Materiality

To gain consistency throughout the project and minimal material weight, material is assigned to the functions of the building (fig: 94).

Steel:

Steel will be used as the primary loadbearing structure (columns and beams) and in the secondary structure as façade cladding. This is consistent with the following concepts:
• Steel is a product of service - after the life of the building the steel can be re-used in the same capacity.
• Steel is energy efficient - light steel frame buildings are significantly more energy-efficient than heavy construction methods, both with regard to embodied energy of the materials and components, as well as operational energy relating to heating and cooling of the building over its design life. While the embodied energy of high-strength steel, used for the light steel frame, is significantly higher per kilogram than conventional building materials, a significant lower mass of steel is used, rendering low-steel frame-wall assemblies vastly superior in this regard (Barnard, 2008).
• Steel is an economic building method. In the industrial sector this is a very important factor; the financial savings emanating mainly from significant time-saving to complete the building project, less rework, reduced logistical costs (which is of growing importance due to the escalation of fuel prices) and a drastic reduction of rubble on building sites, when compared with the brick-and-mortar alternative (Barnard 2008).

Timber

Timber will be used as a secondary structure, to differentiate between the production processes and the human-related processes. Distinction between the timber and steel structure is accentuated in the connections: the steel structure focus on the functional where the components are lined up to form seamless connections and in contrast; with the timber structure the connections are pulled apart (see timber detail on page 154). The aim of timber is to stitch a human scale into the production scale. This is consistent with the concept of integrating the industrial building into the surrounding urban fabric.
• Timber is a fully-sustainable, and natural product.

These social spaces are vital for the workers to relate to their surrounding environment where the focus isn’t on the product but on social interaction. This is important in terms of social wellbeing to enable workers to engage in conversation on the everyday mundane subjects of life, being part of a bigger community, talking about the weather, their children’s achievements in school and the best bargains at the shops while observing the daily urban activities that surround the bio-diesel plant.

Masonry

The structure of the two service areas at the back of the bio-diesel plant will consist of masonry and mortar, to relate to adjacent power station building B (fig: 93).
Figure 94. To gain consistency throughout the project and minimal material weight, material is assigned to the functions of the building: Author 2010.
Figure 95. The Pretoria West Bio-diesel Plant: showing the structural components of the building: Author 2010.
LATTICE BEAM

VERTICAL LOUVRES (SECONDARY STRUCTURE)

HORIZONTAL LOUVRES (SECONDARY STRUCTURE)

EXISTING CONCRETE ASH-BUNKERS

TIMBER PERGOLA STRUCTURE

VERTICAL IBR STEEL SHEETING (SECONDARY STRUCTURE)

STEEL H-COLUMN

STEEL I-BEAM

TIMBER GUMPOLE STRUCTURE (FILLING STATION)

STEEL PERFORATED STEEL SHEET (SECONDARY STRUCTURE)

HORIZONTAL IBR STEEL SHEET ROOF CLADDING (SECONDARY STRUCTURE)
Figure 96. On the left is the threshold between the production process and the street. In the middle back is the bio-diesel fuel station that will establish connectivity through activity. To the right is the informal market that will spill over to the Bio-diesel plant and will be accommodated in the existing ash-bunkers to establish integrated social spaces: Author 2010.
PRETORIA WEST BIO-DIESEL PLANT
THRESHOLD SPACE
BIO-DIESEL FUEL STATION
BUITENKANT STREET
TAXI RANK WITH INFORMAL TRADING ON THE STREET EDGE

ON THE LEFT IS THE THRESHOLD BETWEEN THE PRODUCTION PROCESS AND THE STREET. IN THE MIDDLE BACK IS THE BIO-DIESEL FUEL STATION THAT WILL ESTABLISH THROUGH . TO THE RIGHT IS THE INFORMAL MARKET THAT WILL SPILL OVER TO THE BIO-DIESEL PLANT AND WILL BE ACCOMMODATED IN THE EXISTING ASH-BUNKERS TO ESTABLISH...
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GROUND FLOOR PLAN: PRETORIA WEST BIO-DIESEL PLANT
Figure 97. On the left is the production annexe that forms a non-linear facade and accommodates the social spill out space. The facade is opened up to have a visual connection with the production activities. On the right is the existing ash bunkers that will accommodate the informal market, this leads into the social space along the facade (the timber pergola structure and trees will programme the appropriate human scale along the facade).
SOCIAL SPACE ALONG THE FACADE

ASH BUNKERS WITH INFORMAL MARKET

On the left is the Production Annex that forms a void and accommodates the spill-out space. The facade is opened up to have visual contact with the production activities. On the right is the existing ash bunkers that will accommodate the informal market. This leads into the social space along the facade (the timber pergola structure and trees will programme the appropriate social activities).
ASH BUNKERS WITH INFORMAL MARKETS, FRAMING THE ENTRANCE TO THE BIO-DIESEL PLANT
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PRETORIA WEST BIO-DIESEL PLANT  THRESHOLD  INFORMAL MARKET IN EXISTING ASH BUNKERS

