CHAPTER
7

TECHNICAL EXPLORATION

There are so many ways to heal. Arrogance may have a place in technology, but not in healing. I need to get out of my own way if I am to heal.
(Schaef, 1995)

INTRODUCTION & TECHNOLOGICAL AESTHETIC

INTRODUCTION

The following chapter expresses the technical investigation explored for the dissertation with the previous theories and design in mind (see fig. 7.1). The technological aesthetic is firstly expressed through diagrams which show the concept intentions as related to the technological aspect of the project that will be expressed and followed.

From here, various three dimensional technical aspects are explored whereby the reader can engage fully with the building and its construction.

Relevant precedents are explored which have been inspirational and can be used to express and highlight the ideas set out in the dissertation thus far.

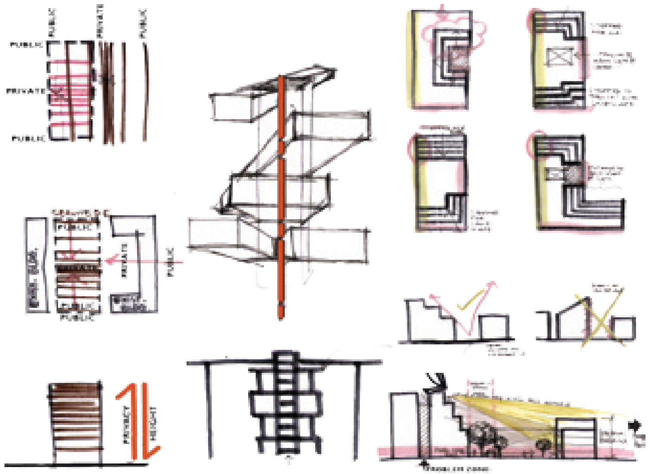

fig. 7.1

TECHNOLOGICAL AESTHETIC

A building can mediate between tectonic and stereotomic technological aesthetics, as described by Frampton. Issues of siting, spatial definition, construction and environmental responses create results which usually lie in the middle of these two aesthetics where all aspects of a building are addressed.

TECHNICAL PRINCIPLES EMPLOYED

The technical development and responses for this dissertation were guided by the theoretical argument so as to relate back to, and strengthen, the design decisions made. The experiential aspects of the design provide the basis for all technological decisions made.

It has been highlighted throughout the dissertation that the *Centre for Healing* should be a facility where layers of healing and growth can occur in a building that encourages recovery within an existing therapeutic city block. These ideas need to be taken into account when making any decision with regards to the technological aesthetic of the building.

The facility is firstly to be seen as a stable structure that supports the patients that are housed at the facility and thus, the technology used that makes up such a facility should highlight and express this as an important aspect. However, the facility is to also be seen as a building that houses the healing process, a process that relies on this stable structure. It was therefore concluded that the facility should clearly show both these aspects of it's nature and how the one relies on the other to any user or passer by (see fig. 7.4-7.5). These aspects should be shown on all the various levels of technology that relate to the construction of the building, from the structure, to the infill, circulation, services, material choice, junctions of materials and even to issues of sustainability.

It was also found necessary to design the various experiences through the building on a human scale to allow the user to become aware of the materiality, spatiality, massing and light quality within the building, however still allowing a monumental feel to the facility entrance

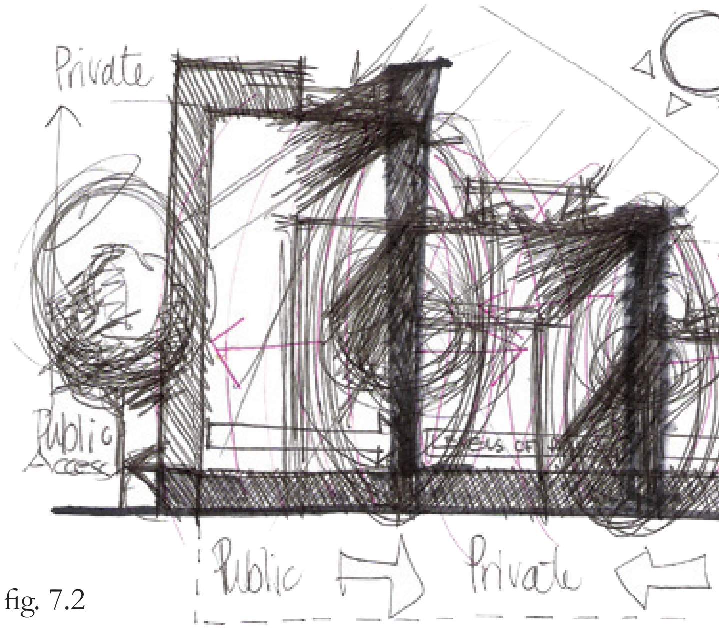

fig. 7.2

fig. 7.1 Summary sketch of the concept architectural intentions from chapter 5
fig. 7.2 Technological aesthetic intentions (1)
fig. 7.3 Technological aesthetic intentions (2); highlighting technological and environmental aspects
fig. 7.4 Technological aesthetic intentions (3);highlighting the creation of a solid core from which the healing arms of the building radiate
fig. 7.5 Developed section showing the aesthetic intentions highlighted in fig. 7.4

to highlight it's importance in the community it serves.

The result is that the technological aesthetic adopted through the resolution of the building should not only follow the conceptual approach followed through the design of the facility, but it should also consider practical issues such as construction techniques and availability of materials, cost and environmental requirements necessary to make the project a success.

Figures 7.2-7.5 show a summarized technological response to the concept and items highlighted above that were used as a basis for all decision making in terms of upholding the technological aesthetic required within the facility.

These technical aspects are identified and each explained in more detail throughout this chapter .
They are: the structural system, circulation, services, sustainability and materiality.

