07 DESIGN DEVELOPMENT

7_01 INITIAL IDEAS

7_02 REVIEW/Critt PROCESS DOCUMENTATION IN SKETCHES

7_03 FINAL DIAGRAMS
   - MAIN ROLEPLAYERS
   - PEDESTRIAN FLOW
   - MOVEMENT ITERATIONS
   - COMBINED FINAL MOVEMENT DIAGRAM
   - PROGRAM
7_01 INITIAL IDEAS

DESIGN PROCESS STRUCTURE

The design was developed through various different techniques such as sketching, model building, computer aided drawing and photography. The process was documented after every review during the year in the form of summarizing sketches that indicate progression in the form of iterations and explorations. The following section includes a condensed version of sketches and other graphic explorations selected by the author in order to form a coherent documentation of the design process.

The first site visit sketches indicate an interest in the views of Noord Street from Johannesburg Art Gallery, which was used as a base-point for every site visit.

The strong axis of movement of both the sunken railway line and pedestrian activity on Noord Street feature prominently in these drawings. Relationships between the prominent roleplayers which frame the various ‘urban scenes’ were established. As the project progressed, selected scenes organically evolved into focal points, which became the most important design drivers.

The most challenging part of the design development, was creating an architectural language that spatially respond to the surrounding environment and manipulating movement to establish physical links on a local scale. These aspects are therefore eminent in the process documentation.

Sketch 1 indicates the sectional relationship of JAG with the railway fissure and Joubert Park. Prominent features of JAG like the entrance portico are noted. Lines of movement and activity and the relationships of existing structures in terms of scale and public space are also explored.
Sketch 2 indicated an exploration on plan of Noord Street’s pedestrian activity, views across the railway fissure and prominent frames to public performance and urban scenes [facade relationships]. The location of public gathering spots are also mapped on this sketch for further investigation.
FIG 59.2 Initial site concept sketches
Sketch 3 indicates an evolved exploration on plan of Noord street with views across the railway fissure, edges and obstructive elements being mapped. A possible connection between JAG, Noord Street and Noord Taxi Rank is also starting to feature.

Sketch 4 indicates the first stages of an architectural language being formed and possible location of the building (in Noord Street), floating above the market. On an urban scale - the possibility of follies (scattering elements across the site) to challenge the typology of JAG and conceptually creating a static vehicle features in this sketch.
FIG 59.3 - 59.4 Initial site concept sketches
Sketch 5 indicates an evolved exploration of the architectural language by establishing relationships with surrounding elements [framing an urban stage] as well as allowing movement through and underneath the building.
KEY IDEAS
Promenade over North Street market, different levels of public interaction, massing of program, connection to market in North and Wolmarans Street as well as Johannesburg Art Gallery. Screens framing the urban event spaces. The reinstating of the old Union Grounds.
ELEVATED STRUCTURE 06/2014

KEY IDEAS
Elevating the building to allow open pedestrian flow beneath. Openings in screens that [at this stage] touch ground level, for better pedestrian flow. Scale [appropriate to Johannesburg Art Gallery and Noord Taxi Rank].

MAIN ITERATION
Removal of formal market underneath building - risk of institutionalizing the informal.
**KEY IDEAS**
Playing with the possibility of follies as elements removed from the building. Creating an element of the building that relates to a feature of JAG (entrance portico). Lifting the screens for one continuous open public space between Joubert Park and the Union Grounds.

**MAIN ITERATION**
Twisting screens to represent the dynamic and incomplete. Central solid knuckle representing the permanent and monumental.
FORMAL AND FUNCTIONAL DECISIONS 08/2014

KEY IDEAS
Service core’s need to have a ground level connection, therefore, the building is moved out-off Noord Street into the Union Grounds (on the city grid) as elements touching ground plane become obstructions to pedestrian flow. Developing landscaping ideas for the Union Grounds as the section reads flat and to open – a possible conceptual reference to the Highveld landscape (mounds, veld-grass).