THRESHOLD SPACE BETWEEN THE BIO-DIESEL PLANT AND INFORMAL MARKET. THE THRESHOLD SPACE IS PROGRAMMED TO ACCOMMODATE SOCIAL INTERACTION.
Figure 98. The threshold social space between the Bio-diesel plant (office) and the adjacent main public space, which will contribute to the integration of the industrial building into the urban fabric: Author 2010.
THRESHOLD SPACE BETWEEN BIO-DIESEL OFFICE AND ADJACENT PUBLIC SPACE

FICE AND BOARDROOM
Figure 99. The social space at the back between the train station and the Bio-diesel plant: the workers are the most important source of energy in the production process, and it is therefore vital to have a space where they can interact in conversation, have a quite lunch or just be surrounded by other people away from their machine dominated work environment: Author 2010.
The social space between the Bio-Diesel Plant and the Rail Freight Centre production area of Pretoria West Bio-Diesel Plant is significant. The laboratory and training area production area of Pretoria West Bio-Diesel Plant, Kitchen and communal area. The view at the back between the train station and the Bio-Diesel Plant are the most important source of energy in the production process, and it is therefore vital to have a space where they can interact in, have a lunch or be surrounded by others away from their machine-dominated work environment.

The area is depicted in the illustration.
Building systems (energy strategy)

The author’s energy strategy in terms of the Pretoria West Bio-diesel Plant is recognising the workforce of the industrial plant as the most important energy resource. Optimal and efficient levels of production depend on the wellbeing of the workers in their work environment. The following passive design strategies are proposed to be applied to the spatial design in order to obtain this goal:

**Natural light:**

Natural light will enter through the louvers which will be manually-operated. The functions in the bio-diesel plant are then arranged in relation to the daylight that enters the building. Human related activities are placed where the most light enters, and the storage and passive production processes where least amount of natural light reaches (fig: 101).

The lighting level (fig: 100) depends on occupancy and activity, and is determined in accordance with the requirements of SANS 10114-1. Daylight is used in the design to reduce the levels of energy used. A part of the roof angle is 27° (fig: 102) to accommodate photovoltaic panels that will generate electricity for lighting of the bio-diesel plant.

**LUX calculations:**

Production:

LUX: 500  
AREA: 490sqm  
LUX = LUMEN/m²

500 = LUMEN/490m²  
LUMEN = 500 X 490m² = 245 000

Production : LUMILUX T8ES - 4800 LUMEN

Total need = 245 000 LUMEN

245 000/4 800 = 51 Luminaires are needed, with the day light factor of the bio-diesel plant only 50% will be used, thus:

25 Luminaires at 51W will be used - 25 X 51W = 1 275

Hours used - 10

1275 X 10 = 12 750W/H or 12.7kW/h
Storage: 0,896kW/h
W/C: 1,496kW/h
Retail: 3,344kW/h
Lab and Training area: 2,856kW/h
kitchen and Communal area: 0,23kW/h
Office: 6,12kW/h
Toatal: 25,142 kW/h is needed

Photovoltaic panels:
100 W = 1m²
10 sqm = 1kW

Pretoria solar factor = 6,2

Bio - Diesel Plant: 493,96m²
thus 493,96 will yield 49,39 kW
solar factor will be half due to the fact that the building is in the shade for most of the afternoon

49.4 x 3.1 = 153.14 kW

Hot water services:
The solar water heating system will comply with SANS 1307. The hot water services for the building will be heated using devices and equipment that would provide a minimum of 50% of the heat energy requirement via solar energy (fig: 102).
Figure 100. Pretoria West Bio-diesel Plant lighting levels: the lighting level depends on occupancy and activity, and is determined in accordance with the requirements of SANS 10114-1: Author 2010.
Figure 101. Daylight will enter through louvers which will be manually operated. The functions in the bio-diesel plant are arranged in relation to the natural light that enters the building; human-related activities are placed where the most light enters, and the storage and passive production processes where the least amount of natural light reaches: Author 2010.

Figure 102. A part of the roof angle is 27° to accommodate photovoltaic panels that will generate electricity for the lighting of the bio-diesel plant and solar water heating panels. From: Author 2010.
Figure 103. Earth tubes will be connected to the adjacent coal bunker where cool and fresh air will be collected. The earth tube must be sunken into the ground to a distance of at least 2m, and the tube must be installed at a 1:100 slope for condensation to run off and prevent a sick building syndrome to develop: Author 2010.