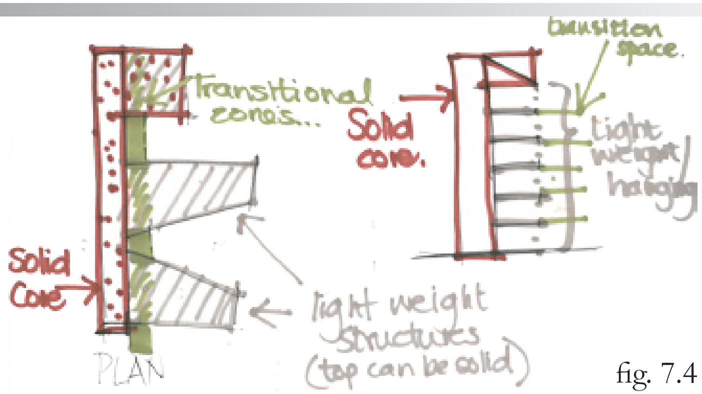

fig. 7.4

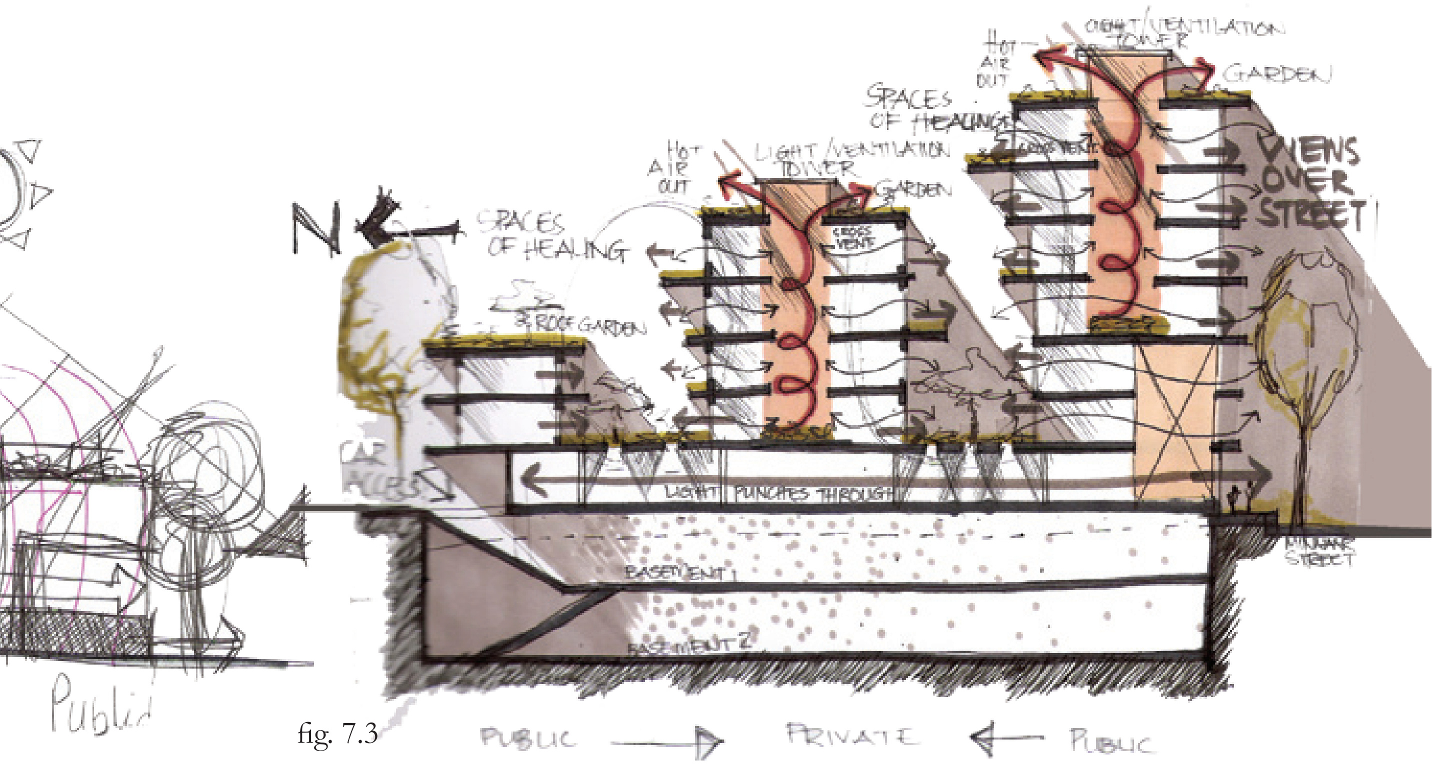

fig. 7.3

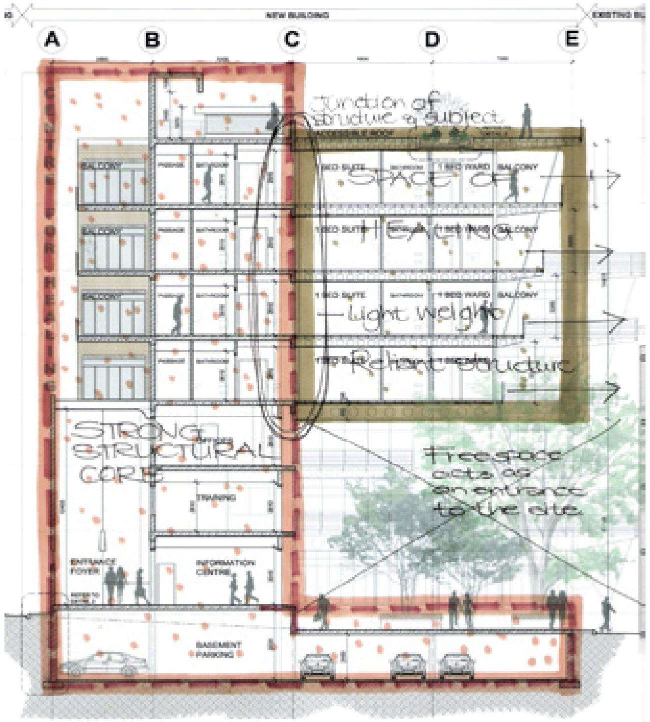

fig. 7.5

STRUCTURAL SYSTEM

STRUCTURAL SYSTEM

The primary, secondary and tertiary structural systems employed within the facility highlight the concept intentions laid out earlier in the dissertation, with the primary structure acting as a stage from which all activities occur through the facility. It should be noted that both the primary and secondary structures were designed by the author in consultation with a structural engineer - Mr. Dudley deKlerk of ARQ Consulting Engineers.

PRIMARY STRUCTURAL SYSTEM (red & grey)

A concrete slab, column and beam configuration is used along the main "spine" of building (see fig. 7.6-7.7). This represents the solid structure/core of the facility and the platform from which healing can occur and from which the secondary structure of the building can rely on, as the patients rely on the structural support of the nursing staff at the facility (see fig. 7.8-7.10).

SECONDARY STRUCTURAL SYSTEM (green)

The secondary structural system of the facility consists of a steel cellular beam construction hung in tension from the primary structure by means of high tensile steel cables (see fig. 7.8-7.10). This portion of the building represents the area of healing within the facility. It is the portion of the building that relies on the primary structure for support, as the patients at the facility lean on and rely upon the staff at the *Centre for Healing*.

TERTIARY STRUCTURAL SYSTEM

The tertiary structure for the facility is the non-structural building infill of the entire building. The building infill for each of the two sections (primary and secondary structural systems) should reflect the ideas that are highlighted by the choice of structure employed. For example, the infill for the primary structure (the solid core of the building) will mainly have solid infill materials such as brickwork and concrete. The secondary structural portion of the building needs to be seen as a light weight 'floating' item. The infill for this portion therefore, needs to be light weight materials such as steel, Nutec board, glass and GKD mesh.

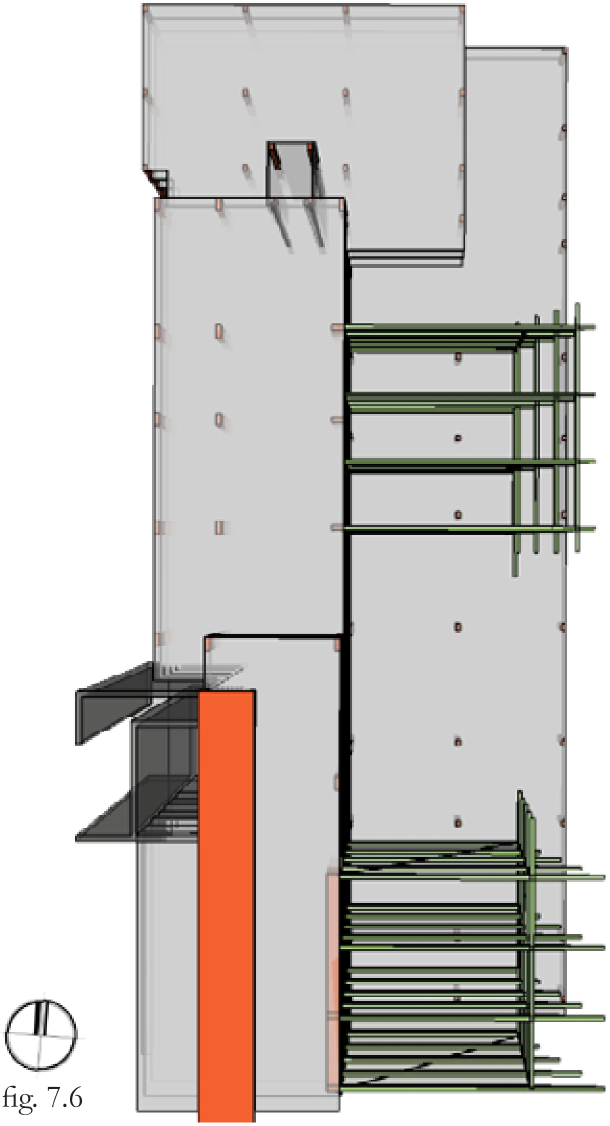

fig. 7.6

fig. 7.7

fig. 7.6 Aerial view showing the various structural systems
fig. 7.7 Three dimensional view from the west showing the primary structural system (red)

fig. 7.8 Three dimensional view from the south east showing the primary (red) and secondary (green) structural systems

fig. 7.9 Three dimensional view from the north east showing the primary and secondary systems

fig. 7.10 Concept sketch indicating how the secondary structural systems relies on and is connected to the primary structural system

STRUCTURAL GRID

To ensure the minimum use of concrete columns in the primary structure, a structural grid is created along which the slab, column and beam configurations evolved. The secondary structure starts along this grid due to the fact that the high tensile cables need to connect to the concrete columns, however it varies off this grid the further away from the primary structure it reaches. This represents the idea of a patient venturing further away from the structure and stability of the staff (and in turn the primary structure) at the facility during the healing process.

The spacing of the columns was designed in such a way so that the basement below could be used for parking with intervals varying between 5m and 7.5m and maintaining a structural rhythm of 5;7.5;5;... in the north-south span. The size of the primary structural columns are determined by the maximum force that they will need to transfer to the ground from the high tensile cables that support the secondary structure. As discussed with Dudley deKlerk, a column to the equivalent size of a 0.5m² circular column should be efficient to distribute the load appropriately. It was however decided to design the structural system with rectangular columns to allow them to form part of the walls in this portion of the building. It was also decided to not only make the columns that transfer the high tensile load larger columns, but rather to make all the columns along this grid the same size for ease of construction, with the only variation being to make the columns in the northern most block of the facility smaller (330x270mm). This was due to the fact that this is a low rise portion of the building and can function as it's own structural element, thus lowering costs and rendering the facility more sustainable.

