[07][00[00] TECHNICAL NOTES

[07][01][00] INTRODUCTION

MATERIAL SELECTION

[07][01][01] CONCRETE

CONCRETE

The superstructure of the proposed development consists of a reinforced column and slab structure.
The alterations and extensions to the gallery will include the new balconies and walkways in the atrium. New openings will be formed in the gallery slabs, to create interesting access points from the north and south.

The reinforced concrete column and slab construction will also form the first floor dining area in the new restaurant.

This construction method will also be used for the altered theatre, especially in the additional areas of the pre theatre, which include the newly created entertainment area and the administration volumes, as well as in the southern service areas and the stage.

There are numerous advantages to using concrete construction, one of which is its good thermal mass due to its high density. It can achieve large spans and is easily moulded and cast in situ. Various finishes and textures can be achieved in concrete, depending on the formwork used and the addition of oxide pigments.

[07][01][02] BRICK

Many of the buildings at the arts campus are of concrete construction with brick infill, as are many examples in the CBD. This is the case with the design drivers at the proposed project, not only derived from the existing hostel and the school hall but also from the neighbouring buildings.

Brick has a low embodied energy and is produced locally. The erection of brick structures relies on intensive labour by local bricklayers, empowering the local labour force.
Brick has good thermal mass and load bearing / structural properties. Brick is recyclable and easily reused.
The proposed project requires two different types of bricks: stock bricks will be hidden by cladding and plaster and will serve as thermal mass. The face brick will tie in with the existing envelope and create the wholeness that that the design strives for.

DANCE DEPARTMENT; SOUTH EAST

GALLERY; NORTH/ EAST
'HEIDEHOF'

DESIGN DRIVERS; THE TWO COLOURS RED FACE BRICK, THE SASH WINDOWS

EXISTING ENTRANCE; SOUTH
'HEIDEHOF'

SOUTH / WEST ELEVATION; NEW
MAIN ENTRANCE FROM THE SQUARE

THSE SANDSTONE SURROUND AT THE FRONT DOOR TO REPEAT AT THE NEW ACCESS

EAST ELEVATIONEXISTING HALL

SOUTH ELEVATION THEATRE
EXISTING HALL

fig [**45**] DESIGN DRIVERS

THE FACE BRICK, THE LARGE FRAMED WINDOWS AND THE CONCRETE PORTAL FRAMES

TECHNICAL NOTES

[07][01][03] STEEL.

The proposed project uses steel sparingly, except in the restaurant where the effect of lightness is communicated, as demonstrated by the “shop front” of the support system to the glazed southern glass wall that opens onto the verandah and stage. Steel is utilised for its tensile qualities.
The advantages of steel include the following: it can be recycled and reused, has good structural properties and requires very little maintenance. Standard steel sections will be used in the project, the assembly of which will be executed on site. Steel is a non-renewable resource.

[07][01][04] GLASS

Glass introduce natural light into the buildings, merging interior and exterior space. At the restaurant, as discussed, a feeling of weightlessness, translucency and illuminating the verandah and the stage during the evening performances.
The advantages of glass is in the interior exterior visual link, and the natural day light penetration.
It can be recycled and reused, it ad to occupant comfort.
At the restaurant where larger areas of glass are a prominent envelope treatment it will be to minimum 19mm insullvue glass or similar as spesi ed by the manufacturer.
The glass must have a low emissivity outer layer in order to reduce heat loss at night, due to the low thermal insulation value of glass. The proposed project relies on shading devices on the northern and western facades of the restaurant, reducing the most disadvantages associated with glass

TECHNICAL NOTES

[07][02][00] STRUCTURE

The off-shutter reinforced concrete columns are not only structural, but also provide volume in the composition of the elevations, as in the colonnade in the gallery atrium and in the treatment of the theatre auditorium.
All the columns to have 20 mm chamfered edges and to be cast in single-storey heights.
Concrete to be cast with vertical movement joints at 10.0 m intervals, with expansion joints providing a complete break through the entire structure. Joints in the brickwork to be sealed with 12 mm bitumen-impregnated soft board.
340 mm concrete slab in the theatre service areas and in the restaurant. All reinforced concrete work, slabs, columns and beams to the specification of the structural engineer.