MAIN ITERATION
Moving the building, improving interior circulation, developing the program and placement thereof in the building.
STRUCTURE AND TECHNICAL DEVELOPMENT 09/2014

KEY IDEAS
Environmental concerns such as noise levels from the railway line and North Street (acoustic insulation), high thermal mass material choice on North side on horizontal planes (corresponding with the idea of the monumental / permanent). Arranging and punching through structure to create tectonic ‘scenes’ for rhythm and better programmatic organisation.

MAIN ITERATION
Structural development (steel to concrete), improved programmatic organisation, material research and application thereof.
TECHNICAL REFINEMENT 10/2014

KEY IDEAS
Structure to be functional (house services and contribute to multifunctional event space by housing spatial dividers), refinement of program and construction of auditorium [to appear thin and floating].

MAIN ITERATION
Internal shuttering need to be minimized. The structure needs to simplify and improve formally and functionally. Material choice for exhibition spaces on the South of the building should correspond with concept and therefore become a lightweight insert in order to respond to the dynamic and incomplete site component.
TECHNICAL REFINEMENT 10/2014

KEY IDEAS
The programming of exterior spaces and ground floor (small scale informal interventions), finalization of the program, formal and technical improvement on main structural elements.

MAIN ITERATION
Proportion, structure, circulation, service core functionality.
7_03 FINAL DIAGRAMS

MAIN ROLEPLAYERS

DRILL HALL

NOORD TAXI

JAG

FIG 61.1 Main Roleplayers
PEDESTRIAN FLOW (URBAN VISION)

FIG 61.2 Pedestrian flow / urban movement
MOVEMENT ITERATIONS

Light to dark = Process of iteration, (darkest red represents final design)
Multifunctional event spaces

Outdoor cinema

Informal Theatre

EXTERIOR AND INTERIOR EVENT SPACES

Multifunctional event spaces

Holographic exhibition studio

Camera obscura

Digital media exhibition boxes

EXHIBITION SPACES

© University of Pretoria
Formal auditorium
Admin / curators office

FORMAL PROGRAM

Service and vertical circulation core

SERVICES AND CIRCULATION
08

TECHNICAL INVESTIGATION

8_01  TECHNICAL DEVELOPMENT
      ORGANISATION OF STRUCTURE AND SPACES
      SABS REQUIREMENTS
      SYSTEMS DESIGN FOCUS: WATER

8_02  MATERIAL CHOICE AND APPLICATION

8_03  DETAIL RESOLUTION
      1:20 DETAIL SECTION
      1:10 DETAILS
ORGANISATION OF SPACES AND STRUCTURE

The exploded axonometric drawing (figure 62) indicates a combination of all programmatic and structural elements, coming together according to the architectural concept and parameters set up by the author. Solid monolithic elements and lightweight slender inserts into the main structure (concrete pile-on ‘scenes’) becomes the architectural language of thresholds, inter-penetration and overlaying of spaces and planes.

Ramps serve as the urban connectors. The expanded metal solar and outdoor projection screens are clipped onto the structure on the North and South with a steel structure, creating an inter-play between the seeing and being seen on the interior and exterior of the building. The central knuckle responds to Johannesburg Art Gallery in rhythm and monumentality. The service and circulation cores penetrate horizontal planes with the formal auditorium double volume curved space on the Western end. The curves and linear elements as well as proportional relationships became conscious attempts in relating plan to section and *vico-verca*.

The rest of this chapter will expand further on systems-focus [water], sectional and detail resolution as well as the choice and application of materials.
SABS 10400 REQUIREMENTS

At the initial stages of the design, the SABS 10400 was consulted in order to establish functional as well as technical guiding principles for the building. Research from various sections are listed below, with application thereof explored further in the technification process of this project.