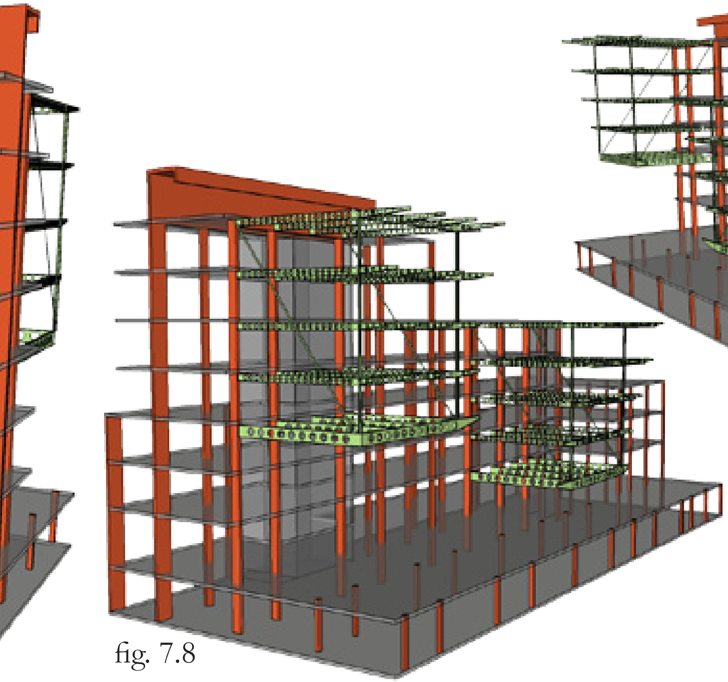

fig. 7.8

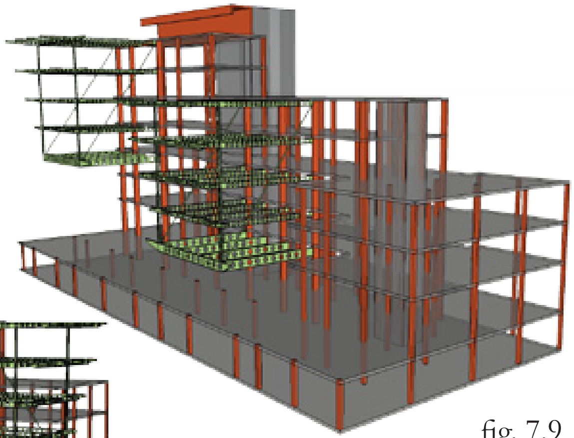

fig. 7.9

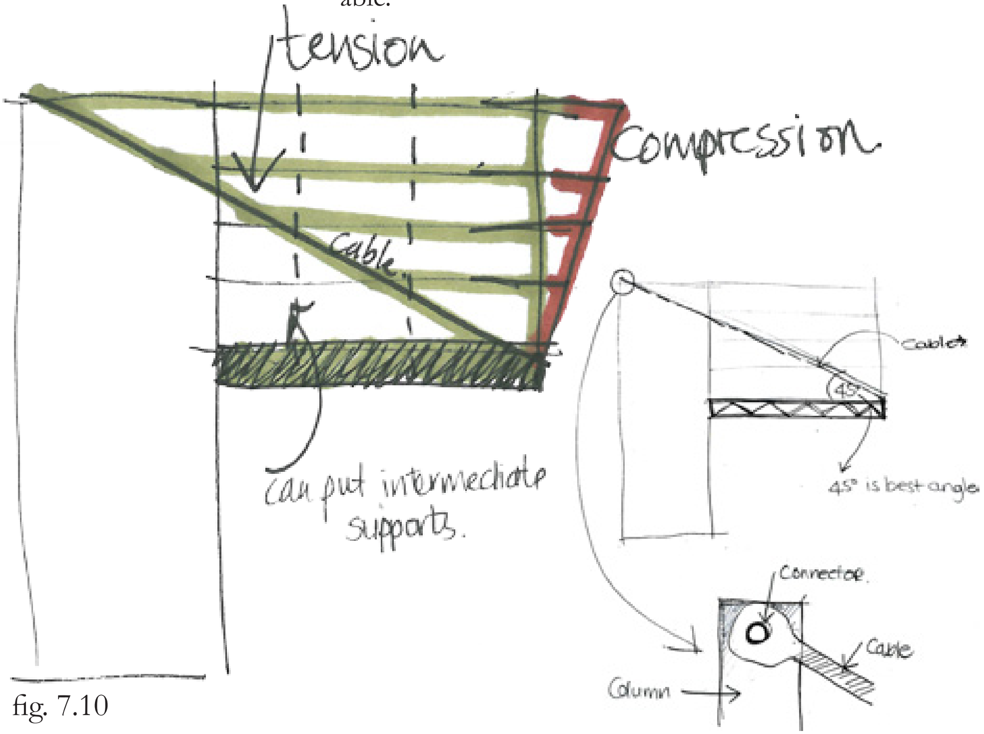

fig. 7.10

CIRCULATION

CIRCULATION

A consistent circulation path is created through the vertical and horizontal axes of the facility. This has been done as a way of developing a wayfinding path through the building that does not involve the use of blunt signage.

VERTICAL CIRCULATION

Due to the length of the site, two vertical circulation cores are designed with lifts and stairs; one on the southern and one on the northern side of the facility (see fig. 7.11-7.13). A ramp was included earlier in the project, however, it became overpowering and was removed, with only a simple ramp remaining in the gym.

As the majority of the patients at the facility will not be fully mobile, it was found necessary to provide three lifts within the facility due to the fact that they are the primary form of vertical circulation within the building. The lifts will also be the only means of escape in the event of a fire for many of the patients due to this fact, therefore lift cores are made into separate fire compartments, ensuring a two hour fire safe area.

It should be noted that lift 3 does not go to the basement level. This is because this particular lift is to be primarily used for deliveries and services. Due to the fact that deliveries occur on the ground floor and the functions that it services are on the levels above, it did not need to go to the basement level. This decision was further confirmed by the fact that more parking bays could be accommodated in the basement level.

fig. 7.11 Aerial view of the facility structure showing the vertical and horizontal circulation paths
fig. 7.12-7.13 Three dimensional view from the south west and north east showing the vertical circulation cores

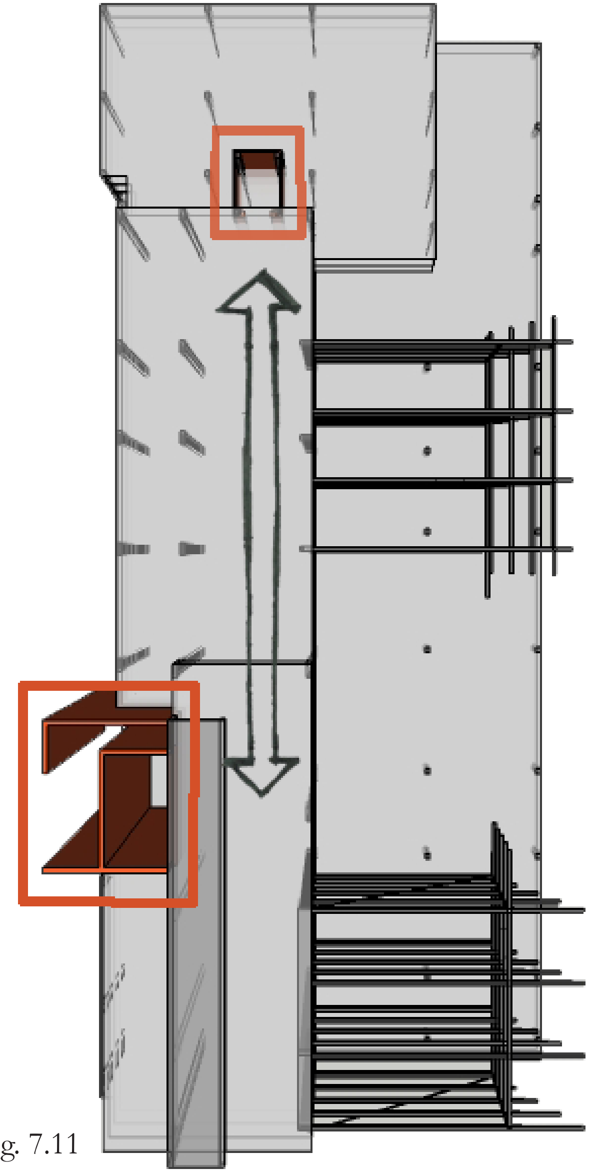

fig. 7.11

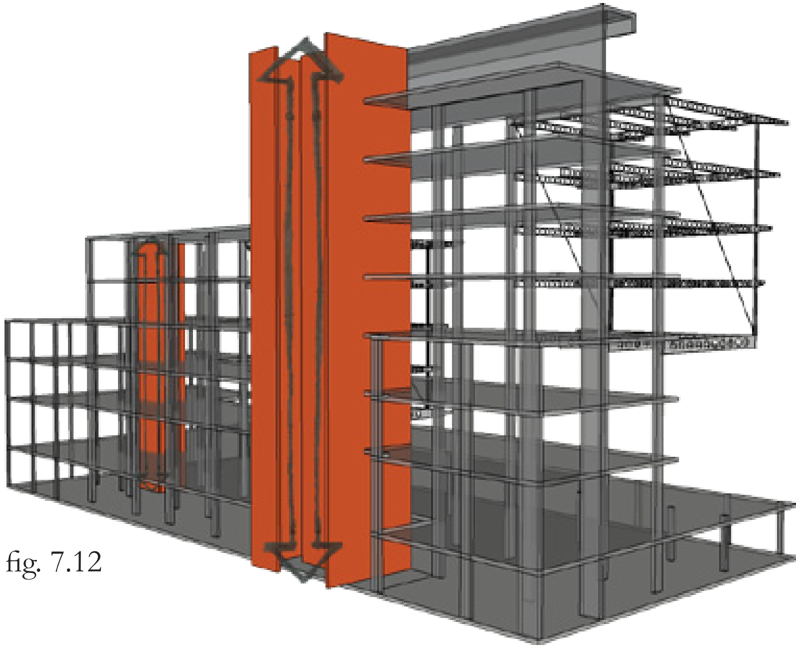

fig. 7.12

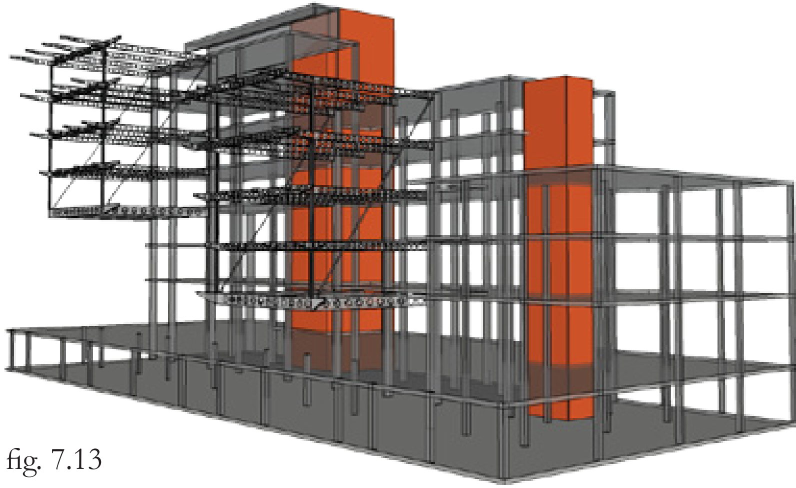

fig. 7.13

fig. 7.14 Typical ward block plan; highlighting the horizontal circulation
fig. 7.15 Sketch indicating services moving through the cell openings of cellular beams

SERVICES

HORIZONTAL CIRCULATION

The main horizontal circulation through the facility moves through the primary structure of the building running from south to north (see fig. 7.11). This emphasizes the idea that this is the solid core and continuously familiar portion of the building which aids orientation and thus healing within the facility.