Figure 104. The floor of the production area is a raised steel mentis grid floor with a concrete funnel base which would allow for any spillage to be saved. The strategy is aimed at using use rainwater to run down the funnel base to move and ‘wash’ the oil (washing the oil is a process where the impurities of the discarded cooking oil react with the water). The constant water movement will cool the air from the lower level vents, that will be used to naturally ventilate the production area: Author 2010.
Natural ventilation is achieved by means of the following strategies:

Earth tubes (fig: 103) will be connected to the adjacent coal bunker where cool and fresh air will be collected. SANS 10400-0 requires that 5l/s/person of outside air is provided for office spaces. The earth tube must be sunken into the ground to a distance of at least 2m, and the tube must be installed at a 1:100 slope for condensation to run off and prevent a sick building syndrome to develop.

Earth tube size: 5l/s per person according to the national building regulation

\[ 5l/s \times 25 = 125 \text{ l/s} \]

\[ 0.125m^3/s \]

Thus \( 0.125m^2 \) area for the tube is needed (conventional ventilation), for displacement ventilation this figure can be doubled = \( 0.25m^2 \)

The timber pergola structure will assist in allowing and exclude heat to the building through vines growing on it; to allow sunlight through in the winter and exclude in the summer.

Another strategy that could be applied to reduce the energy load in cooling down the space is night-flushing. Offices and other commercial buildings operate during the day and are typically unoccupied at night. During the day the building gets warm, both from the sun and internal heat loads. Typically at the end of the day, office buildings are locked up and the heat remains trapped inside the building and it would still be warm at the start of the next day. The concept of night flushing entails using the cool night air to cool down the building so that the building is cooler when occupied again in the morning. Usually the night air is blown through the building for about an hour or two just before sunrise.

Production area:

Heat is generated in the production process of bio-diesel. In summer the heat is removed from the building when the hot air rises and escapes through the louvers. In the winter the heat will be redirected and used in other parts of the building; such as the laboratory, training room, office and boardroom.

The floor of the production area is a raised steel mentis grid floor with a concrete funnel base, allowing for any spillage to be saved. The strategy is to use rainwater to run down the funnel base to move and ‘wash’ the oil (washing the oil is a process whereby the impurities of the discarded cooking oil react with the water). The constant water movement will generate cool air from the lower level vents, that be is used to naturally ventilate the production area (fig: 104). Natural convection can now start to take place due to the temperature difference (cold air at floor level and rising hot air from the production process), and stimulate the circulation of air through the building.
RAIN WATER HARVESTING

RAIN WATER HARVESTING CALCULATIONS

<table>
<thead>
<tr>
<th>MONTH</th>
<th>RAIN FALL</th>
<th>HARVEST</th>
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<th>SURPLUS/ (NEED)</th>
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RAIN WATER HARVESTING CALCULATIONS

<table>
<thead>
<tr>
<th>WATER CONSUMPTION DEVICE</th>
<th>WATER CONSUMPTION</th>
<th>AMOUNT OF DEVICE</th>
<th>USE</th>
<th>TOTAL</th>
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<tr>
<td>FLUSH W/C</td>
<td>9L</td>
<td>5</td>
<td>8</td>
<td>360</td>
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<tr>
<td>HAND BASIN</td>
<td>3L</td>
<td>7</td>
<td>8</td>
<td>168</td>
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<tr>
<td>SHOWERS</td>
<td>40L</td>
<td>5</td>
<td>4</td>
<td>800</td>
</tr>
<tr>
<td>CLEANING</td>
<td>20L</td>
<td>5</td>
<td>3</td>
<td>300</td>
</tr>
<tr>
<td>NATURAL VENTILATION/</td>
<td></td>
<td></td>
<td></td>
<td>1000</td>
</tr>
<tr>
<td>WASHING OF OIL</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

TOTAL

WATER CONSUMPTION PER MONTH: 81468L

Figure 105. Rainwater harvesting strategy of the Pretoria West Bio-diesel Plant: Author 2010.
Rainwater harvesting:

Tanks are used to catch and store rainwater that is harvested from the roofs of the building (fig: 105). The tanks are placed three meters high in the air to use gravity to move the water to where it is needed.

Greywater is wastewater harvested from handwash basins and showers. Using the table in the Green Building Handbook for South Africa (Gibbert, 2009), the production of greywater can be calculated. The amount of grey water produced by the handwash basins (168l) and showers (800l) adds up to a total of 968l. The water consumption of the flush toilets is considerably below total at 360l/day, indicating that there should be sufficient grey-water capacity to be used to flush toilets, with the excess being used for irrigation.