PART A
Table 1: Building classification

A1 / A2 - Entertainment and Public Assembly, Theatrical or Cinematographical

Table 2 - Occupancy planning
Number of fixed seats or 1 person per square meter if there are no fixed seats
Estimated number of users = +-120

PART O
Table 2 - Air and ventilation requirements
Assembly halls, Theatres, Cinemas

3.5 l/s per person
3.5 x 120 = 420 l/s for auditorium
3.5 x 20 = 70 l/s for digital exhibition boxes

PART P
Table 4 and 6: Provision of sanitary fixtures

<table>
<thead>
<tr>
<th>REQUIRED</th>
<th>PROVIDED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td></td>
</tr>
<tr>
<td>3 WC pans</td>
<td>4 WC pans</td>
</tr>
<tr>
<td>5 Urinals</td>
<td>4 Urinals</td>
</tr>
<tr>
<td>4 Wash hand basins</td>
<td>6 Wash hand basins</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Female</strong></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>7 WC pans</td>
<td>8 WC pans</td>
</tr>
<tr>
<td>4 Wash hand basins</td>
<td>6 Wash hand basins</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Disabled</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2 WC pans</td>
<td>2 WC pans</td>
</tr>
<tr>
<td>2 Wash hand basins</td>
<td>2 Wash hand basins</td>
</tr>
</tbody>
</table>
SYSTEMS DESIGN FOCUS: WATER

The project which deals with the reinstatement of public space (Union Grounds) in the form of a plaza or park, and the site location naturally led to selecting water as a theme for a systematic investigation. The intention is to design a water recycling system that minimizes the water required from Rand Water. The strategy is to collect surface run-off and grey water from roofs, roads and hard surfaces on site, treat the water as required and recycle it back into the system.

The building’s water budget is first calculated according to the principles and guidelines of The council for Scientific and Industrial Research South-Africa (CSIR).

The domestic (internal) demand will then be combined with site requirements (irrigation and outdoor use) as well as environmental considerations such as climate date, to further explore water storage and recycling options.

### DOMESTIC WATER BUDGET

<table>
<thead>
<tr>
<th>FITTING USE</th>
<th>FLOW</th>
<th>m³³</th>
<th>USES/DAY</th>
<th>M3/DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilet flush</td>
<td>half flush</td>
<td>0.005</td>
<td>20</td>
<td>0.2</td>
</tr>
<tr>
<td>Toilett flush</td>
<td>full flush</td>
<td>0.009</td>
<td>10</td>
<td>1.8</td>
</tr>
<tr>
<td>Urinal flush</td>
<td></td>
<td>0.005</td>
<td>30</td>
<td>0.15</td>
</tr>
<tr>
<td>Basin</td>
<td>6l/min</td>
<td>0.003</td>
<td>60</td>
<td>0.12</td>
</tr>
<tr>
<td>Bar/cafe</td>
<td></td>
<td>0.2</td>
<td>3</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Total water requirements per day = 2.88 m³
Total water requirements per week (2.88 x 6) = 17.28 m³
Total water requirements per month (17.28 x 4) = 69.12 m³

The climatic data of the site (Johannesburg, 26°11'55 S; 28°02'50, 1754 meters above see level, in the period 2014 - 2015) are used in combination with a mathematical spreadsheet, co-created by Mr. Derek Townshend (CSIR) to calculate water storage possibilities.

The average monthly precipitation (table 1) with surface run-off coefficient are used to determine the average monthly yield (table 2). The domestic demand combined with the demand for irrigating a planted area of approximately 3150m² are combined to determine the total water demand per month (table 3). A safety factor is applied to the total water budget to determine the water storage capacity and tank sizes.
The researched and calculated data (from the CSIR water budget spreadsheet) to determine the water storage capacity is summarized below:

- The yearly precipitation is 809.5mm in an average of 87 days.

