TECHNICAL PRODUCTION

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"Real technology must be employed in translating the brief and in the determination of the nature of operation, form and valid social life span of the proposed building. If indeed such an investigation suggests a building is the best solution". (Cedric Price, 2003, p308)

The most complex unit of any piece of architecture is the human being for whom it is designed. The goal of the technical production is to design a building, which will be sustainable and user friendly.
Passive design

"Passive design systems is a broad term used to encompass a wide range of strategies and options resulting in energy-efficient building design and increase occupant comfort. The concept emphasizes architectural design approaches that minimize building energy consumption by integrating conventional energy-efficient devices, such as mechanical and electrical pumps, fans, lighting fixtures and other equipment, with passive design elements, such as building siting, an efficient envelope, appropriate amounts of fenestration, increased daylighting design, and thermal mass.

Many passive buildings are compatible with active components such as solar hot water systems. Passive solar design balances all aspects of the energy use in a building: lighting, cooling, heating, and ventilation. It achieves this by combining, in a single concept, the use of renewable resources and conventional, energy-efficient strategies. (Koh, Fong and Lai

(www.bse.hk/bs/e-con/f/k/solar_k.htm)

The basic design principles that can be applied when one designs a passive building are:

- Design for thermal comfort, this can be achieved through thermal massing. Thermal mass is desirable for both summer and winter climate.

- Reduce glazing where possible or provide solar shading. (In the design of the centre where glazing is provided shading devices are offered).

- Design the building to maximise cross ventilation. Cross ventilation in summer can remove most of the heat in the building.

- Use deciduous trees for shading in the summer.

How the above principles have been applied in the design of the Art Centre will be discussed later.

Sustainable design strategy and materials

The issues pertaining to sustainable design is the use of recycled materials in the building. These materials will be sourced locally from the area where B. Kunz is proposing a building material recycling yard. All material that will be used in the building of the project will be sourced locally. Central to sustainable design is that the designed building should have low embodied energy and that the services designed for, should consume low energy.
Space

Site
The site is a consolidation of 642, 643, 645, 646, 647 and 648. The site is owned by the City of Tshwane Metropolitan Municipality. All the buildings on site except the Orient cinema will be demolished for reasons cited earlier. The bricks of the demolished buildings will be cleaned and re-used in the construction of the new building. The existing sewer lines will be moved and connected to the main sewer line on the eastern side of the site on 9th street.
The site’s existing building and the pedestrian interface influenced the geometry of the building.

Environmental qualities
Natural light will be utilised in the building. All spaces in the building will have appropriate natural light and will have views to the outside. The lobby will be the heart of the centre and a feeder area for people to other spaces in the building. The lobby will therefore have to be a vibrant social area that will act like a low street and in that case will have very few planting.
All the levels will have a view of the lobby, and of the outside. The use of natural light in the building is important in that it will add drama to all the spaces within the building through the shadows that will be cast.

Geometry
The geometry of the building was determined by the site, context, climate, user/building interface and the needs of the users. The site dictated that the form be North-South which is not desirable. The geometry of the building however, supports the flow of pedestrian movement. The form consist of two rectangular masses and a circular form on the South-Eastern side of the site. The geometry of the building plays an important role in how the users respond to the building. The South-East corner geometry for example, frees that corner and facilitates a smooth and easy movement around the corner, while giving the user access to the interior space.

Structure
The structure of the building was determined mainly by the programme. The structure was also influenced by the working concept of accessibility and the idea of minimising energy consumption. Energy consumption strategies that were applied are:
- Insulation
- Heat storage
- Internal micro-climate
- Illumination

Heat penetrates the interior of the building through windows and it is stored on the interior surfaces. The surfaces re-radiates some of the absorbed energy into the space and stores some of the energy. The amount
stored by the surfaces depends in the colour of the surface and its mass. For the Art Centre, the building of the structure will be labour intensive in order to provide employment to the locals. For this reason in situ concrete structures will be specified even though it is a bit costly. Concrete as a material was chosen despite its high embodied energy. The advantage with concrete is that it is recyclable.

All the facades of the building except the Southern facade will have sun screening devices. Where sheetmetal sun screens are provided for, a square hollow section carries them. The sheetmetal screen protects the facades from the heat during the day.

**Materials**
The use of bricks generated from the recycling yard in the vicinity, as a building material, will contribute to sustainability. The steel that will be used in the building will be sourced from ISCOR Steel locally.

For the new building the designer will use a combination of 190 X 190 X 90 hollow clay blocks with a textured surface finish and a single skin of 90 X 90 X 190 modular bricks. The combination of the above will offer optimal thermal and acoustical performance.
Clay blocks offer good thermal performance through its cavity. Modular bricks act as thermal storage. In-situ concrete columns were used in the building. Two T steel sections bolted back-to-back are bolted to the columns to carry the long spanning curved roof.

The roof structure has a theme of lightness. The roof overhangs beyond the enclosure. The articulation of the roof is by structural RSJ sections. The puddles used are top hats which create a shadow line when viewed from the interior. King Klip 700 sheetmetal was chosen as a roof material.

**Landscaping**

Hard landscaping is used around the site. The northern and western side of the site will be planted with trees.

Floor finishes on the outside of the building are used to bring texture and also emphasis events that happen around the building, for example where access to the building is, 220x100x50mm clay cobblestone pavers are used. The red colour of the pavers will highlight where the entrance and exits are. To carry on the theme of accessibility the same clay pavers are used in the inside of the building. Where other events happen, for
example where a food take away counter is provided for, access is emphasised through the use of stone pavers. In-situ concrete floors will also be used and the community will be involved in the patterning of these areas.