WARD CIRCULATION

Each ward is designed around a central atrium with a passage around it to encourage interaction between patients and to allow more natural light to enter the building (see fig. 7.14). These atriums are placed along the main horizontal circulation path of the building and the ward circulation passages branch towards the east from here. Services have been situated within the ceilings of these secondary circulation passages to allow easy access in the event that they need to be serviced.

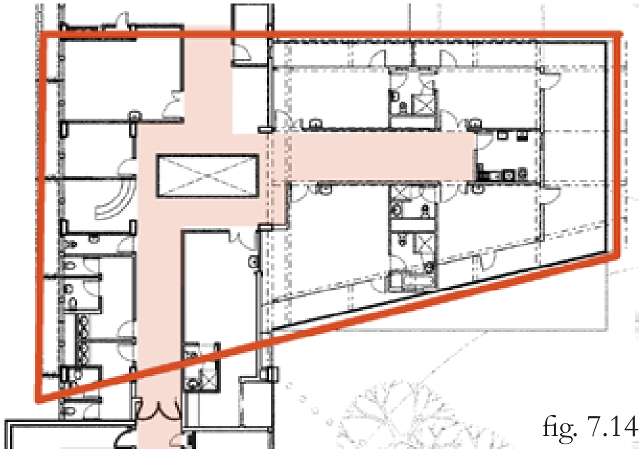

fig. 7.14

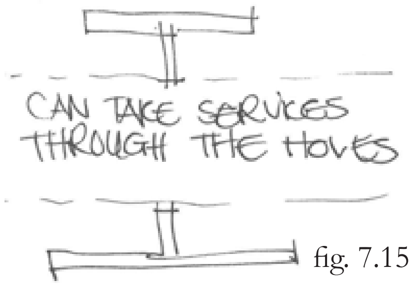

fig. 7.15

SERVICES

Creating a clean environment is the first step to creating a safe, therapeutic environment for people to heal and grow in. This means that specific services need to be considered and provided for in the *Centre for Healing*. It also needs to be considered that these services listed below need to work together properly within a medical facility in order to create such an environment.

Due to the fact that the building is eight storeys high, it became important that services be easily accessible from each level of the facility. It is also imperative that services can be switched off/isolated per floor to allow servicing on one floor without having to affect the services on other levels during this time. Vertical service ducts have been placed within the facility that lie on top of one another and only step where extremely necessary (eg. where the south portion of the building does not have a ground floor to third floor level). It should be noted that these service ducts are all accessible from passages on each floor and not from the inside of any patient facilities or rooms.

Horizontally, services are reticulated in one of two ways. They either move in the ceiling void (in the ceiling space or through the cells of the cellular beam construction - see fig. 7.15) or they are chased into walls (or placed in the drywall cavity where applicable)

The main services considered in the design of the *Centre for Healing* are: fire, drainage, water, medical gases, medical waste, light, ventilation/environmental control.

FIRE

According to the SABS0400, part TT, a facility such as the *Centre for Healing*, and its supporting services, (kitchen, laundry and workshop) are classified as an occupancy class E2. There are however some areas within the building that are specifically placed under a different occupancy class due to the nature of their functions; such as the administration and conference facilities (these are to fall under the G1 occupancy class).

According to the NBR TT 16.2, a building with more than 3 storeys needs to be furnished with two unobstructed escape routes in the event of a fire, therefore two fire escape cores have been created in the building; one on the northern side of the facility, and one on the southern side of the facility. The travel distance between any point of the building and a fire escape is never more than 45m and all fire escape routes are easily identified. Each of these two cores consist of an external fire escape staircase, a lift/s, a fire hydrant and a fire hose reel with a reach of 30m each (see fig. 7.16).

Due to the fact that no ramp has been provided for in the building, it was imperative that these two cores be designed in such a way as to allow the lifts to be used as a vertical escape alternative to the external stairs in the event of a fire. These cores have therefore been made into separate two hour fire compartments surrounded by 220mm thick walls and accessible via fire doors held open by magnets in a normal situation which are connected to a fire alarm which closes the doors when a fire occurs (opening in the direction of fire escape).

Each ward has been made into a separate fire compartment (maximum of 1225m²) to be able to compartmentalise a fire should one occur (see fig. 7.17). Due to the fact that the laundry and kitchen are high fire risk areas, they have also been made into separate fire compartments, however because there will always be people moving in and out of these areas, the fire doors to these facilities are not on the fire alarm magnet system mentioned previously. The access door to these rooms is rather a fire door that will be held open during the day by a cabin hook and locked at night.

All steel members (cellular beams included) are to be painted with intumescent paint to provide two hour fire protection.

A drencher system has been used at certain parts of the building where fire protection is required, however the design called for glass to be used. These drenchers are linked to a fire alarm system where in the event of a fire (through smoke detection) the drenchers will be set off to allow water to flow over these glass openings forming a safe zone around them.

There is a loop system placed around the entire site which provides continuous water supply for the three fire hydrants placed around the site. These fire hydrants have been placed in areas where they will be easily accessible by fire trucks. Boosters connected to this loop system have been placed at the two fire cores of the facility to allow water to be passed to the fire hydrants and fire hose reels on the various levels of the facility.

A booster connection is also provided for at the southern fire core of the building to provide water for the sprinkler system on each level of the building. Only one booster for the sprinkler system has been provided for because the water for this can be boosted up on one side, and the water circulated on each floor in the ceiling void (a cheaper alternative).

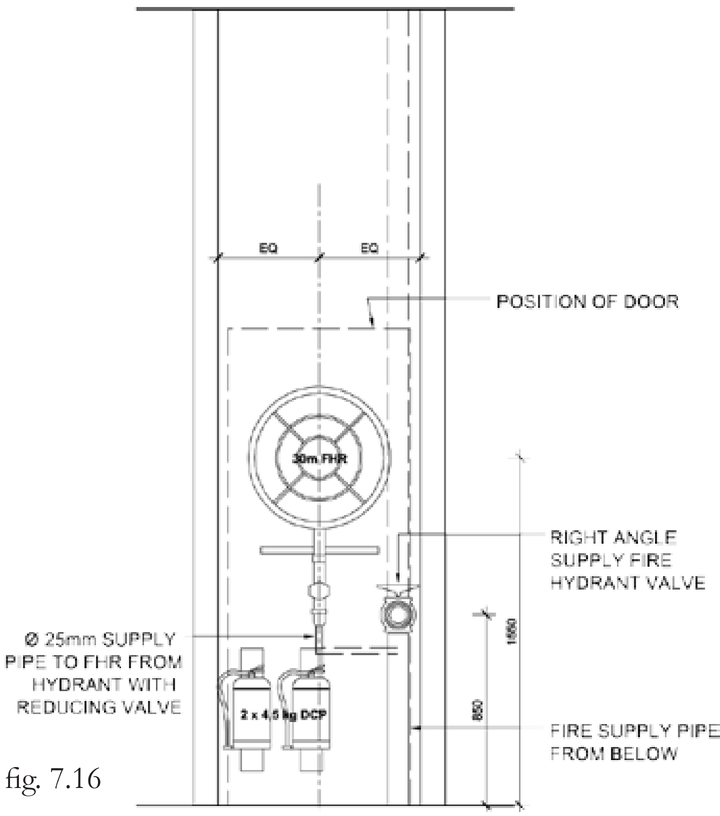

fig. 7.16

fig. 7.16 Typical detail of a fire hose real cupboard and its contents

fig. 7.17 Typical fire plan; notice the lift lobbies as separate fire compartments
fig. 7.18 Typical drainage plans showing reticulation through ceiling voids