- The total yield \([P(m) \times A(m^2) \times C]\) is 4740m³.
  
  \[P(m)\] = precipitation average monthly
  
  \[A(m^2)\] = area
  
  \[C\] = Run-off Coefficient

  \[A(m^2)\] rooftops = 1200m²
  
  \[A(m^2)\] parking, paving, hard surfaces = 6100m²
  
  \[C\] = 0.8

- The total water demand per year (domestic and irrigation)
  
  Irrigation of a 1800m³ area; 0.04 m depth per week = 3733m³
  
  Domestic = 760m³

The greatest volume of water in tank/reservoir at anytime and the minimum capacity of the tank is calculated to be 1757m³. With a safety factor of 2, the final reservoir size is calculated at 3513 m³ = [15 x 250l Jojo Tanks] or custom reservoir of 70 x 10 x 5m.

For a project of this nature, the infrastructure necessary for storing the calculated amount of water is excessive. Therefore, the safety factor of 2 will be adapted to a more suitable size tank of 1800m³. If flash floods or unusually high rainfall occur, excess water can be treated and recycled back into the city (Rand Water) grid via and overflow and safety pump. The water collected will only be used for irrigation and recycled grey-water within the building (flushing of toilets, urinals), therefore the pollutants that need to be removed are:

- Floating debris [removed with grid inlets at specified points]
- Pollutants lighter than water [removed with oil traps at specified points]

A diagrammatic layout of water run-off and necessary distribution networks (for irrigation and grey-water recycling) is indicated on the next page.
WATER DISTRIBUTION SYSTEM

FIG. 64.2 Water distribution system
8_02 MATERIAL CHOICE AND APPLICATION

STRUCTURE

CONCRETE
The main representative structural elements consist of 250 - 345 MPa cast-in-situ concrete at 7.6 to 8 meter intervals. The concrete structure unifies all spaces and required services. The elements have an inherent robustness, ideal for its context and conceptually representative of the monumental.

STEEL TUBING
The facade structure is constructed with 150mm square steel tubing, bolted to a steel cleat system which is fixed to the main concrete with cast in place anchor-bolts. The structure becomes a lightweight add-on and contrasting feature to the robust concrete, therefore representative of the temporal or dynamic.

STRUCTURAL STEEL
The main exhibition feature (digital media boxes) are framed with structural steel elements, to appropriately contrast and represent a floating additive form, protruding into the solid concrete form and the exterior urban space. The steel structures are cantilevered from the main concrete structural.

STRUCTURAL GLAZING
To benefit from natural light, to maximise the view towards the reinstalled Union Grounds, and for a clear, unobstructed glass aesthetic, structural glazing is used at main auditorium’s Southern edge. Double glazing system to be used in order to minimize acoustic disturbance.

FAIR-FACE CONCRETE WALLS
Cast-in-situ with specialist form-work, used as repetitive element at event space and gallery as well as at the auditorium (plywood shuttering). Waterproofed where required with Sika 1 specialist add mixture.

VERTICAL

POWERFLOATED CONCRETE SCREED
This element is implemented as alternative to brick floor finish to indicate spaces of lower traffic and as transitional material to acoustic flooring. Material chosen for its relative simplicity, low maintenance and aesthetic quality.

BOND DECK
25-50 MPa Robertson bond-deck lightweight composite floor and roof system applied to digital media exhibition space. System supported by structural steel framing. Element on Southern side of the building represents the concepts of temporality.

50mm COROBRIC BURGUNDY PAVER
Paving bricks used at public gathering or event spaces (high traffic) for its low maintenance, thermal massing, easy construction, relatively low cost and warm aesthetic quality. Used at interior and exterior spaces, the material acts as transitional element, bringing the outside

ISocrete ACOUSTIC FLOORING
The digital media exhibition boxes require sound insulation. The Isocrete floor panel system is an excellent sound insulator and closest to the aesthetic of concrete, which is implemented in various other parts of the design.

PLYWOOD FLOORING
Used as floor finish in the main auditorium. This material performs well acoustically, it is affordable and available as a recycled product. The plywood panels will be installed in combination with polypropylene reinforced acoustic floor panels and fixed to steel channel framework.
CONCRETE 245MPa
170, 255 and 340mm
Cast-in-situ reinforced concrete (according required span). Concrete floors are used as high thermal mass material and flat roofs as part of water gathering system.