**Plants**

All plants that will be specified on site will be indigenous. On the North-Western side of the site the plants that will be specified are *Tulbaghia violacea*, *Cape Aloe* and *River Bush Willow*. The fever tree will also be specified.

On the South-Eastern corner of the site, fever trees will be planted as indicated on the plan. The old building will be lined with lavender trees along the entrance. Everywhere else on site where shrubs are specified, *cape thatching reeds* will be planted.

**Facades**

The orientation of the building poses problems. The thermal properties of the western facade had to be addressed. Fortunately the existing building facade has a skin that is 385mm thick. Due to the depth of the building though, the building could not have glazing. The glazing was provided in order to allow natural light in the building. The new building also has glazing on the western facade to optimize natural light in the building.
Solar control

"At certain times of the year, in both temperate and hot climates, excessive solar radiation passing through glazing to interior surfaces and can cause occupant discomfort. External shading, especially when fixed, is a significant architectural element, as in the Schroder house by Gerrit Rietveld. Shading elements may be external, or internal; and seasonal, fixed, or movable." (Carleigh, P91, 1996)

Different types of external shading suit different orientations. For west facing glazing, one needs to screen out low-level summer evening sun, and in such cases vertical screens are preferred. In other areas, a combination of horizontal and vertical screening may be necessary.

Looking at the above diagrams, it is clear that external shading devices are more effective than internal devices. After careful consideration, external shading devices will be used in this design. The screen that will be used on the western façade will be composed of two 2mm perforated sheetmetal screens.

The outer sheet will have 60% perforations, and the inner façade will be 40% perforated. The outer perforations are smaller than the inner perforations are, this means that the light that goes through the screen will...
and will lose most of the heat before it reaches the interior. The screen assembly will have a frame to hold the two sheet metals together.

**Ceramic tiles sun screen**

The façade of the library is screened with a ceramic tile sun screen. The tiles’ positions will be held in place fixed in position. This means that the tiles do not move. Local artist will be commissioned to design the tiles.
Glazing

Glass admits light and solar radiation into a building. Depending on the type of glass, a portion of incident radiation is admitted to heat a building. The fraction heat admitted is referred to as the Solar Heat Gain Factor (SHGF). It differs with the type of glass. The degree to which solar radiation of a given wavelength varies depending on material composition, thickness and the refractive index of glass. All glass have a shading factor, that is the heat gain of a particular glazing as a fraction of that allowed by clear glass. The following table outlines the shading factors of different types of glass.

<table>
<thead>
<tr>
<th>Glazing</th>
<th>SHGF</th>
<th>Shading Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear glass</td>
<td>0.0403</td>
<td>1</td>
</tr>
<tr>
<td>Heat absorbing glass</td>
<td>0.0390</td>
<td>0.78</td>
</tr>
<tr>
<td>Reflective glass</td>
<td>0.2090</td>
<td>0.48</td>
</tr>
<tr>
<td>Clear glass with reflective screen</td>
<td>0.1390</td>
<td>0.16</td>
</tr>
<tr>
<td>Double glazing</td>
<td>0.0750</td>
<td>0.60</td>
</tr>
</tbody>
</table>

The glass used on all facades except the library and the café is 6mm thick. The library and café will have a 12mm thick sooty glass tinted grey. All glazing is fit with mild steel mullions.
Ventilation
The primary mode of ventilation in building is passive. Natural ventilation depends on where the openings in the building are. It also depends on air movement. In the library and all the spaces the visitors can open and close windows at will. This offers an opportunity for interaction with the building. There is also a small air conditioning plant provided for peak temperature.

Stack effect: hot air radiated by a building's occupants and equipment tends to rise towards the ceiling or open windows. This principle has been applied on all the windows on the Eastern side. The windows have an opening at the bottom and the top. The principle is that air vents out the top, thereby encouraging hot air to rise, and drawing fresh air at the bottom. The plan of the building is narrow, so as to facilitate cross ventilation from the calm North-Eastern winds in the morning and the North-Western winds in the afternoon.

Insulation
The roof is insulated with iso-board ceiling, in order to reduce heat gain. The concrete floor slabs and masonry walls mediate internal temperature variations through their mass.
Fire and emergency requirements

All steelwork in the building will be coated with fire protective coating.

Fire extinguishers: A fire extinguisher which can be easily reached, will be kept in the building. There are different types of fire extinguishers available: there are dry powder extinguishers, which are effective and can be recharged on site. The others are water fire extinguishers, which will take care of most fires, except electrical fires. In the building powder extinguisher will be used. A 45m fire hose will be provided for every 500m².

Water
Water that will be used on site will be municipal water. On the side where the informal market is situated, a tap will be provided for underneath the fire escape stair. The tap will be used and managed by the informal traders.

The run-off water on site will be channelled towards the planters around the site. The planter beds will be well drained in order to prevent water clogging around. The planters' bottoms will have gravel to provide effective drainage. On top of the gravel a mat will be put to prevent the next layer of sand to fall through. On top of this layer ordinary potting soil will be used.
Services

A single connection is made to the municipal water supply with a 76mm diameter pipe. Single stack system (building less than 30m) with vent pipes will be used. The municipal sewerage to be connected to is on Mogul street.

Waste disposal from the kitchen and the building will happen on 9th Street.

Electrical: Electricity is needed for lighting, power, emergency, IT power and cabling, supplies to lifts, air conditioning, earthing and lighting protection, security, voice and data services.

Transport: Workers and visitors to the centre will have access to established public transport. They will have access to taxis, buses and trains. There are two bus terminals, a railway station and a few taxi ranks including long distance taxi ranks.

Acoustics: Where required acoustic criteria as set out in the (SABS0103; 1994).