Rain water harvesting calculations:

Roof 1:
Summer rain fall 140mm/sqm

140 x 462.5 = 64 750 l

140mm/m² = sqr root of 64 750
= 254.46 gutter size

The gutters will be over sized by half what is needed, to prevent any unpredictable flooding situation

Down Pipe:
462.5 x 0.5 = 231.25

231.25 x 100mm/m² = 23 125

Diameter of gutter = 170mm

Gutter size:

Roof 2: 300mm X 300mm

Roof 3: 300mm X 300mm

Roof 4: 250mm X 250mm

Roof 5: 300mm X 300mm
Rainwater harvesting:

Tanks are used to catch and store rainwater that is harvested from the roofs of the building (fig: 105). The tanks are placed three meters high in the air to use gravity to move the water to where it is needed.

Greywater is wastewater harvested from handwash basins and showers. Using the table in the Green Building Handbook for South Africa (Gibbert, 2009), the production of greywater can be calculated. The amount of grey water produced by the handwash basins (168l) and showers (800l) adds up to a total of 968l. The water consumption of the flush toilets is considerably below total at 360l/day, indicating that there should be sufficient grey-water capacity to be used to flush toilets, with the excess being used for irrigation.

Rain water harvesting calculations:

Roof 1:

Summer rain fall 140mm/sqm

140 x 462,5 = 64 750 l

140mm/m² = sqr root of 64 750
= 254,46 gutter size

The gutters will be over sized by half what is needed, to prevent any unpredictable flooding situation

gutter size: 450mm x 450mm

Down Pipe:

462,5 x 0,5 = 231.25

231,25 x 100mm/m² = 23 125

Diameter of gutter = 170mm

Gutter size:

Roof 2: 300mm X 300mm

Roof 3: 300mm X 300mm

Roof 4: 250mm X 250mm

Roof 5: 300mm X 300mm
3 GALVANIZED STEEL BEND PLATE GUTTER IN 5m LENGTHS, WELDED AND SUPPORTED BY GUTTER BRACKETS WITH FALL OF 1:200

175 DIAMETER DOWPIPE OF 0.6 CONTINUOUS HOT-DIP ZINC COATED CARBON STEEL SHEET

STEEL GUTTER BRACKET @ 1250 CENTRES, WILL ACCOMMODATE THE 1:200 FALL

50 DIAMETER OVERFLOW OPENINGS AT 5m cc

Perspective view of gutter

Exploration of gutter detail
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**Detail A: Gutter Detail 1:50**

- 3 Bubble Foil supported with wires that are tied to I-beam.
- 0.6 Galvanized Steel IBR profile sheet for roof cladding. Max span of 2000, fixed 600 cc.
- 125 x 75 x 8 Steel angle cleat welded to rafter.
- 125 x 50 x 20 x 3 Steel lipped channel purlin bolted to cleat with 2 x M16 bolts.
- 50Ø Overflow opening at 5m cc.
- 2.5 Pressed Metal Capping.
- 254 x 146 x 63 Steel I-beam.
- 3 Galvanized Steel bend plate gutter in 5m lengths, welded and supported by gutter brackets with fall of 1:200 towards outlets. To comply with SANS 3575/4998.
- 175Ø Downpipe of 0.6 continuous hot dip zinc-coated carbon steel sheet complying with SANS 3575/4998 Class 2275 seamed along pipe length. Fixed to steel column with galvanised mild steel bracket at 2m intervals.
- 254 x 254 x 132 Steel H-column.
- Rainwater to rainwater harvesting tank.
38 x 150 x 1400 BALAU TIMBER TREATED FOR OUTSIDE RESISTANCE TO COMPLY WITH SANS 10005:2005
100 x 50 x 3 GALVANIZED STEEL L PROFILE
254 x 254 STEEL H-COLUMN
60 x 110 x 3 GALVANIZED STEEL RECTANGULAR HOLLOW PROFILE
60 x 110 x 3 GALVANIZED STEEL RECTANGULAR HOLLOW PROFILE
1500 x 1250 ALUMINUM WINDOW FRAME TO COMPLY WITH SANS 1651
254 x 146 STEEL I-BEAM
100 x 100 x 8 GALVANIZED STEEL EQUAL ANGLE

GLAZING: GLASS TO COMPLY WITH SANS 50572

3 mm PRESSED METAL DRIP FLASH

18 mm HIGH TENSILE STEEL THREAD ROD WITH M.S WASHER (3 mm THICKNESS) & FRICTION NUT TO SUIT THREADED ROD ON BOTH ENDS. FASTENERS TO COMPLY WITH SANS 1700, STEEL NAILS TO COMPLY WITH SANS 820
254 x 254 STEEL H-COLUMN
100 x 100 x 8 GALVANIZED STEEL EQUAL ANGLE

