Introduction

Tectonic decisions are influenced by the parti diagram through response to architecture as communication activator, extension of public space and gateway formation. Entopia is created through response to context, thereby influencing material selection, roof design, hierarchy of space and selection of passive systems.
Free Standing Posilock Tate Access Floor System supplied by Pelican MIS Systems with a carpet tile finish to the 600x600 Type 3 steel clad cementitious core panels supported by and including all necessary understructure components as per the manufacturer's specification for a 170 floor height.

6 ARMOURPLATE low E safety glass to be installed from 1000 above FFL to underside of soffit all edges to be polished to reduce thermal breaks reinforced masonry lintel in rowlock bond.

170 concrete ramp @ fall 1:6

ENT PARKING SERVICES/WATER STORAGE TAKE AWAY/RESTAURANT COMMUNICATION/COPY CENTRE

ABET READING ROOM ABET OFFICE SETA OFFICE SETA SKILLS LAB WAITING/SPILLOUT SPACE DISCUSSION SPACE DISCUSSION SPACE

INTERNET RESEARCH FACILITIES SOCIAL SPACE PUBLIC SQUARE

50 MVA BRICK grey twin cobble paving double layer 4 polymer modified bitumen membrane to be torched and overlap minimum of 100 according to SANS 10021

330x440 reinforced in-situ concrete column

254x254x73 parallel flanged steel H beam on 10 steel flat plate with predrilled holes fixed to 440x440 concrete column with M12 U-bolt

260x90x28 steel parallel flanged channel fixed to concrete slab with M16 U-bolt

500 concrete upstand beam 6 translucent ARMOURPLATE low E safety glass to be installed from top of slab to 1000 above FFL all edges to be polished to reduce thermal breaks.

85 pre cast concrete beams to be built masonry wall @ 300 from top of slab

1.6 purpose made steel solar screen factory welded to 50x50x8 steel frame fixed to gusset plate with M4 bolts

200 Ø twist outlet floor diffuser
The role of architecture as communication activator is expressed in the building envelope. The building envelope responds to function and hierarchy of space and allows the nature of the program to be legible from the outside of the building.

Programs with public functions opening onto the square directly or visually makes use of glass curtain walls, thereby creating continuous visual activity to internal spaces. Programs where higher levels of privacy is required such as overnight facilities, classrooms and discussion spaces within the offices are constructed from a masonry envelope thereby solidifying the facade and achieving higher levels of privacy.

The expression of hierarchy on facade and establishing visual connection to activity within the building contributes to pedestrian legibility and understanding of the design as well as counteracts the experience of abandoned public space that reigns in numerous public squares within Pretoria CBD.

Extension of public space and the urban floor are expressed tectonically at thresholds to the square and internal spaces.

At thresholds to the square, extension of public space is articulated through material choice which continues the palette used in Station Square and the cantilevered slab of the new public square floor plate. This blurs the boundary firstly between the site and Station Square, and secondly the threshold between the sidewalk and newly created public space. The threshold to internal spaces is also blurred through the use of shadow lines at entrances. Shadow lines are created by extending the floor slab 100mm over the square with the slab thinning to 85mm to accommodate the shadow line underneath.

Gateway formation is translated tectonically through the resolution of the screen which responds to context, shades the site from western sun and announces entrance onto site and into the city.
6 ARMOURPLATE low E safety glass to be installed from 1000 above FFL to underside of soffit.

220 stretcher bond masonry wall all joints to be racked and refilled with plaster cement to achieve flush pointed joints.

6 ARMOURPLATE low E safety glass to be installed from top of slab to 1000 above FFL.

255 pre stressed in situ cast concrete slab.

50 MVA BRICK grey twin cobble paving.

50 COROBRIK burgundy clay paver 40x40x3 stainless steel corner protector supplied by Milga Manufacturing.

255 pre stressed in situ cast cantilevered concrete slab.

50x270 precast concrete stair tread with 10 steel rod @ 600 centres.

8 steel rod @ max 600 centres.

5 steel threaded rod @ max 600 centres.

85x25x2 galvanised steel angle iron.

25x25x2 galvanised steel angle iron.

4 steel threaded rod @ max 600 centres.

35x35 steel equal legged angle.

85x25x2 galvanised steel angle iron.

6 threaded rods to be inserted and held in position until set.

8 steel rod @ max 600 centres.

50x270 precast concrete stair tread with 10 steel rod @ 600 centres.

holes drilled @ 600 centres in accordance with tread rods and filled halfway with injection chemical anchor, tread to be lowered into place and held in position until set.

shadow line.

35x35 steel equal legged ang

25x25x2 galvanised steel angle iron.

8 threaded rods to be inserted and held in position until set.

Figure 3.24: Detail: shadow line at entrance to internal space.

Figure 7.3: Strip section indicating response to function and hierarchy through building envelope.

Figure 7.4: Detail: cantilevered slab of new public square.
Building Structure

During the technical investigation the building structure was developed through consultation with Civil Engineers Professor Walter Burdzik and Carl von Geyso.

Column spacing has been determined by the basement layout in combination with programmatic spatial requirements. The grid allows parking and circulation within the basement while accommodating modular sized units within the overnight facilities and preferred sized classrooms and still allows the structure to be adaptable in order to accommodate possible future change in program or envelope. This allows the building to adapt to changing needs within the environment thereby strengthening entopia and extending the building lifetime.