[07][02][01] ROOF CONSTRUCTION

The roof construction of the proposed project will match the roof treatments of the existing buildings on campus.
Steel rafter construction to the design details of the roofing specialist and the structural engineers.
The curved design as indicated on the sections of the theatre and the restaurant roofs will bring a softer, more organic form to the precinct.
The stepped detail creating the skylight at the restaurant allows natural light to penetrate deep into the restaurant interior.
The theatre roof construction detail being similar to that of the restaurant, with the pre-theatre and stage service areas opening to central atriums, create the interesting curved roof volumes to the west of the proposed project.
Corrugated galvanised sheet roof finish, to match the existing roof finish.

TECHNICAL NOTES

[07][03][00] INCLUSIVITY

The project allows for easy access by visitors with disabilities. The demarcated enlarged parking bays at the main access point onto the square lead to a ramp that avoids the threshold curb at the parking area.

There are access ramps at the entrances to all three the buildings. All ramps have a maximum gradient of 1:12. The paving layout and installations on the square will be easily manoeuvrable.

The disability toilets are part of the ablution facilities in the buildings, and comply with the requirements set by Section 8 of the National Building Regulations. These amenities are provided close to the entrances for easy access, near foyers or courtyards.

[07][04][00] SUSTAINABLE FEATURES

The new restaurant will be placed 26 degrees east to avoid the harsh and hot northern solar orientation. The orientation of the existing “heidehof” hostel is successful to the north. The enclosed design of the theatre will not be affected by the northern orientation.

The provision of a skylight in the split level, roof construction of the new restaurant, with the orientation of the building to the South and provision of ample glazing while blocking western sunlight with masonry walls, will effectively block unwanted solar gain.

The interiors are organised around a courtyard – atrium in the gallery and so receive abundant light, fresh air, and views to the outdoors.

TECHNICAL NOTES

The project's many **GREEN FEATURES** include:

- precise mapping and load separation of areas receiving outside air to **minimise the mechanical load** of the air-conditioning,
- deep **daylighting**, achieved by ceiling configurations,
- envelope upgrades that include **good insulation and overhangs**, resulting in a well-insulated and comfortable building.

SUSTAINABLE FEATURES include:

- A **rain water** collection and filtration system for the ablution facilities and landscaped areas in and around the buildings.
- Optimal building **orientation** and the provision of **natural ventilation** with operable windows located to optimise exterior air currents, in order to deliver good indoor air quality.
- Energy systems such as a **photovoltaic** array, ground-source **heat pumps, daylighting, ceiling fans, and efficient lighting** integrated into the building. An interactive panel will show how these energy systems can be controlled to balance energy demands with incoming **solar powe**r.
- One of the design features of the restaurant is the prominent roof construction forming a **solar umbrella** , or shading solar canopy, that is passively adapted to the temperate-arid climate of Northern Gauteng. Rather than deflecting sunlight, this solar canopy will use amorphous **photovoltaic panels** to transform sunlight into usable energy, providing the building's electricity. At the same time, it will **screen** large portions of the structure from direct exposure to the intense sun, protecting the body of the building from **thermal heat gain** . A future net meter should be provided by the electricity distribution authorities that will connect the photovoltaic array to the municipal supply grid, eliminating both the need for a storage system and the time-of-use charges associated with traditional electricity use.
- **Solar hot-water panels** will preheat hot water.
- The **day-lit interior** requires no electric lighting on sunny days.
- Materials will be selected for their durability and **environmental responsibility**.