MASONRY (RECYCLED & COROBRIC AGATE TRAVERTINE)
Recycled bricks from the Park Central Shopping Centre in combination with Corobic Agate Travertine to be used for construction of the main service core and other smaller feature elements to closely resemble JAG sandstone and brickwork of Meier Pienaar addition.

40mm DAMPALON TRANSLUCENT POLYCARBONATE CLADDING
Durable, translucent, lightweight material to be used as double skin wall cladding at digital media exhibition boxes in order to permit light towards the exterior without disturbing exhibition activities.

EXPANDED METAL MESH
Lightweight screen covering, representative of the dynamic and incomplete. Welded to secondary steel structure.

PERFORATED STEEL CLADDING
Panels to be used at event space as interior wall skin and acoustic ceilings, creating a warm aesthetic and also acoustically sound environment. To be used in combination with therm-acoustic insulation.

FIG 65.1-65.15 Materials Palette
8_03 DETAIL RESOLUTION

LIGHT

ACOUSTIC INSULATION

VENTILATION

ELECTRICAL AND ELECTRONIC

THERMAL MASSING

WATER

© University of Pretoria
FLOOR STRUCTURE: 260 x 90 x 8mm STEEL FLOOR JOISTS at 3800mm CENTERS
120mm THERMO-ACOUSTIC INSULATION
20mm PLYWOOD STAIRCASE
FLOOR FINISH ON 50mm POLYPROPYLENE REINFORCED ISOCRETE FLOOR PANELS FIXED TO ISOCRETE ACOUSTIC SPACERS
75 x 40 x 3mm STEEL CHANNEL FRAMEWORK WELDED TO FLOOR JOISTS

© University of Pretoria
CONCRETE CLADDING
FIG 68.1-68.4 Construction details 1:10

ROLL DOWN BLINDS FIXED TO A 150 x 10 x 10mm STEEL ANGLE, BOLTED TO STEEL FLAT SECTION AND CONCRETE SLAB WITH ANCHOR SEALS

4 WAY SPIDER CLAMP FITTING BOLTED TO STRUCTURAL GLAZING FIN

3mm GALVANIZED PLAIN STEEL SHEET BOLTED TO CHANNELS AND 100 x 65 x 8mm GALVANIZED STEEL ANGLES

255mm CAST-IN-SITU REINFORCED CONCRETE SLAB TO ENG. SPEC.

170mm CAST-IN-SITU REINFORCED CONCRETE BEAM TO ENG. SPEC.

155mm x 250mm CAST-IN-SITU REINFORCED CONCRETE UPSTAND / PARAPET WALL

200mm CAST-IN-SITU REINFORCED CONCRETE CLADDING WALL

DPM WATERPROOFING LAYER ON SCREED TO FALL 1:70 MIN TO RAINTRIM Outlet

76mm Ø GALVANIZED ROUND HOLLOW STEEL SECTION AS CURTAIN RAIL, SUPPORTED BY 100 x 50 x 6mm CHANNELS AS END BRACKETS, WELDED TO A 100 x 100mm FLAT STEEL SECTION AND FIXED BETWEEN COLUMNS

3mm GALVANIZED PLAIN STEEL SHEET BOLTED TO CHANNELS AND 100 x 65 x 8mm GALVANIZED STEEL ANGLES

80 x 40 x 2mm STEEL CHANNEL WALL SKIRTING

BLIND JOINT WITH RUBBER SEALANT

4 WAY SPIDER CLAMP FITTING BOLTED TO STRUCTURAL GLAZING FIN

250mm CAST-IN-SITU REINFORCED CONCRETE SLAB TO ENG. SPEC.

200mm RECYCLED BRICK BACHING WALL

170mm CAST-IN-SITU REINFORCED CONCRETE SLAB TO ENG. SPEC.