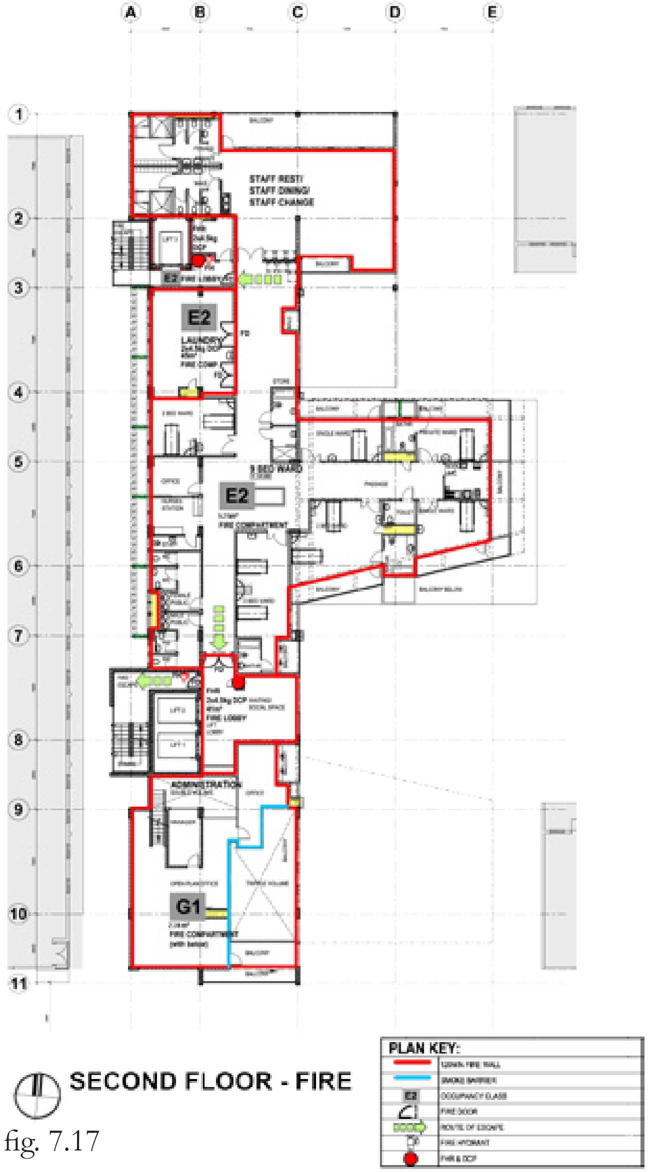

fig. 7.17

DRAINAGE

The following are minimum requirements for ablution facilities provided for within such a building as per the R158:
Number of toilets - 1 toilet per every 8 beds
Number of medical basins - 1 medical basin per every ward
Number of wc basins - 1 basin per every 8 beds
Number of baths/showers - 1 bath/shower per every 12 beds
Number of disabled toilets - 1 disabled toilet per floor
Number of assisted bathrooms/showers - no minimum, however after extensive research, it was found that a minimum of one per facility is acceptable. Due to the nature of the *Centre for Healing*, however, it was found necessary to provide more.

The following are minimum requirements for ablution facilities within such a building as per the SABS 0400:
Number of public toilets - 3(male)+4(urinals)+6(female)
Number of public toilet basins - 4(male)+4(female)

See appendix 3 for total number of ablution facilities.

Sanitary fittings have been provided for within 6m of the vertical service ducts due to the fact that no drain or waste pipe should travel more than 6m before linking up to the appropriate vertical connection.

From each sanitary fitting, a drain or waste pipe either connects to a collection pipe that runs in the ceiling void below which collects various drainage points and then connects to the vertical stack situated within the service duct, or they connect directly to this stack. These pipes either run in the ceiling void in the primary structural portion of the building or through the cells of the cellular beams in the secondary structural portion (see fig. 7.18).

From these stacks, the drainage runs down to the lowest level of the system (collecting sewerage from other levels on the way) where it then moves horizontally (at a fall of 1:60) to connect to the existing sewerage line on the western side of the building.

fig. 7.18

WATER

At every point where sanitary fittings are situated, water points need to be provided. As mentioned previously, all sanitary fittings have been placed within 6m of the vertical service ducts. These ducts have been made large enough to be able to house not only the drainage (mentioned before), but also the vertical water and medical gas reticulations (see next heading and fig. 7.19).

A water supply connection is created linking the building water supply to the municipal water supply along Minnaar Street. The water is dispersed vertically through a booster system within the service ducts and then circulates to the various water supply points on each floor through the ceiling void (see fig. 7.19). Again, the water supply pipes run in the ceiling void in the primary structural portion of the building, and run through the cells of the cellular beams in the secondary structural portion of the facility (the same as the drainage). Please note, for sound insulation, Sisalation is to be used above the ceiling boards and a plywood is used as an insulation below the wooden floor boards in the secondary structural system areas.

Where water needs to move down from the ceiling void to the sanitary fitting, the water pipes will either be chased down in the wall or placed in the void between two layers of drywalling until they reach the tap points. Please note, all pipes are to be wrapped in building paper where chased into walls and all hot water pipes are to be insulated.

Geysers will be placed in lowered ceiling spaces (650mm ceiling void required) throughout the primary structural system of the building or between cellular beams from where all hot water will be distributed as described above. Water temperature will also be regulated (at a maximum of 60 degrees celsius) from each geyser for various uses and distribution purposes.

Water for fire hydrants and fire hose reels within the building is provided for as described in the 'fire' section mentioned previously, however it should be noted that the swimming pool on the roof is to be used as an emergency fire water supply.

Water runoff from the roofs of the facility will be channeled to fulbore outlets on the roofs and into down pipes which lead to water storage tanks placed around the facility (5000l tanks). This water will primarily be used to water the gardens around the facility.

According to the R158, a facility of this nature has to have a protocol for 24-hour emergency water supply to the building in the event of main water supply failure. Water tanks are therefore placed on the roof of the facility whereby water is constantly filtered through to be used in the event mentioned above. According to Brian Woolls-King of BWK Engineering, the SABS requires a minimum of 450l of water per bed per day, therefore, for a facility of 56 beds, 25200l of emergency water will need to be provided. To distribute the load over the area of the roof allocated for these tanks, three 10000l tanks will be used with a diameter of 2.2m and a height of 3.040m. The extra water is to accommodate the use of the public toilets as well as the ablution facilities linked to the offices.

fig. 7.19 Typical water and medical gas reticulation plan

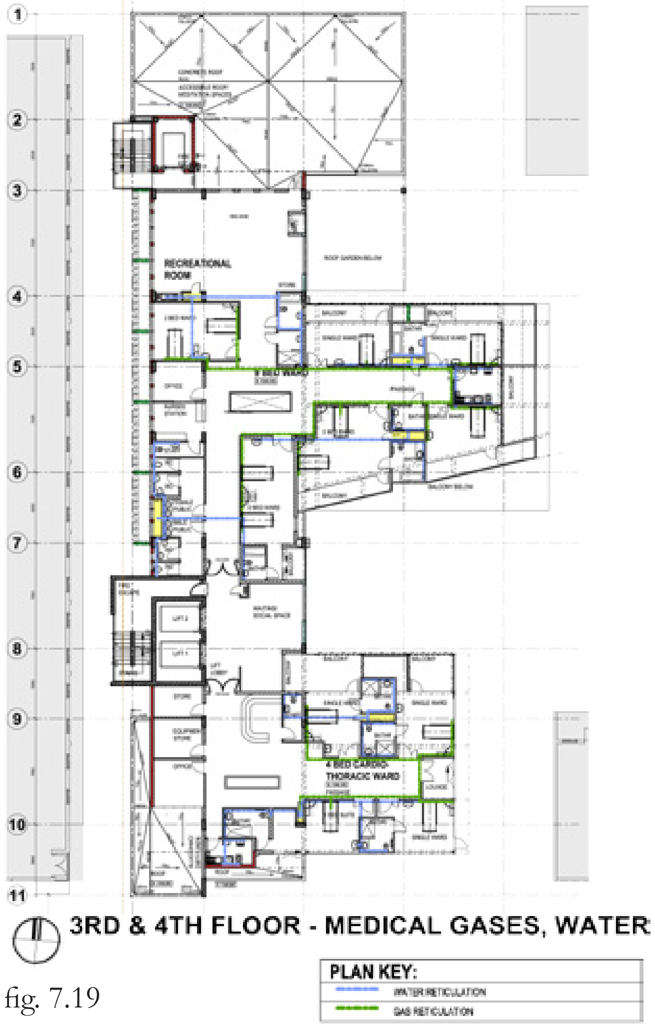

fig. 7.19

fig. 7.20 Medical gas bottle labels are colour coded to clearly identify the various medical gases supplied

fig. 7.21 Summary diagram of where what type of medical gas is required in a hospital

MEDICAL GASES

Although the patients at the *Centre for Healing* are in a stable condition, provision needs to be made for various medical gases that may need to be used in the interest of the patients. According to Brian Woolls-King, these gasses are: oxygen, nitrous oxide, nitrogen, carbon dioxide and medical air vacuum.

Medical gasses need to be provided for at every bed headboard within the facility (see fig. 7.21). Therefore they are only circulated vertically through the building in the ducts that are provided in the secondary structural portion of the facility.

Once on the correct floor, the medical gases are circulated through the cells of the cellular beams in the ceiling space above the passages (see fig. 7.19). From the passage, branches are created (in the ceiling void) to each room (1 per bed) with the gas being lowered to the bed headboard height at each bed. Please note, each gas branch per level and per room should be able to be isolated in the event of servicing.

Oxygen - green
Medical Air - Yellow
Vacuum - White
Nitrous Oxide - Blue
Nitrogen - Black
Carbon Dioxide - Gray
WAGD - Purple