38 x 150 x 1400 BALAU TIMBER TREATED FOR OUTSIDE RESISTANCE TO COMPLY WITH SANS 10005:2005

60 x 110 x 3 GALVANIZED STEEL RECTANGULAR HOLLOW PROFILE
100 x 50 x 3 GALVANIZED STEEL L PROFILE

1500 x 1250 ALUMINUM WINDOW FRAME TO COMPLY WITH SANS 1651
GLAZING: GLASS TO COMPLY WITH SANS 50572

VOID BETWEEN STEEL STRUCTURE AND TIMBER CLADDING
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600 x 12.7 vertical lining gypsum plaster board to comply with SANS 266, scrim wire over all joints, fixed 600 center to center

10 stainless steel shadow line profile

Reinforced concrete column footing

1000 x 250 x 50mente grid

300 x 130 x 8 steel gutter

Waterproofing for steel column: bituminous paint

100 Ø gutter flow opening

300 x 130 x 8 steel gutter

1000 x 250 x 50 mente grid

300 x 130 x 8 steel gutter

100 Ø gutter flow opening

LATTICE BEAM MADE OUT OF 80 x 80 x 3 EQUAL ANGELS

LATTE BEAM MADE OUT OF 80 x 80 x 3 EQUAL ANGELS

3 x 1.5m collar beam

12 x 50 x 20 x 3 steel lipped channel purlin bolted to cleat with 4 x M16 bolts

Vertical louvre on the eastern facade

Aluminium louver frame

12 steel base plate bolted to 254 x 254 h-section with 4 - M26 grade 8.8 bolts

3mm pressed metal drip sill

1500 x 1250 aluminium window frame to comply with SANS 1651

Glazing: 1300 x 1200 x 6 glass to comply with SANS 50572

3mm pressed metal drip sill

10 sealant to comply with SANS 1305

10 stainless steel shadowline profile

254 x 254 x 132 steel h-column at 5000 cc, brushed according to SANS 10064, painted with corrosion protected paint to comply with SANS 12944.

100 x 50 x 20 x 3 steel lipped channel

0.6 galvanized steel ibr profile sheet for external wall cladding. Max span of 2000. Fixed 600 cc

10 gypsum plaster. Hardwall gypsum plaster must be a retarded hem-hydrate finish plaster

Recycled wood fibre insulation

5 seamless epoxy mortar floor to comply with SANS 10070. Ensure screed is clean, sound and dry. Sandblast or sandblast the surface to provide the necessary grip

10. Screed. Mix proportion of cement-sand-screed must be 1 part cement to 4 parts sand.

-0.25 smooth green polyolefin damp proof membrane complying with SANS 952, type C

Compacted earth filling

Fixed h-column and base plate to reinforced concrete column footing with anchor bolts

500 x 350 x 10 steel base plate

27° SLOPE

3° SLOPE

DETAIL C: typical wall section [nts]
ANCHOR BOLTS

500 X 350 X 10 STEEL BASE PLATE

WATERPROOFING FOR STEEL COLUMN WITH BITUMINOUS PAINT

OUTSIDE

INSIDE

Wall plan [nts]

0.6 GALVANIZED STEEL IBR PROFILE SHEET FOR EXTERNAL WALL CLADDING.
MAX SPAN OF 2000. FIXED 600 CENTER TO CENTER

600 X 12,7 VERTICAL LINING GYPSUM PLASTERBOARD TO COMPLY WITH SANS 266.
SCRIM WIRE OVER ALL JOINTS. FIXED 600 CENTER TO CENTER

254 X 254 STEEL H-COLUMN

125 X 50 X 20 X 2.5 LIPPED CHANNEL

10 STAINLESS STEEL SHADOW LINE PROFILE

1000 X 250X 50 MENTIS GRID ON TOP OF GUTTER

222 X 106 X 75 GREY PAVERS TO COMPLY WITH SANS 1575

OUTSIDE

INSIDE

100 DIAMETER GUTTER FLOW OPENING

170 REINFORCED CONCRETE RAFT FOUNDATION

300 X 130 X 8 STEEL GUTTER

Wall detail: Column connection

Wall detail: showing ground connection
TIMBER LATHS: THICKNESS OF ENDS TO RANGE BETWEEN 25mm-38mm NAILED WITH NAILS TO RAFTER AT 270mm CENTERS

50 X 50 X 3 STEEL L PROFILE
254 X 146 X 8 STEEL I-BEAM

38 X 150 STRUCTURAL SOFTWOOD, GRADE S5 TO COMPLY WITH SANS 1783

150Ø X 2770 GUMPOLE. GUMPOLES SHALL BE FROM TREES OF THE GENUS EUCALYPTUS GROWN IN SOUTH AFRICA AND TREATED WITH A PRESERVATIVE SOLUTION OF COPPER CHRONIUM ARSENATE COMPOUND WHICH COMPLIES WITH SABS 457 AND APPLIED IN ACCORDANCE WITH SABS HAZARD CLASS H4