TECHNICAL NOTES

The Norris -Eyring Formula :

$$T60 = \frac{0.161V}{-2{,}3 s \log(1-a)}$$

v = volume of the room (m3)
s = total surface area (m2)
a = average absorption coef cient

sound absorption of auditorium is not homogeneous
the average absorption is ;
the amount of absorption in m2 for each sub surface
The total amount of absorption (sum absorp of all sub surfaces) devide total absorption by total surface area of room .

$$a = \frac{a}{s}$$

$$a=(s1a1 + s2a2...+ snan)= \sum_{i=1}^{n} siai \text{ (m3) or sabines}$$

sabine formula for reverberation time

a simpli ed formula for quick calculation of reverberation time

$$t60= \frac{0{,}161v}{a}$$

this formula is accurate for a= 0,25

[07][05][00] ROOM ACOUSTICS THEATRE

In the auditorium the control of background noise and optimisation of reverberation times are crucial requirements for attaining good speech intelligibilit y. One of the main parameters controlling reverberation is sound absorption .

[07][06][00] REVERBERATION TIME

Reverberation time entails the reduction in sound power and in sound pressure levels after a number of re ections . The sound pressure level (db) of a sound wave under going re ections bet ween the boundaries of a room deca ys linearl y with time , at a rate ka which is the function of the average absorption coef cient . The total reverberant sound pressure level will fall at a constant rate , if the source of the sound is stopped . The less absorption in the room , the smaller the rate of deca y and the longer the time it will take for the sound pressure level to fall by a speci ed amount . Reverberation time is de ned as the time that it takes for the sound pressure level to fall by 60db after the source has been switched of f. Reverberation time is indicated by the symbol t60 and is calculated by the Norris -Eyring formula .

[07][06][01] FREQUENCY DEPENDENCE

The sound absorption of an y material is frequenc y dependent , and the reverberation time of a room is also frequenc y dependent . Reverberation time is calculated at octave band or third -octave band centre frequencies .

TECHNICAL NOTES

[07][06][02] TYPICAL REVERBERATION TIMES

The reverberation time is an important parameter in the design and performance assessment of the auditorium. There are no international standards for optimal reverberation times, and the task should be left to an acoustic specialist. In general, music requires relatively long reverberation times, but good speech intelligibility requires short reverberation times.

Examples of typical mid-frequency range (500hz) reverberation times are:
Auditorium 500 m³ 1.0
Auditorium 2500 m³ 1.2
Unisa Chapman hall with adjustable acoustics
(set for speech) 1,90

T60 is directly proportional to volume V.
T60 is indirectly proportional to absorption.
For reverberation purposes, a certain minimum volume is required in a room.
It is dependent on the number of seats in the room, and the purpose of the room.
For speech: the volume increases from 4,5 m³ per person for 50 seats
to 6,5 m³ per person for 5,000 seats.

The contents of a room affect the amount of absorption and in turn the reverberation time.
The desired reverberation time may be designed for a room that is ¾ of its capacity. The desirable reverberation time is a function of the intended use of the space and room volume.
For speech; the ideal reverberation time increases from 0.7s for 300m3 to
1,0s for 3000m3
1,3s for 30,000m3

[07][06][03] SOUND ABSORBERS

Dissipative absorbers are employed in the acoustic design for the control of reverberation time and noise, and are used in conjunction with insulating materials for the cladding of walls, panels and ceilings. Materials to be used: glass wool, mineral wool, open-cell polyurethane foam and underfelt.

The porosity of the surface materials will allow sound penetration. The internal porosity will consist of elastic particles and thin   bres connected by small air passages or cavities, allowing sound to enter and set   bres in motion. Soft, resilient panels of materials as above will be provided.

These dissipative absorbers will allow sound energy to penetrate their surfaces and enter the small passages and air- lled cavities in the material.
Kinetic energy in the sound wave is transferred to the material and sets   bres, particles and cavity walls into vibration.
Due to friction and viscous losses, this energy is eventually transformed into heat.