fig. 7.20

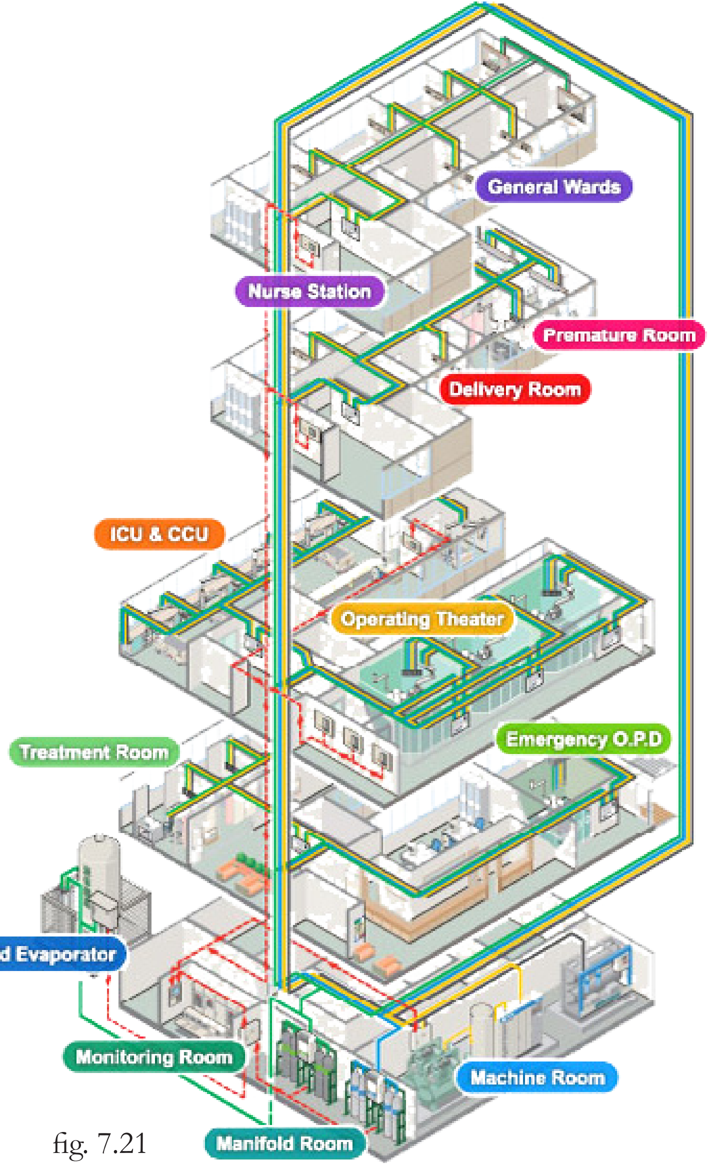

fig. 7.21

MEDICAL WASTE

Due to the fact that the patients at the *Centre for Healing* are in a stable condition, no major medical waste will be created at the facility. However, minor medical waste accommodation needs to be created for within the facility for items related to wound care, such as gauze. To provide for this, a sluice has been created in every ward where minor medical waste items can be disposed of or stored until taken away by the correct authorities and where supportive instruments can be disposed of/cleaned, this room having a minimum area of 5m².

This room can (according to the R158) be housed with the house maids closet (HMC) and the dirty linen rooms for each ward, however then the minimum size for such a room is 9m². In this dissertation, it was deemed necessary to provide all three of these functions within one room to utilise less space within the ward, therefore, the minimum size used is 9m² and such rooms have the following sanitary fittings as required by the R158: a wash hand basin, a wash trough, a single sink, a slophopper and a macerator. It should be noted, a macerator is a more environmentally friendly alternative to a bedpan washer (which is what most medical facilities use) because a bedpan washer uses plastic bedpans, while a macerator uses recyclable bedpans that the machine is able to recycle.

fig. 7.22 Table indicating minimum average illuminance and glare index productivity values for different types of rooms in the facility
fig. 7.23 Diagram showing how sunlight is used to power fibre optic daylights within a building

fig. 7.24 An example of the use of fibre optic daylights
fig. 7.25 A variety of light fittings are available for fibre optic daylights

LIGHT

Throughout the entire dissertation, increasing the amount of northern light that accesses the building has been an important design aspect.

There are however certain light intensity/quality requirements that need to be provided for through artificial means within the facility - see figure 7.22 which lists the illuminance and glare index productivity values required according to the SA Building System Ass.

Atriums are provided within each ward to create a central socializing space as well as bring natural light into the building. Due to the fact that the building is eight storeys high, a single atrium could not be created at the desired width to allow natural light to the bottom floors. Two double volume atriums have therefore been provided where the lower one is illuminated from above a bulkhead using fibre optic daylights that are able to draw energy from the natural daylight outside and transfer it inside the building through a light fitting (see fig. 7.23-7.24). The light created through the fitting is in every way like natural light, the only difference (and benefit) is that the fibre optics do not pass through the harmful UV rays that natural sunlight emits.

The higher level atrium has a skylight that protrudes on the roof top allowing natural light into the atrium space. These two situations allow for natural light to enter the building and therefore allow for a sufficient environment which plants can grow in within the building using limited maintenance and servicing.

ROOMS	**ILLUMINANCE AND GLARE INDEX PRODUCTIVITY VALUES (min. average)**
LOUNGES	150 lux
KITCHENS	500 lux
STORE ROOMS	150 lux
COUNTERS	300 lux
PASSAGES & LOBBIES	150 lux
RECEPTIONS	200 lux
STAIRS & RAMPS	150 lux
INTERIORS OF LIFTS	100 lux
READING ROOMS	500 lux
WORKSHOPS	400 lux
COMPUTER ROOMS	500 lux
LECTURE ROOMS	500 lux
ROOMS	150 lux

fig. 7.22

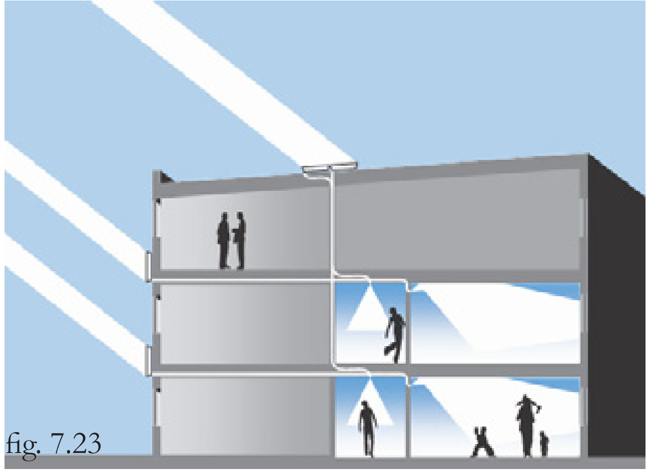

fig. 7.23

fig. 7.24

fig. 7.25

VENTILATION / ENVIRONMENTAL CONTROL

In order to create a healthy environment in which healing can occur, sufficient ventilation and environmental control needs to be considered in the design of such a facility. Mechanical ventilation is used as little as possible within the facility with only the atrium spaces and selective isolation rooms/wards being mechanically ventilated with an air conditioning system (see fig. 7.26-7.27).

Where only the atriums are mechanically ventilated, ward blocks have been designed as narrow as possible around these spaces with windows to the outside and fan lights between the rooms so that these spaces can allow for sufficient cross ventilation which will allow fresh air conditioned air in and force older stale air out. This is not the case in isolation wards/rooms for infection purposes.

All habitable rooms have been designed to have access to openable windows to allow this cross ventilation (as well as allow natural light into the building) to occur, however a few bathrooms have not been able to follow this system, and will therefore have to have air mechanically extracted from them into the service ducts that border them. Such extractors will be connected to the light switch so that if the bathroom light is on (and therefore in use) the extraction fan will operate, and when the light is off (and therefore not in use) the extraction fan will be off, saving electricity consumption as much as possible.

fig. 7.26 Sketch plan identifying the various passive design measures addressed in the facility

fig. 7.27 Sketch section identifying the various passive design measures addressed in the facility

SUSTAINABILITY

SUSTAINABILITY

It is essential that buildings are designed to respond to issues of sustainability. The following have been considered throughout the duration of the dissertation as methods of increasing the sustainability of the building:

- services (see pages 159-166)
- passive design measures (see below)
- material choices (see pages 167-171)

PASSIVE DESIGN MEASURES

Various passive design measures were considered to ensure a comfortable and healthy climate within the facility that responds to the SA climate and the surrounding environment effectively.

The following items have been considered (see fig. 7.26-7.27)

- building orientation; north facing arms have been created on a largely east-west facing site
- materials chosen - see pages 167-171
- overhangs; to shade large glazed surfaces on the northern facades
- window sizes and orientation
- use of sun screens and louvres; horizontal on north, vertical on east and west
- vegetation as shading devices; large succulent trees and planted shading devices

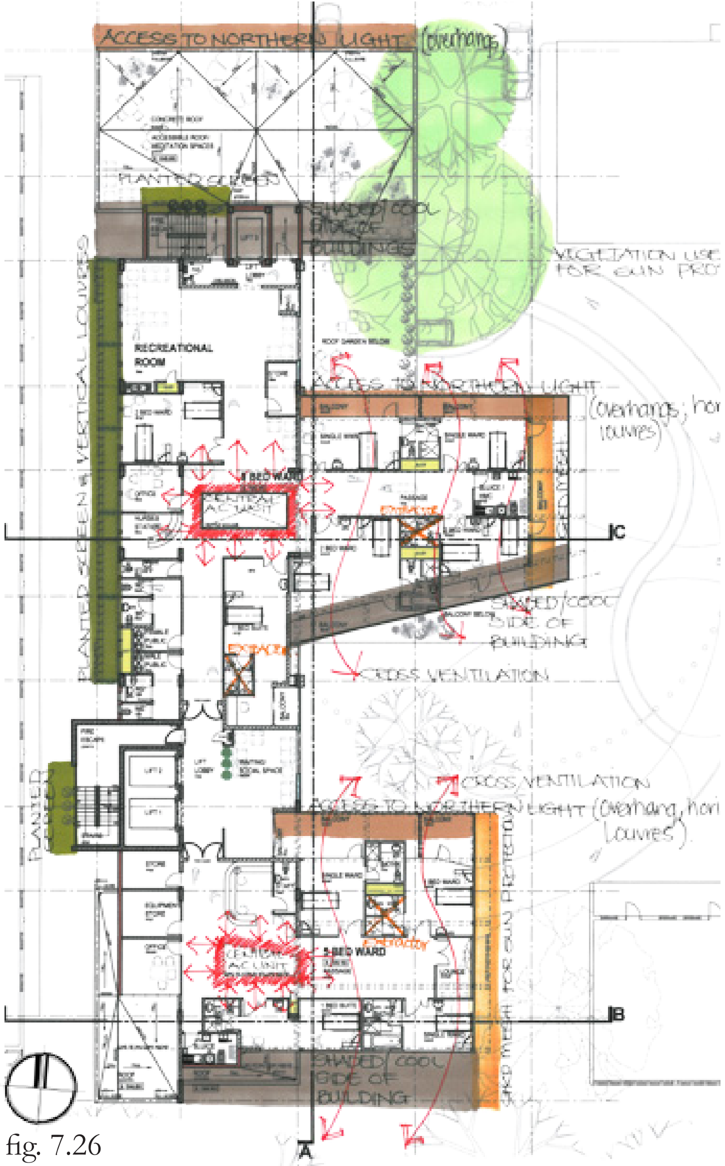

fig. 7.26

fig. 7.27

fig. 7.28 Plan and 3-D image of a concrete column
fig. 7.29-7.30 Photos of the existing building to the west of the site illustrating the varied use of concrete in the area

fig. 7.31-7.33 Photos of various buildings in the area showing the variation of facebrick used

MATERIALITY

MATERIALITY

Appropriate technologies within any environment may express the current technologies, materials and skills in a particular area. They may however also introduce new technologies, materials and skills transfer by the introduction of a new way of construction.

