilation, electrical motor and air replacement calculation. Differences of energy stored in power packs at rooftop, to be used for low voltage incandescent lighting in public toilets and along public corridors at night time

5.3.7.6 TOTAL SITE WATER CATCHMENT INTO STORMWATER CHANNEL & BERMS:  
SITE AREA EXCLUDING BUILDINGS : 8272m²  
ALTERATION ROOF AREA: 144m²  
TOTAL AREA: 8416m²

MAX MONTH.  
9.07mm / 1000 = 0.009

5214m² x 0.01m = 52.14m³, per day at max rainfall
52.14m³ / 31 = 1616.34m³ per month at max rainfall
1000l = 1m³, thus 1616.34m³ = 1616340L per month of max rainfall

ANNUAL MAX AVERAGE –
4.244m³ / 1000 = 0.004

5214m² x 0.004m = 20.86m³, per day at max yearly average
20.86m³ / 365 = 7612.44L per year at max yearly average
1000l = 1m³, thus 7612.44L = 7612440L per year at yearly max average

5.3.7.7 WATER CONSUMPTION:

TOTAL WATER STORE AVAILABLE:
1 x 1000l = 1m³

GUTTER AREA REQUIRED = (345429mm², reason for over size, for architectural aesthetic and steep roof pitch angle 25°, thus increased flow rate.

Note: existing storm water channel has been designed to handle all public stormwater of sites and road surface as per zoning regulations noted on this drawing at the relevant site zoning information for this site: ERF 29552 Mamelodi ext 5 storm water channel to be modified, RENO MATT to be installed, as per manufacturer: MACAFERRI specification.
5.3.7

Figure 42
New proposed Community Engagement facilitator (CEF) roof plan

Historic and contextual analysis Mamelodi

FLANK A
FLANK B
FLANK C
Figure 116
3D images of ventilation shafts & stack vents in CEF building.

Concrete
Walkways & stairs
Steel
Ventilation systems
Service areas

Passive vent system. Heat stack system, cross ventilation
Passive vent system. Over Computer LANS
Passive vent system. Two shafts
Passive vent system, central shaft
Figure 117: 3D image of light shafts in CEF building.

Figure 118 a & b: 3D image of service points in CEF building.

- Concrete
- Walkways & stairs
- Steel
- Ventilation systems
- Service areas
- Light shafts

Light shaft, slab openings for trees

Slab opening between stairs and building

Concrete Walkways & stairs Steel Ventilation systems Service areas Light shafts

Passive vent system, Over Computer LANS Ablutions, flank B & C Grd - 3rd Water harvest towers

In-house washrooms Public ablutions private

Ablutions, flank A Level Grd & 2nd

Service delivery Yard External staircase 2 Public & service lift Water harvest towers

External staircase 1

External Staircase 2
TECTORNIC APPROACH

“The distinctive quality of any man made place is enclosure, and its character and spatial properties are determined by how it is enclosed.”

SEE FIGURES: 121 - 123 for tectonic clarification

Central core structure
Concrete columns, with brick infill

External structure
Lightweight steel structure with balustrading and polycarbonate sheet skin

Central floor structure:
Two way span concrete slab system on concrete beams, effectively forming a ring beam with the steel I-BEAM. The span of 10550mm for a floor slab has been reduced to 5300mm by using the beams. This also allowed for the entire structure to form a single module and thus reduce any possible deflection. If one looks at the costing analysis done for the most effective slab, column and beam as seen on Section Z-Z dwg this outweighs any other tested system.

Outer floor structure: ( walkways )
Steel frame with mentis grid and timber floor boards allowing ventilation vertically along building, to work in conjunction with the polycarbonate skin on the Univeristy facade of flank B.

“A meaningfull relationship between horizontals and verticals also depends on the form of the roof.”

The roof typology is intended to be an extended skin over building. Becoming a morphology of scale and shape, terminating at public square into light weight Permeable wall structure.

Top roof Flank A + B; figure 121
Curved edge to match curved roof topology of existing building on campus
Contrast on topology by using lightweight polycarbonate sheeting as appose to heavy weight steel sheeting.
Roof typology changes as it moves towards the eastern side on the public facade, opening up and covering the square. Matching single lean-to roof typology of surrounding shack and informal housing. Use of corrugated sheeting Br 7 to match the use of steel plates and sheeting for shack dwellings.
Roof and structure, laid into modules enforcing the principle idea of layers, with vertical steel members breaking the massing, dividing the unit into smaller units. This gives a more human scale appearance to the built form. The detail on Section Z-Z expresses this principle with the sheeting laid between steel member and flashed under and over.

Top roof Flank C; figure 121
A morphology of roof A & B, transforming into light shaft roof pitches: facing north north west. Allowing light to enter meeting rooms and public corridors through the cut back concrete slab openings. This allows light on Flank C during morning and afternoon, avoiding cold shadow spaces. Simultaneously dividing the public space and the private space but connecting the sense of place of the two domains. As noted by Shultz.

“Evidently this meeting is expressed in the wall and in particularly in the openings which connect the two domains.”

Rooftop function venue with flat slab, roof light openings fitted over computer flat slab to allow natural light to enter the double volume space and lan without ambient light affect functionality of room

Top roof Flank C front.
Roof line completed with curved skin of polycarbonate over sealed windows, as room houses computer LAN.

Note: All structural calculations for beams, columns: steel, concrete and timber on technical drawings.
Figure 120a
Tectonic dialogue a story board, precedent images of site and immediate context - small scale structures.