Examples of acoustically translucent protective covers to be used: perforated vinyl, perforated steel, woven cloth, wooden slats with openings and expanded metal.

The acoustic   nish to the ceiling:

A wooden slatted ceiling with openings and 100 mm glass wool insulation absorbers to is be installed at the back and the front of the theatre (as against the back wall).

Seats: open weave upholstered
occupied/p.seat 0.42 @ 500hz/m2

Re ective non-absorptive   nish to the
  oor - ceramic or vinyl tiles
0.01 0.05
absorption at 500 hz

A lobby is to be created at the access to the theatre to serve as a sound absorber.

[07][07][00] FIRE MANAGEMENT

The National Building Regulations stipulate in Section TT 16.2 that a building with three storeys or less in height is not required to include an emergency escape route.

The NBR specifies that the distance to be travelled by those fleeing a fire, measured to the nearest escape door, must not exceed 45 m. The buildings in the project are double storeys and the distance from any point in the interior is close to an outside door.

In section TT7 the NBR requires structural elements to have the following fire resistance levels:
The restaurant: 60 minutes
Exhibition space: 90 minutes
Offices: 60 minutes

All exposed structural steel to be fire retardant treated with Fire Barrier Intumescing paint and a finishing coat of non-flammable acrylic paint. Matt finish, colour to match envelope treatment as indicated on the elevations and the finishing schedules.

Steel load-bearing elements must be cast in-situ, at connection points with concrete and masonry work.

All fire protection systems to comply with SABS 0400, i.e. fire management, water sprinkler system, fire detectors, alarms, carbon dioxide fire extinguishers and fire escapes. See fire management drawings.

[07][08][00] CLIMATE CONTROL

Climate control is achieved through orientation, solar control and natural lighting.
The site has a strong north / south orientation. As a result the design, being informed by the site and its context, has long north and south facades.

TECHNICAL NOTES

Making use of natural daylight was an important objective during the design process and roof lights and atriums are incorporated to open up the design and let natural daylight into the buildings. On northern and western facades, preference was given to offices, administration and retail functions. Southern and eastern light was preferred for the galleries to facilitate the display of sensitive art works. Indirect northern light, provided by the atrium, enters the gallery. The extended roof overhangs over the balconies and walkways create further diffusers, and prevent direct solar radiation from entering the north-facing galleries in the south wing.

Similar to the treatment of the restaurant, the northern light is diffused by deeply recessed narrow windows. The southern facade with its bigger glazing opens to the view, the square and the outdoor stage. The stepped roof detail allows natural daylight deep into the restaurant through the double-volume central internal atrium.

[07][09][00] THERMAL MASS

Thermal mass will be provided by the brick exterior of the western and the northern facades of the theatre, gallery and restaurant. It will contribute to the comfort of these spaces during evening performances and functions. The facades absorb direct and indirect solar radiation during the day and radiate the accumulated heat at night. This delay period is determined by the density and thickness of the materials used.

The thickness of the hard-baked face brick exterior finish provides a sufficient delay period to ensure that interior temperatures are effectively cool during the day and comfortable at night.

[07][10][00] VENTILATION

Passive ventilation is an important consideration in the design process, in order to reduce the amount of energy used. All windows can be manually opened and closed to maximise occupant comfort. The design incorporates internal open areas, such as the double-volume dining area in the restaurant, an atrium that is not roofed, and central internal courtyards in the gallery and the pre-theatre area.

Mechanical ventilation systems will be introduced in the auditorium and stage, for use during performances. These systems will also be provided for the western of ces, the administration of ces at the gallery, and for the kitchen and of ce at the restaurant.

[07][11][00] LIGHTING

Lighting Measurements

Lumen – denotes the measurement of the light output of a lamp.

Lux - denotes the measurement of the light intensity falling on a surface. One lux is equal to one lumen per square metre.