The following materials and building technologies are believed to be appropriate for the development of the ideas set out in the dissertation thus far.

EXISTING BUILDING TECHNOLOGIES IN THE AREA

- Concrete column, beam and slab construction
- Structural brickwork and concrete slab construction

CRITERIA FOR MATERIAL CHOICE

- Materials that are currently used in the surrounding area (familiar materials).
- Availability of materials in Pretoria.
- Labour intensity of construction.
- On-site assembly and erection of various parts.
- Economic viability of materials/products.
- Possibility of simple, clean connection methods.
- Environmental factors of materials.
- Cleanliness/clinical nature of materials.
- Requirements in terms of the specific facility needs.
- Natural sunlight requirements within the building.
- Use of the existing items provided for on site, eg. shade of large trees.
- Ease of maintenance.
- Use of varied materials to express the different ideas set out in the theory part of the dissertation.

CONCRETE

Reinforced concrete is used as the main structural material within the primary structure of the facility in the form of columns, beams and slabs. Only two column sizes are used throughout the entire building (270x500mm and 270x330mm) to minimise the different shuttering required for on-site casting. Solid reinforced concrete slabs (255mm thick) are used throughout this portion of the building with a variety of upstand, downstand and inlaid beams where necessary.

Main advantages:

- Material is used widely in the area (familiar).
- Easily available.
- Cost-effective and timeous to construct.
- On-site erection of shuttering.
- Concrete slabs can be sealed to not soak in any medical waste if this becomes a problem.
- Low maintenance.
- Represents a solid structural material as is the primary structure of the facility - familiar association to most people.

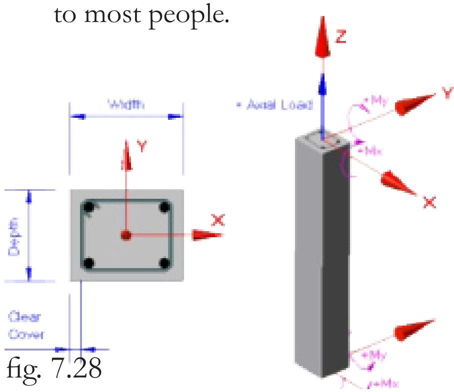

fig. 7.28

fig. 7.29

fig. 7.30

FACEBRICK

There is a variety of facebrick used in the area, the most common appearing to be the *Country Classic Travertine*; a red, semi-smooth facebrick. These are to be used on the primary structural side of the facility as a more solid infill for the building and forcing the design of the facility to be in accordance with brick courses throughout to create clean, neat openings and joints. The facebrick is to have a flush joint every 5th brick course for aesthetic and functional purposes.

Main advantages:

- This is a widely used material in the area (familiar).
- Corobrik produces large amounts of facebrick in the Pretoria area.
- Minimal labour intensity for installation.
- Economically viable - initial costs cheaper as no plaster or paint is required and maintenance is therefore also cheaper.
- Helps force a constant height of openings following brick coarse calculations.
- Environmental factors of material are favourable
- Cleanliness of product fine for outside, but would need to be plastered on inside to avoid dust collection.
- “Solid” material with minimal openings to express the strong, solid core of the facility.

fig. 7.31

fig. 7.32

fig. 7.33

fig. 7.34 Diagram showing a plaster and paint wall construction
fig. 7.35-7.36 Photos of existing plaster and paint building construction in the area
fig. 7.37 Diagram showing how a cellular beam is made

fig. 7.38 Photo of a laser cutter manufacturing cellular beams
fig. 7.39 Photo of cellular beam roof construction
fig. 7.40 Photos of cellular beam construction with services being reticulated through the cell openings

PLASTER & PAINTED BRICKWORK

To create an architectural typology that would suit the area, plaster and paint was used to continue the language present in the area. Earthy colours will be used to create a warmer feel to the medical building rather than the use of clinical cold colours such as white.

Main advantages:

- Plaster and painted brickwork is widely used in the area in conjunction with concrete and facebrick.
- Easily available in a wide variety.
- Average labour intensity at construction, with maintenance only having to be carried out every 10 years
- Economically viable.
- Can create simple clean lines on the building walls, or patterns/textures can be created where wanted.
- Favourable environmental control factors.
- Clean and dust free finish for interior and exterior of the building.
- Variety in terms of colour throughout the facility can be created at any time with relative ease.
- Lighter paint colours can create reflective surfaces where natural light may be limited.
- Solid, yet smooth material to highlight the solid support of the primary structure of the building.

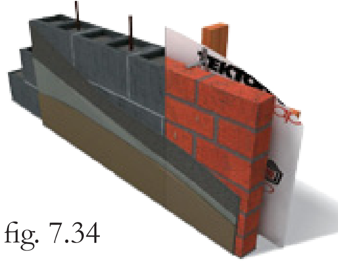
fig. 7.34


fig. 7.35


fig. 7.36

STEEL CELLULAR BEAMS

Steel cellular beams are the modern version of the traditional 'castellated' beam which has resulted in a beam ±40-60% deeper than the parent section and having a depth:length ratio of 1:25. Manufactured from steel i-beams, the final depth, cell diameter and cell spacings are flexible and is up to 2.5 times stronger than the parent section and is used to create efficient, large, unsupported spans in construction. Cellular floor beams are also used for their ability to integrate structure and services, minimizing overall construction height.

Main advantages:

- Steel would be a new unique material to the area.
- Easily available in Pretoria in various sizes (purpose made).
- Minimal labour intensity.
- On-site assembly and erection possible.
- Simple, clean connections allowed for.
- More sustainable product - less raw steel used to cover further distances.
- When painted with intumescent paint, the steel has a 120min fire rating.
- Lighter weight construction to highlight the reliant, light weight feel required in the secondary structure of the facility.
- Natural light can enter the building through the cells on the edge (sealed with glass).
- Economically viable - 12-20m clear spans can be built at the same depth and cost as short spans.
- Allowance for service integration - ducts/services can run through the cells of the cellular beam.
- More shallow overall floor depth and thus construction height.
- Allows for a more flexible layout as there are no intermediate column supports necessary.
- Aesthetic qualities unique to this product.
- A light weight construction is produced that will require less high tensile support (and primary support) to hang the structure.

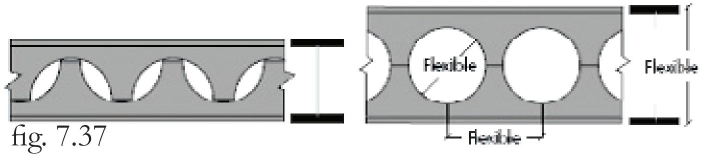

fig. 7.37


fig. 7.38

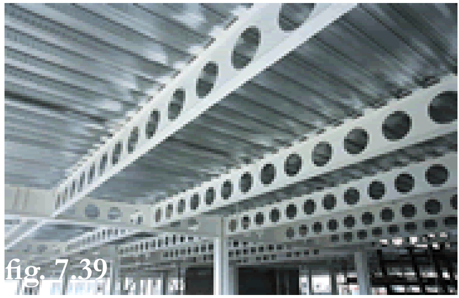
fig. 7.39


fig. 7.40

fig. 7.41 Diagram showing a cantilevered high tensile structure held up by its primary structure
fig. 7.42 Photo of a turn buckle which is used to connect the high tensile cable to the structure it supports or is supported by

fig. 7.43 Photo of steel H-columns in use
fig. 7.44-7.45 Photos of steel I-beam construction
fig. 7.46 Diagram showing the connection of two steel I-beams

HIGH TENSILE STEEL CABLE

A 120mm diameter high tensile steel cable will be used on either side of the two 'hanging arms' where the wards are housed within the facility (size and number confirmed by Dudley deKlerk. These cables will be fixed on one end by a steel turn buckle attached to the deepest cellular beam (850mm deep), and on the other side to the concrete column that will distribute the load of the overall structure. During construction, the 850mm deep cellular beam will be propped up by supports until the high tensile cable can support the beam. From here, steel H-columns will be erected above carrying the load from the storeys above to the main cellular beam and then into the high tensile cable and finally to the solid concrete structure.

Main advantages:

- Steel would be a new unique material to the area.
- Easily available material and fixings.
- Medium labour intensity of initial erection.
- On-site assembly and erection possible.
- Simple clean connections via use of turn buckles.
- Will allow portions of the building to 'float' rather than read as objects in compression as the primary structure of the building reads - allows for a contrasting architectural language to be developed within the building.