18mm HIGH TENSILE STEEL THREAD ROD WITH M.S WASHER (3mm THICKNESS) & FRICION NUT TO SUIT THREADED ROD ON BOTH ENDS, FASTENERS TO COMPLY WITH SANS 1700, STEEL NAILS TO COMPLY WITH SANS 820

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perspective view of timber pergola with vines

DETAIL D: timber pergola structure 1:50
DETAIL E: roof lattice beam detail

- 2.5 metal flashing
- 102 x 133 x 15 steel top rafter T-section bolted to H-section beam with 4-M20 grade 8.8 bolts
- 254 x 254 x 132 steel H-column at 5000 c.c.
- 100 x 100 x 15 steel equal angle welded to H-column and bolted to lattice beam
- 0.6 galvanized steel IBR profile sheet for roof cladding, max span of 2000, fixed 400 c.c.
- 125 x 50 x 20 x 3 steel lipped channel purlin bolted to cleat with 4 x M16 bolts
- 102 x 133 x 15 steel top rafter T-section cut from I-profile
- 50 x 50 x 5 steel equal angle brace beam fixed to rafter with M16 grade 4.8 bolts
- 3 bubble foil supported with wires that are tied to lattice beam
- 102 x 133 x 15 steel bottom rafter T-section cut from I-profile

DETAIL F: bracing

- 102 x 6 steel circular hollow section
- 254 x 254 x 132 steel H-column
- 360 x 250 x 15 steel gusset plate
- 30Ø tie rod (tension member)
- Ties bolted to gusset plate with M20 grade 8.8 bolts
- 1.5mm steel plate gusset welded to steel H-column
perspective view of green and social space between production space and adjacent urban environment

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**Technical report**

- 90 x 3 steel plate welded to stud. Welding must comply with SANS 657 Part 1. Corrosion protection by paint must comply with SANS 12944.
- 222x106x75 gray clay pavers in complying with SANS 1575.
- 120 x 60 x 5 steel rectangular hollow stud. To comply with SANS 687 Part 1. Corrosion protected by paint must comply with SANS 12944.
- Lawn and planting area, loosen existing topsoil and mix thoroughly with 2:3:2 fertilizer in the ratio of 30 kg. Fertilizer to 150 m² of topsoil.
- Min hardcore compacted fill.
- 400 x 400 concrete footing.

---

**DETAIL G. Perforated steel caldded screen section 1:50**

- Sheet connection to steel frame:
  - 27ø steel circular hollow section welded to 50 x 25 x 2 steel flat bar welded to circular section
  - 12 mm high tensile steel threaded rod with M5 washer (2 mm)
  - Friction nut to suit threaded rod on both ends
- 1100 x 1100 x 3 steel perforated sheet (with perforated edges), no corrosion protection.
- 1100 x 160 x 5 gray enamel coated steel plate, connected to stud with pop rivets, to comply with SANS 1700.
DETAIL G. Perforated steel caldded screen section 1:50

1100 X 1100 X 3 STEEL PERFORATED SHEET (WITH PERFORATED EDGES). NO CORROSION PROTECTION

27 (diam.) STEEL CIRCULAR HOLLOW SECTION WELDED TO STUD. PAINTED WITH GREY ENAMEL PAINT

12mm HIGH TENSILE STEEL THREADED ROD WITH M.S WASHER (2mm). FRICTION NUT TO SUIT THREADED ROD ON BOTH ENDS

50 X 25 X 2 STEEL FLAT BAR WELDED TO CIRCULAR SECTION

120 X 60 X 5 STEEL RECTANGULAR HOLLOW STUD

27Ø STEEL CIRCULAR HOLLOW SECTION, WELDED TO STEEL STUD

50 X 25 X 2 STEEL FLAT BAR WELDED TO CIRCULAR SECTION

STEEL PERFORATED SHEET BOLTED TO FLAT BAR WITH M8 BOLTS

1100 X 1100 X 3 STEEL PERFORATED SHEET (WITH PERFORATED EDGES). NO CORROSION PROTECTION

DETAIL G. Perforated steel caldded screen plan 1:50
The production area section shows the relationship between the urban fabric, threshold space and Bio-diesel plant. The threshold space will have a visual connection to the street, function as a spill out area for the workers, and the openings will allow ample day light and fresh air into the building: Author 2010.
Figure 94. The office area section shows the stitching between the urban activities (informal market at the ash bunkers) and industrial building (Bio-diesel plant); through the integrated social space - the social space is a light structure to strengthen the human scale to that of the industrial scale that is associated with the solid concrete ash bunker structure. The ash bunkers are retained because of their position on the street edge and ability to accommodate an urban activity (informal market): Author 2010.
The office area section shows the stitching between the urban activities (informal market at the Ash Bunkers) and the industrial building (Bio-diesel plant); through the social space is a light structure to strengthen the to that of the industrial scale that is associated with the solid concrete Ash-bunkers structures. The Ash bunkers are retained because of their position on the street edge and ability to accommodate an (informal market).
Key performance objectives according to the Green Building Handbook for South Africa (Gibbert, 2009)

7.1. Daylight:

Performance objective: The design of the building envelope ensures that an average daylight factor (DF) of 2.5% is achieved in all occupied (living and working) areas in the building.