One of the factors used when designing architectural lighting systems is illuminance. One lux is the illuminance at the same point at a distance of 1 metre from the source. Good lighting depends on more than just illuminance levels. The direction, distribution, colour temperature and colour rendering index of the source all contribute to effective lighting (and visibility). The task reflectance and contrast also contribute greatly. Illumination levels are generally dictated by the needs of the visual task. Typically, the more light available, the easier it is to perform a speci c task.

It is important today that the lighting designer provide appropriate lighting levels required by any !! task. In new constructions, energy restrictions and building codes often tend to limit lighting to the number of watts per meter. It must be remembered that these are average   gures in that a storage room might require lower lighting levels and an of ce area might require higher lighting levels.

There is great value in the task/ambient approach to lighting. This method   rst provides general room illumination and then speci c, brighter illumination - only where needed. In this way, ambient lighting levels may be reduced to save energy and task area lighting may be increased for optimum human performance.

TECHNICAL NOTES

The Illuminating Engineering Society has published illuminance recommendations in table form

TABLE 1

ACTIVITY	CATEGORY	LUX
Public spaces with dark surroundings	A	20-30-50
Simple orientation for short temporary visits	B	50-75-100
Working spaces where visual tasks are only occasionally performed	C	100-150-200
Performance of visual tasks of high contrast or large size	D	200-300-500
Performance of visual tasks of medium contrast or small size	E	500-750-1000
Performance of visual tasks of low contrast or very sm size	F	1000-1500-2000
Performance of visual tasks of low contrast or very sm size over a prolonged period	G	2000-3000-5000
Performance of very prolonged and exacting visual tasks	H	5000-7500-10000

TABLE 2

ILLUMINANCE CATEGORY	DIFFICULTY OF VISUAL TASK	IMPORTANCE OF SPEED & ACCURACY non critical	/ critical
A	MOVEMENT THROUGH PUBLIC SPACES	50 - LUX -	75
B	INFREQUENT READING OR WRITING; High contrast & large size	100	150
C	FREQUENT (& easy) READING OR WRITING; High contrast & large size	200	300
D	MODERATELY DIFFICULT READING OR WRITING; low contrast or small size (e.g. penciled mechanical drawings)	300	450
E	DIFFICULT READING OR WRITING; low contrast & small size	500	750

PROPOSED LIGHTING AND CONTROL

TECHNICAL NOTES

THEATRE				
LOCATION	FITTING TYPE	QUANTITY	POWER	TOTAL POWER(W)
Intermission and service bar	35W IRC Low Voltage	20	35	700
Kitchen and Storage	2X36W, T8 Surface	4	72	288
Male and Female Toilets	18W CFL DOWNLIGHT	20	19	380
Storage	2X36W, T8 Surface	3	72	216
Gallery	LF UV STOP 1X58W DIM	20	58	1160
Gallery	Tube Light:LF UV STOP 1X58W DIM	10	58	580
Entrance Foyer and Lobby	35W IRC Low Voltage	18	35	630
Dressing Areas	18W CFL DOWNLIGHT	20	19	380
Theatre L Cove Surroundings	2 X 80W, T5	30	160	4800
Plant Room	2X36W, T8 Surface	4	72	288
Storeroom and workshop.	2X36W, T8 Surface	4	72	288
Management and Admin	2 X54W, T5 Pendant	6	56	336
First floor office and storage	2 X54W, T5 Pendant	6	56	336
Control and office over bar	2 X54W, T5 Pendant	2	56	112
DALI Control Solution with P/D and L/S	BECKHOFF	1	10	10
				10504

RESTAURANT				
LOCATION	FITTING TYPE	QUANTITY	POWER	TOTAL POWER(W)
Kitchen	2X36W, T8 Surface	4	72	288
Restaurant (Ground floor)	2 X54W, T5 Pendant	30	108	3240
Restaurant (1st floor)	2 X54W, T5 Pendant	15	108	1620
Bath Rooms	18W CFL DOWNLIGHT	10	19	190
DALI Control Solution with P/D and L/S	BECKHOFF	1	10	10
				5348