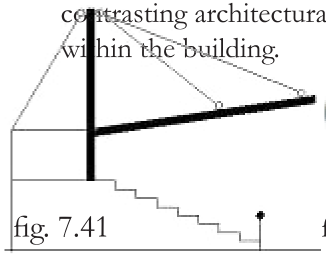
fig. 7.41


fig. 7.42

STEEL I-BEAMS AND H-COLUMNS

Steel I-beams work well as horizontal support structures and are therefore being utilized as the main flooring structural material (a variety of 100x55mm and 120x64mm sections). Steel H-sections work well in compression and are therefore being used as the columns (200x200mm sections) between the floors where cellular beams are being used to transfer the loads from above to the main cellular beam structure below (which then gets transferred to the primary structure of the building through the high tensile cables).

Main advantages:

- Steel would be a new unique material to the area.
- Easily available material and fixing methods.
- Minimal labour intensity at construction.
- On-site assembly and erection possible.
- Minimal machinery required for erection.
- Mechanical joints possible.
- Easy maintenance.
- This light weight structural infill allows this portion of the building to read as a contrasting architectural language of light weight construction versus the heavier construction of the primary structure.

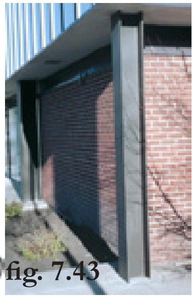
fig. 7.43


fig. 7.44


fig. 7.45

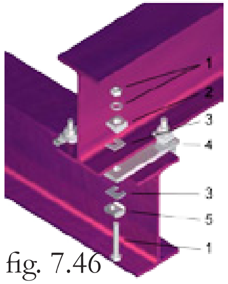
fig. 7.46

GLAZING

Large amounts of surfaces are glazed in the secondary structure portion of the building, it was therefore important to choose a glass that would allow the necessary light to enter the facility, while still allowing for a comfortable environment within the building. It should be noted that the majority of this glazing on the eastern and northern sides have also been protected by solar shading devices. Smartglass Coolvue has been used in the facility placed in powder coated aluminium frames. This glass has a 5,8 (W/m²).k U value and a 35 ISO noise control rating.

Main advantages:

- Smartglass is readily available in Pretoria.
- On-site assembly and erection of parts is possible.
- With a 5,8 (W/m²).k U value, this glass can control the climate inside the building to some degree.
- A 35 ISO sound rating allows minimal sound to travel to the balconies as well as between floors.
- The appropriate amount of light will be allowed into the facility to aid the healing process.
- Existing trees/vegetation and new solar shading devices will allow the required amount of light in the building, but still create a comfortable environment within the building.
- All glass panes are accessible from balconies, making maintenance easy.

fig. 7.47 Diagram of GKD mesh with supports
fig. 7.48 Diagram of Nutec drywall system
fig. 7.49 Photo of a building that was constructed with the Nutec drywall system
fig. 7.50 Photo of possible planted screens to utilise
fig. 7.51 Sketch indicating the use of solid planted walls
fig. 7.52 Photo of possible planted screens to be utilised

GKD MESH

Sunscreens are designed on the eastern side of the facility to shelter the large glazed facades of the wards. An AISI Type 316 stainless steel GKD metal fabric in the Ombre range has been used. The ends of the mesh are folded and fixed between a steel flat bar and a steel angle bar that is then fixed to a steel support frame which is attached to the structure of the building.

Main advantages:

- Steel mesh would be a new unique material to the area.
- Available with a 6 week waiting period.
- On-site assembly and erection possible.
- New skills in workmanship are introduced to the area.
- Economically viable alternative to standard vertical/horizontal sun louvres.
- The mesh will stop direct sunlight from entering the building but will still allow light through.
- Will not only provide shading for the facility but also a visual barrier to screen the patients from the public.

NUTEC DRYWALL SYSTEM

This lightweight alternative to brickwork will be used in the secondary structure area of the building. Rhinoboard drywalling is used for interior cladding while Nutec board is used for external cladding for environmental purposes. Both are to be sanded and painted as desired. Thermal and sound insulation will be applied to all drywalls for privacy and environmental control purposes.

Main advantages:

- This material is a lighter alternative to brickwork, allowing the structure that supports it to also be lighter and therefore less expensive.
- Readily available in Pretoria.
- Minimal labour intensity and ease of installation - also, less wet works within the facility making construction time faster.
- On-site assembly and erection.
- With insulation, this drywall system provides the necessary insulation for the facility.
- Clean smooth finish, collecting no dust inside.
- Can easily be removed and a new internal layout can be designed whenever required with relative ease.

VEGETATION

Due to the fact that the existing vegetation around the site is one of the main reasons for wanting to develop in the area, it was important that the vegetation not only be preserved, but that it also be enhanced through the use of plants inside the building and as shading devices. The most noticeable are the planted shading devices on the western and northern facades of the facility as inspired by fig. 7.50 - fig. 7.52.

Main advantages:

- Use of vegetation in the design of the building emphasizes the reasons that the particular site was chosen.
- A variety of creepers/plants can be used whether to create shade all year round or whether only to create shade in summer and let sun through in winter.
- The steel supports require little labour and allows for on-site assembly.
- Economically viable alternative to traditional sun louvres.
- Will not only provide shade but also cool the area around the windows they shade.
- Access to vegetation is an important healing tool.

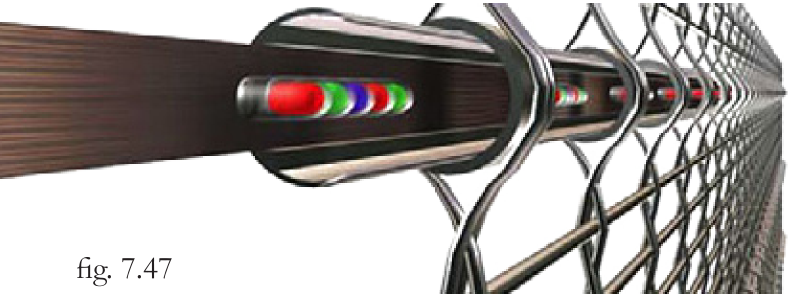
fig. 7.47


fig. 7.48


fig. 7.49

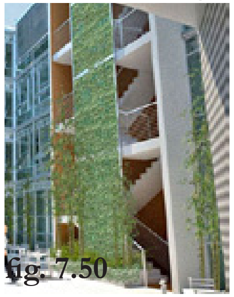
fig. 7.50


fig. 7.51


fig. 7.52

fig. 7.53-7.55 Photos of various vertical and horizontal sun louvres
fig. 7.56 Fibre optic daylight light fitting
fig. 7.57 Interconnecting wooden floor boards

SUN LOUVRES

On the western and eastern sides of the building, vertical sun louvres are used where necessary to create shaded areas over large glazed portions of the building. On the northern facade, horizontal sun louvres are used to provide the same shade. There is no need for the southern facade to be shaded with sun louvres as there is no direct sunlight threat. This indirect light would rather be a good source of dispersed light into the building.

Main advantages:

- Sun louvres would add another layer to the building, one of protection against natural elements.
- The sun louvres specified are all custom made from steel/aluminium sections and can be assembled on site with relative easy.
- Custom made solar shaders of sheet metal are relatively cheaper than standard solar shading devices as produced by companies like Hunter Douglas.
- Shading will be provided for where necessary in the correct way allowing the desired amount of sunlight to enter the building to aid the healing process.
- Not too many solar shading devices are required due to the large amount of shade provide by the large trees that are on the site.

FIBRE OPTIC DAYLIGHTS

Fibre optic daylights take natural daylight to darker portions of a building and can be used as an alternative to normal electric light fittings. Optical lenses are placed on exterior-mounted solar panels on the building facade that capture sunlight and channel it through thin, flexible, fiber-optic cables to luminaires placed in interior rooms, recreating the feeling & experience of sunlight. This has been used for the lower atrium spaces to create the effect that daylight is in fact being accessed through the atrium (where it is not possible for daylight to reach).

Main advantages:

- Available in South Africa.
- Harmful UV rays are not transmitted through the fibre optic cables.
- There are a variety of luminaires available.
- Can be turned to normal electrical light when the sun is not shining/energy stored.
- Can lower electricity use by 20-25%.
- Lower the greenhouse gas emission from a building by 10-15%.
- Can allow the effect of daylight within a building where it is not always possible to get direct sunlight.

WOODEN FLOORING

The main flooring type (the others being vinyl, carpet and tiles) of the facility is wooden flooring. Wooden flooring is good to use in rehab facilities as it is not as harsh on the bodies that are trying to heal compared to other floor finishes. The wooden flooring finds itself at the top of a layered floor system. The steel cellular beams act as the main supports for the entire system with ceiling boards and insulation placed between the cellular beams for practical reasons such as sound insulation. On top of the cellular beams are 100x55mm steel I-beam floor joists that then support a 20mm thick plywood sub-base on which the wooden floor is placed. The plywood adds extra support as well as extra sound and thermal insulation between the floors.

Main advantages:

- Wood has a better quality feel to it for rehab patients.
- Readily available (treated).
- An engineered board provides ample support and allows the steel I-beams to be spaced further apart, therefore using less steel members.
- Provides a warmer feel to a ward in the facility and is more hygienic than carpets.
- The engineered board provides extra insulation, and with the insulation in the ceiling void, even more.

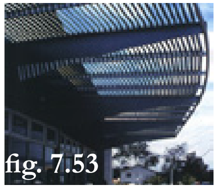
fig. 7.53

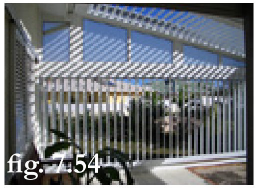
fig. 7.54

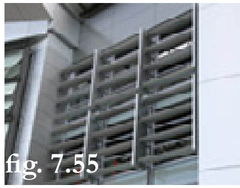
fig. 7.55


fig. 7.56


fig. 7.57