As is the case in most of the buildings within the context, building structure is expressed on facade. The structure is exposed through the use of shadow lines and steel channels fixed directly to the concrete slabs allowing a recessed connection. The channel acts as permanent shuttering for the floor slabs and additionally facilitates fixing of elements to the building facade such as the screen, solar shading devices and ventilation towers.

Primary Building Structure

The primary building structure consists of 255 deep pre-stressed concrete slabs with 330x440 reinforced concrete columns.

Steel columns are used in part for the southern and western wings of the structure to accommodate deflections that will occur due to the lack of horizontal support. In the southern wing where the columns span three storeys, 305x305x158 Parallel flanged steel H columns has been selected with smaller H columns used to support the screen and bridge the two storeys without lateral support in the western wing.

Use of steel columns in these areas allows the use of less material and prevents large columns intruding within the urban waiting rooms.
Screen Structure

Numerous structural elements have been considered during the technical investigation of the screen. Main design determinates were context, materiality, maintenance, weight and sizing as structural elements supporting the screen are not to hamper light and air moving through the shading device. During the investigation process it has been found that vierendeel girders and wide flanged rolled steel sections could not be used due to inadequate required depth, causing the supporting structure to reduce space available for the shading device drastically. Deep rolled steel sections have therefore been used for all horizontal support elements.

The structure used to support the screen are 254x254x73 Parallel flanged steel H columns for vertical support with 260x90x28 parallel flanged steel channel cantilevered beams which allows the screen to step away from the rigid column grid in order to facilitate gateway formation and way finding. The cantilevered beams then have cut back flanges to facilitate bolt fixing to gusset plates, factory welded to steel parallel flanged tie beams.

Where the cantilevered beams are required to connect directly to the building envelope without the use of columns, beams are bolted to gusset plates that are connected to a purpose made parallel flanged channel fixed to the concrete slab. The channel allows the fixing of two cantilevered beams due to the lack of shared structure to allow independent screen placement between different storeys.

Fig. 7.10: Detail: screen construction
Fig. 7.11: Detail: cantilever beam to tie beam

Fig. 7.12: Detail: cantilever beam to slab mounted channel

Fig. 7.13: Development of screen structure
Solar Studies + Response

Comparative solar studies have been done in order to determine shading conditions on site and serve to illustrate improvement on current conditions.

The new design provides 5 times the amount of public external space currently available to pedestrians. During summer, shaded space per m² on site is increased by 240% while in winter external public sunlit space is increased by 5020%.

From the solar studies it can be seen that shade created by the ten storey residential building neighbouring the site to the north completely eliminates direct sun on the northern facade during winter thereby reducing natural light within the building and negating the use of numerous sustainable strategies with regards to heating and cooling.

Lack of northern sun during cold months influenced decision making during the roof design and selection as well as placement of sustainable heating and cooling systems. Low light conditions during winter months led to the introduction of an atrium in the northern wing which allows natural light to enter the building from the roof.

In response to context and shading conditions on site a combined roof has been decided upon. The roof is in part an accessible flat roof with mono pitched sections orientated north. Mono pitched roofs are placed to miss shadows created by the neighbouring building in order to facilitate the use of passive solar strategies and are angled at 25° in order to ensure proper functioning of sun driven systems. Clerestory windows have been added to the mono pitched roof sections to allow diffused southern light to enter spaces thereby increasing natural light within the building.

Fig. 7.14: Solar study
Sustainability

The local ambient environment is known to have both a direct physical and emotional effect on man and is therefore of central importance in building design and development (Rabah & Mitò 2003).

Buildings incorporating passive systems have indicated a decrease in energy use of up to 90% and an increase in worker productivity by 6-15%. Apart from decreased energy consumption and increased productivity, buildings making use of passive systems have indicated an increase in occupant health and social interaction (Stitt, 1999).

System Selection

Ecosystemic thinking is to think of systems as nested. Each system is seen as part of a larger system (Fisher and Clarke, [2010]). The passive design strategy follows an ecosystemic approach where different passive strategies are combined in order to increase their functionality and make them better suited for the Pretoria climate.

Pretoria is characterised by calm winds. The city has 41.1% wind still days during summer and 57.2% wind still days during winter (Wegelin, 2009). Pretoria CBD is therefore not suited for passive strategies that are wind driven. High insolation rates and a relatively low amount of cloud cover however, makes Pretoria a suitable environment for passive solar driven systems. These systems can be used in conjunction with wind based strategies in order to cool buildings during summer and heat them during winter as well as increase wind intake.

With Pretoria having an average relative humidity between 29 and 75% (BBC, 2011) evaporative cooling systems making use of exposed water are not always functional within the environment due to unfavourable levels of humidity (Air & Water, 2011). It has therefore been decided to use indirect evaporative cooling that does not increase humidity, thereby increasing levels of functionality during summer months when air needs to be cooled. During winter months, air will be treated using the same ducts and pipes while diverting them through an evacuated-tube solar collector system in order to generate heat.

During the technical development of sustainable systems mechanical engineer Peet Pelser has been consulted in order to ensure functionality of the selected systems.

FIG. 7.15: Solar suitability

FIG. 7.16: Evacuated-tube solar collector

FIG. 7.17: Evaporative cooling effectiveness

FIG. 7.18: Pretoria wind roses

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<th>Year</th>
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<tr>
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<tr>
<td>2011</td>
<td>57.2%</td>
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<tr>
<td>2012</td>
<td>41.1%</td>
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Graph showing yearly temperature and % relative humidity.