A simple rule of thumb can be used to approximate the daylight factor:

\[ D = 0.1 \times P \]

Where:
- \( D = \) Daylight factor
- \( P = \) Percentage glazing to floor area

E.g. given a room of 100 m\(^2\) floor area with 20 m\(^2\) of glazing

\[ D = 0.1 \times (20 \div 100) \times (100 \div 1) = 2\% \]
Pretoria West Bio-diesel plant (fig: 108):

Office and Boardroom:

P = 319,6m² floor area to 174m² of glazing (112m²) and louvers (62m²)
D = 0,1 x 0,54 x 100 = 5,4%

Kitchen and Communal space:

P = 248,6m² floor area to 189m² of glazing (79m²) and louvers (110m²)
D = 0,1 x 0,76 x 100 = 7,6%

Laboratory and Training room:

P = 323m² floor area to 146,9m² of glazing (36.9m²) and louvers (110m²)
D = 0,1 x 0,45 x 100 = 4,5%

Shop:

P = 50m² floor area to 22m² of glazing
D = 0,1 x 0,44 x 100 = 4,4%

Production:

P = 711m² floor area to 408m² of glazing (132m²) and louvers (276m²)
D = 0,1 x 0,57 x 100 = 5,7%

W/C:
The w/c and shower room DF range from 1,9% - 3,2%
OFFICE AND BOARD RM: 36%
KITCHEN AND COMMUNAL AREA: 60%
LABORATORY AND TRAINING AREA: 39%
SHOP: 22%
PRODUCTION: 48%
W/C: 13.4%
NATURAL VENTILATION: OPENABLE AREA TO FLOOR AREA

Figure 96. Pretoria West Bio-diesel plant, natural ventilation, indicating the openable area to floor area. From: Author 2010.
7.2. Ventilation

Performance objective: The design of the building ensures that spaces can be naturally ventilated. A minimum openable area within the external envelope of at least 5% of internal floor area is provided for natural ventilation.

Pretoria West Bio-diesel plant (fig: 109): The openable area will be calculated on the louver area and on a conservative amount of 50% of the glazed area

Office and Boardroom: Openable area: 118m² / Floor area: 319.6m²
Thus 36% openable area in external envelope for natural ventilation

Kitchen and Communal space: Openable area: 149.5m² / Floor area: 248.6m²
Thus 60% openable area in external envelope for natural ventilation

Laboratory and Training room: Openable area: 128.45m² / Floor area: 323m²
Thus 39% openable area in external envelope for natural ventilation

Shop: Openable area: 11m² / Floor area: 50m²
Thus 22% openable area in external envelope for natural ventilation

Production: Openable area: 342m² / Floor area: 711m²
Thus 48% openable area in external envelope for natural ventilation

W/C (Male w/c and shower room at ground floor): Openable area: 2.95m² / Floor area: 22m²
Thus 13.4% openable area in external envelope for natural ventilation
7.3. Sunlight

Performance objective: Direct sunlight is avoided in office working environments. Sunlight access into the building is only allowed into the building as part of a direct gain passive solar strategy where this plays a useful role in warming the building in winter.

Pretoria West Bio-diesel plant: The timber pergola structure with vines will provide shade and block direct sun from entering in the summer and heating up the space. In winter the vines loses their leaves and will allow sunlight to enter into the interior space, passively warming the building.

7.4. Air tightness:

Performance objective: The building envelope is air tight in order to avoid unwanted infiltration of cold or hot air through the building envelope. Air tightness standards exceed the minimum standards required by SANS 204.

Pretoria West Bio-diesel plant: According to SANS 204; roofs, external walls, and floors that form the building envelope and any opening such as windows and doors in the external fabric shall be constructed to minimize air leakage when it forms part of the external fabric of a conditioned space or habitable room in climate zones 1, 2, 4 and 6. The City of Tshwane is in climate zone 2 according to SANS 204 (temperate interior). The building sealing will be done by methods such as silicone sealing around the window frames and foam/rubber compressible strip around doors. In the office/boardroom, kitchen and laboratory/training areas the walls will be constructed with an extra layer of recycled wood fibre insulation and gypsum plasterboard.

7.5. Noise:

Performance objective: Obtrusive external noise from traffic etc is not experienced in the building and internal noise levels do not exceed good practice standards (ie ambient sound levels not exceed 45dBAeq in open plan offices).