ART GALLERY				
LOCATION	FITTING TYPE	QUANTITY	POWER	TOTAL POWER(W)
Ground Floor Open Areas, L Cove Surroundings	LF UV STOP 1X58W DIM	175	58	10150
Ground Floor Open Areas	Tube Light:LF UV STOP 1X58W DIM	96	58	5568
Workshop and restoration	2X36W, T8 Surface	3	72	216
Admin and Library	2 X54W, T5 Pendant	6	56	336
Plant room	2X36W, T8 Surface	3	72	216
Toilets-male and disabled.	18W CFL DOWNLIGHT	5	19	95
Storage	2X36W, T8 Surface	3	72	216
DALI Control Solution with P/D and L/S	BECKHOFF	1	10	10
LOCATION	FITTING TYPE	QUANTITY	POWER	TOTAL POWER(W)
1st Floor Open Areas, L Cove Surroundings	LF UV STOP 1X58W DIM	145	58	8410
1st Floor Open Areas	Tube Light:LF UV STOP 1X58W DIM	96	58	5568
Staff Rest Room	2 X54W, T5 Pendant	3	108	324
Curator	2 X54W, T5 Pendant	2	108	216
Office	2 X54W, T5 Pendant	2	108	216
Toilets-female	18W CFL DOWNLIGHT	5	19	95
Board Room	2 X54W, T5 Pendant	3	108	324
Storage	2X36W, T8 Surface	3	72	216
				15369

info: Clarkson,M.2008. Osram Jhb.

TECHNICAL NOTES

[07][12][00] THEATRE SIGHTLINE

S=Floor to stage bottom	1000
H1=Height of seated front row viewers top of head	1300
E1=Height of seated rear row viewers eyes (no riser)	1200
D1=Stage to front row viewers eyes	3400
D2=Stage to back row viewers eyes	19000

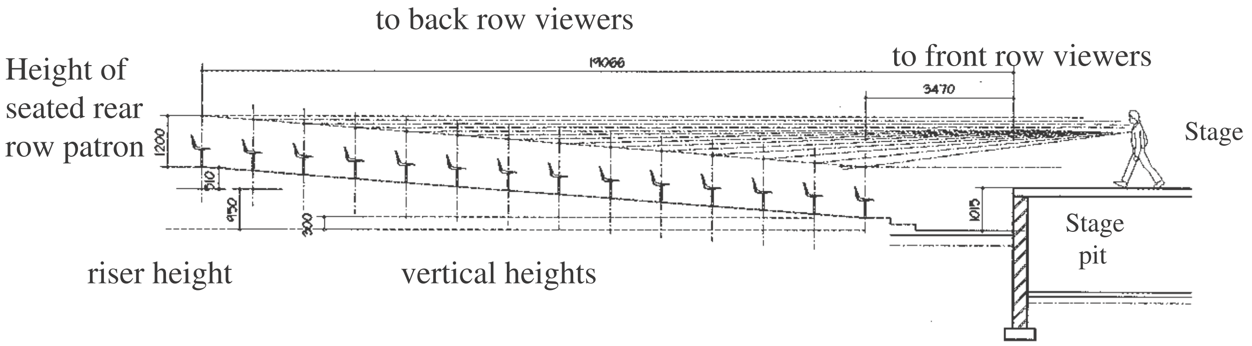
Then, the calculations:

H1-S=V1	300
V1/D1=R	0.09
R*D2=V2	950
V2+S=E2	1710
E2-E1=Riser height	510

V1=300, Vertical V2=950, Vertical E2=1710 Back row eye level (with riser).

GROUND FLOOR THEATRE

THEATRE SIGHTLINES



SECTION; SEATING AREA