Figure 120b
Tectonic dialogue a story board, precedent images of site and immediate context - large scale structures.
Figure 121a, b
Tectonic design development
Figure 121c,d
Tectonic design development
Step-down human scale

Roof skylight, angle & pitch to match main roof

Curved structure, contexts response o campus typology

Public square, wrapped by built form

Module grid structure
In context with shack and formal housing

Remodel off existing lecture halls

Public way/transition space.
West elevation, building mass and typology in context with campus

North East elevation, building mass and typology, opening up to public square

Major mass at centre, stepping down in scale to outer flanks. A & C terminating at roadway.

South elevation, building mass and typology

7.4 Embodied Energy

Note, embodied energy values are based on international standards, South African value will vary depending on material produced locally, thus a 5 - 10% reduction and addition can be expected. These figure are based on new material, preferred use of recycled material, will greatly reduce energy value.

<table>
<thead>
<tr>
<th>Material type</th>
<th>Intended use</th>
<th>Embodied energy</th>
<th>U-VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick</td>
<td>New and recycled</td>
<td>2.5 MJ/kg</td>
<td>0.35 - 0.96 W/m K</td>
</tr>
<tr>
<td></td>
<td>Structure in-fill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrugated steel sheeting Br 7</td>
<td>Main structure</td>
<td>8.9 - 32 MJ/kg</td>
<td>60+ W/m K</td>
</tr>
<tr>
<td></td>
<td>Public architecture</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Taxi waiting stalls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild steel flats</td>
<td>Mentis grid</td>
<td>8.9 - 32 MJ/kg</td>
<td>60 W/m K</td>
</tr>
<tr>
<td></td>
<td>Solar shade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete</td>
<td>Site furniture</td>
<td>1.3 - 2.0 MJ/kg</td>
<td>0.18 - 2.1 W/m K</td>
</tr>
<tr>
<td></td>
<td>Public seating in building</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Portal frame structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plinths and column bases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel H- &amp; I- Beams</td>
<td>Structure</td>
<td>8.9 - 32 MJ/kg</td>
<td>60 W/m K</td>
</tr>
<tr>
<td></td>
<td>Balustrade lazer cutting Artist design</td>
<td>227 MJ/kg</td>
<td>200 W/m K</td>
</tr>
<tr>
<td>Aluminium sheets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polycarbonate sheeting</td>
<td>Skin facade</td>
<td>30.3 - 70 MJ/kg</td>
<td>0.17 W/m K</td>
</tr>
<tr>
<td></td>
<td>Part roofing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>Windows</td>
<td>15.9 MJ/kg</td>
<td>0.8 W/m K</td>
</tr>
<tr>
<td>Per-specs plastic sheeting</td>
<td>Windows</td>
<td>30.3 - 70 MJ/kg</td>
<td>0.17 W/m K</td>
</tr>
<tr>
<td></td>
<td>Selected openings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timber hardwood &amp; soft wood floor planks</td>
<td>Walkways</td>
<td>2.5 MJ/kg</td>
<td>0.13 - 0.20 W/m K</td>
</tr>
</tbody>
</table>

Material intent:

To make use of low budget material, either recycled or new. Intended to be constructed by local artisans, skilled and or unskilled. Promote the idea of work and job creation. It was also intended to make use of material that has an effective heat transfer value, so to allow for least heat gain in summer and similar in winter heat loss, working effectively with the proposed passive ventilation system. As noted the intended use of material must submit to a low embodied energy count. Aimed at being as far as possible carbon friendly, and using recycled material. The use of recycle material does play in favor of this development with relation to context. Effort and research has been done with regards to precedents on materiality as noted under chapter 6, 6.1.

Nelson Mandela Interpretation centre
Phillipi transport interchange

The use of specific materials are not limited to structure and aesthetics, but are also intended to serve as signage and legibility. The material intend to be guidance to the blind using textures, colour to the illiterate that cannot read. Textured images to the colour blind who can not depict colour. Hence the language of the building also serves as signage and guidance of the facility. Examples, figure: 25a

Final material use for signage type, layout and purpose as per signage diagram
Figure: 25b
Figure 124
Materiality:
- Poly-carbonate sheets
- Brick work
- Recycled metal sheets
- Roof corrugated sheet
- Concrete panels

Figure 125a
Materiality: Textures, floor and walls

Figure 125b
Materiality: Early brick detailing at office corridors.

Creating concrete modules, brick layers and colour signage per floor and function
7.5 Technical Design Process Detail Sketches

Figure 126a Technical design process sketches
Figure 126b
Technical design process sketches

Figure 126c
Technical design process sketches
Figure 126d
Technical design process sketches
7.5.2

Figure 1.27a
Technical design, structure modification process

DESIGN STRUCTURE MODIFICATION PROCESS 1

Structure supports phase 1

Figure 1.27b
Technical design, structure modification Phase 2

DESIGN STRUCTURE MODIFICATION PROCESS 2

Structure concrete
Structure steel

Figure 1.27c
Technical design, structure modification process, phase 3

DESIGN STRUCTURE MODIFICATION PROCESS

Structure concrete
Structure steel

Figure 1.27d
Technical design, structure modification process. Final phase

DESIGN STRUCTURE MODIFICATION PROCESS 4

Structure concrete
Structure steel
7.6 EXISTING STRUCTURES IMAGES AND SKETCHES

Figure 128
Site technical sketches:
- Elevations
- Detail section

Figure 129a
Structure Lecture halls: roof steel frame

Figure 129b
Structure Lecture halls: internal
Figure 130
Existing structure site plan