Pretoria West Bio-diesel plant: The sustainable strategies that are implemented to exclude intrusive noise from the building are to move the habitable areas (office/ boardroom, kitchen/communal area and laboratory/training) as far back from the street as possible. Natural air are obtained through earth tubes, this will minimize the need to open windows; that will allow intrusive noise from the outside into the building.
7.6. Habitat and vegetation:

Performance objective: At least 10% of the external building envelope has vegetation cover. This may be provided in the form of green roofs, window boxes, planted terraces and balconies and wall creepers. This is also used to support the creation of wildlife habitat.

Pretoria West Bio-diesel plant (fig: 110): Vegetation cover is provided in the form of the planted timber pergola, planters and trees. The vegetation is incorporated in the design to bring the industrial scale down to a more human related scale. 60% of the building envelope has vegetation cover.

Figure 97. Potential trees that will be appropriate to climate and architectural design intend, and indigenous to local environment: Author 2010.
7.7. Renewable energy:
Performance objective: The building envelope includes renewable energy generation such as photovoltaics, wind turbines and solar water heaters and 10% of the building’s energy requirements are generated from these sources.

Pretoria West Bio-diesel plant:

Solar energy:
The Bio-diesel plant will be in the shade for most of the afternoon, due to the scale of the adjacent building. Part of the roof of the Bio-diesel plant is at an angle of 27° to accommodate photovoltaic panels and solar heating system; that will be sufficient to provide enough electricity for the lighting and heating for the showers and basins. This roof pitch will allow ample daylight and air flow into the building.

Wind energy:
This area is not conducive to high wind generation, so the building is designed to accommodate airflow to assist in the natural ventilation of the building.

Bio-fuels:
Bio-diesel is produced that can be used to power some of the machinery, for example the generator.

7.8. Views:

Performance objective: All working spaces are within 7m of a window and have a direct view of the outside.

Pretoria West Bio-diesel plant: All working spaces are within 4,5m and have a direct view of the outside.

7.8. East and West elevations:

Performance objective: Windows on east and west elevations are minimized and appropriate solar shading is provided where this exists to avoid unwanted solar gain.

Pretoria West Bio-diesel plant: Windows on the west side will not be influence, due to the scale of the adjacent building. The east elevation is shaded with the timber pergola structure at the office, kitchen and laboratory. The production area is shaded with a perforated steel screen and vegetation (detail D).

7.9. Openable windows:

Performance objective: Openable windows are provided where they can easily be controlled by people near them. At least one openable window per 5 running metres of building envelope is provided in occupied areas.

Pretoria West Bio-diesel plant: Openings will be assigned according to this regulation.
7.10. Rainwater harvesting:

Performance objective: Roofs are used for harvesting rainwater and a target of a 50% reduction in mains potable water consumption (relative to conventional buildings) is achieved.

Pretoria West Bio-diesel plant: The objective in the Pretoria Bio-diesel plant is to harvest rainwater and reduce the target of a 50% in water consumption that is used in the production process. The total water consumption related to the production process is 81468 litre and the rain water harvesting that is stored in tanks will be able to supply in this need (see fig:95).

7.11. Cool roofs:

Performance objective: Roofs and large external balconies and terraces are constructed of a material with an absorptance value of under 0.55 (are light coloured) to avoid unwanted heat gains.

Pretoria West Bio-diesel plant: The roof will be a light grey with a typical absorptance value of 0.45 as prescribed by SANS 204-2.

7.12. Passive environmental control:

Performance objective: The building envelopes support passive environmental control strategies as described in the passive environmental control chapter by providing correctly located and sized openings and thermal mass etc.

Pretoria West Bio-diesel plant:

- The workforce (people) is the most important energy resource of the Bio-diesel plant and the use of passive design strategies will give form and spatial quality to the building (natural ventilation, daylight and fresh air into the building)
- Minimize energy required for heating and cooling. In the production process discarded used cooking oil is washed with water, the cool air that is a by product of this process will be used to cool down the building. Heat on the other hand is generated in the production process; in the summer the heat is allowed to dissipate out of the louvers; in the winter the heat will be used in the office, boardroom, laboratory and training room.
- The timber pergola structure with vines will provide shade and block direct sun from entering in the summer and heating up the space. In winter the vines loses their leaves and will allow sunlight to enter into the interior space, passively warming the building.
- Night flushing is implemented through the louvers; typically the night air is blown through for about an hour or two just before sunrise. This should delay the time in which active air conditioning is required.
- Rainwater harvesting: The roofs will be used to harvest the rain water and be stored in tanks that are elevated 3m high in the air, to make use of gravity. The rainwater will be used to wash the discarded used cooking oil; this process will double up as a cooling strategy for the building. Rain water will also be used in the showers and grey water will be used in the w/c.