

12 Technical Investigation:

12.1 Movement ,Access and Security :

The movement through the building is based upon the basic movement patterns over the site, created by daily pedestrian use. These patterns serve to generate the basic layout of the building. The building elements (counseling block, admin block, sports centre and conference centre) are placed along the paths that will be used by pedestrians and centre users alike.

The movement through the building is designed in a way that will enable disabled people to access the whole building in more than one way. The movement elements consists of SABS 0400 regulation ramps as well as gravitational lifts. The users of the centre will have total control over access and movement since they can learn to build and maintain the lifts themselves.

Natural security:

The placement of the building elements along the movement paths ensures passive surveillance all through the day as the different segments house different functions that are active during differing hours of the day.

A further means of security is provided by the gatehouse situated on the vehicular movement spines that run over the site. The gatehouse provides for excellent passive surveillance of these spines.

Artificial security:

One last safety measure is that of CCTV surveillance and security doors. These elements will be strategically placed in spaces that are most likely to provide a safety threat like more remote prts of the buil.

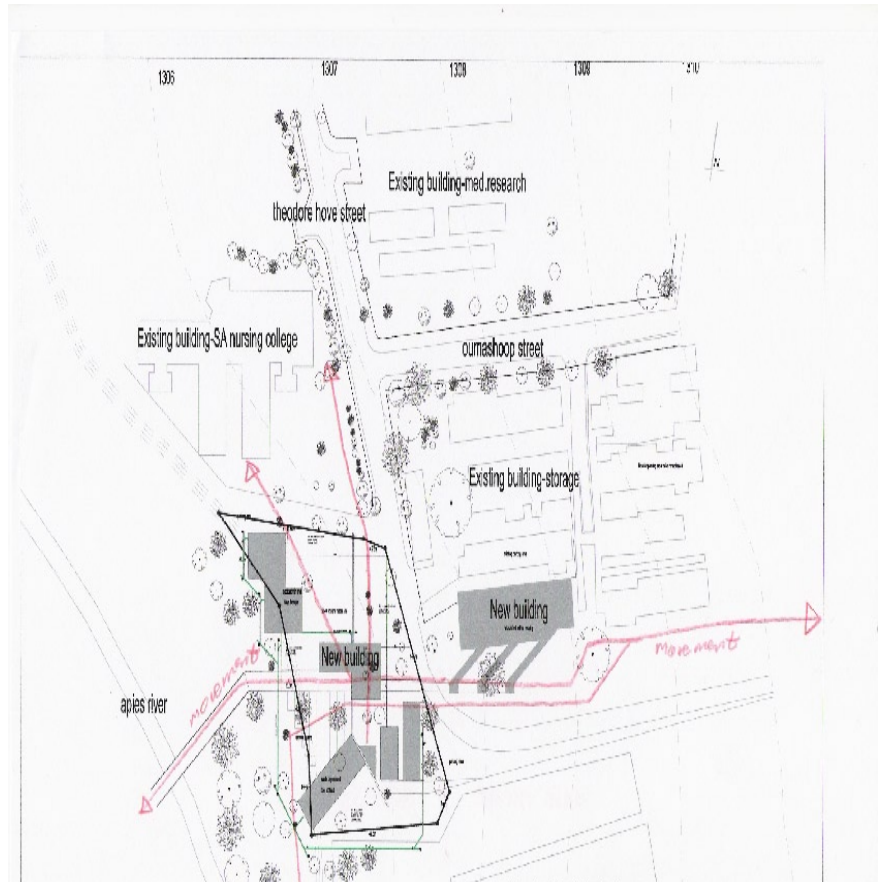
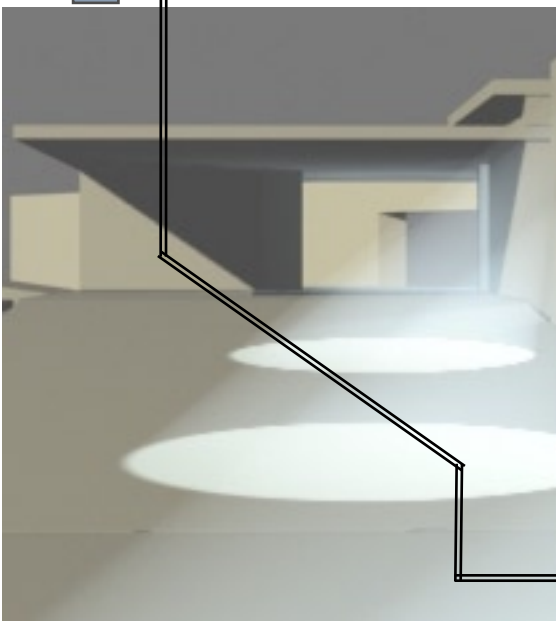


Fig. 147 Final concept model

Fig.148 Final concept model



12 Technical Investigation

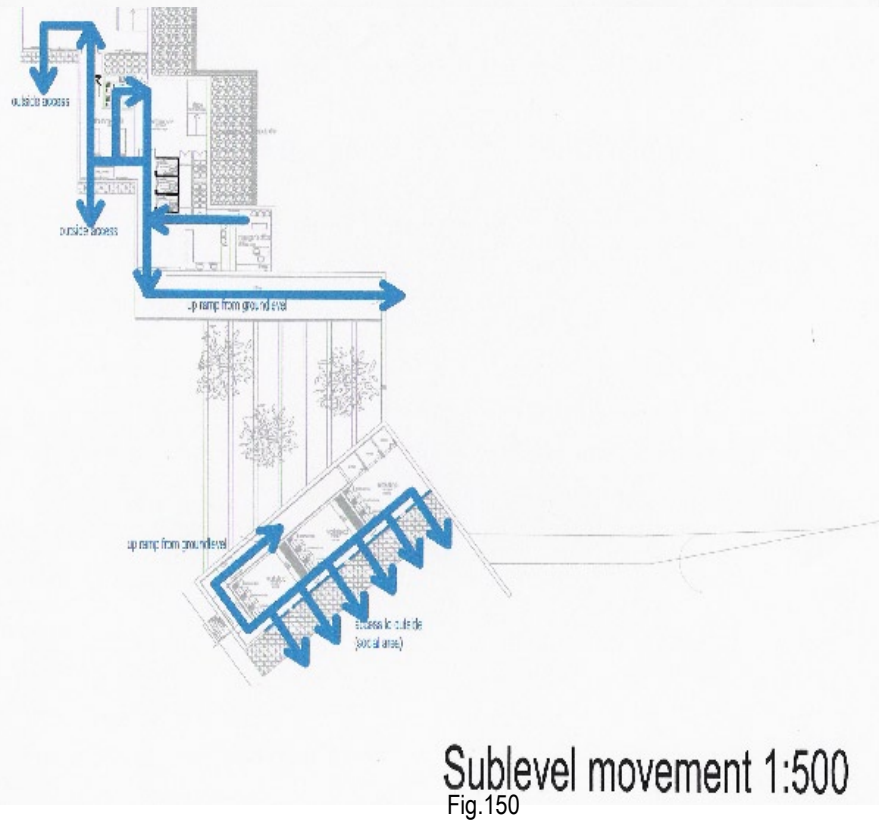
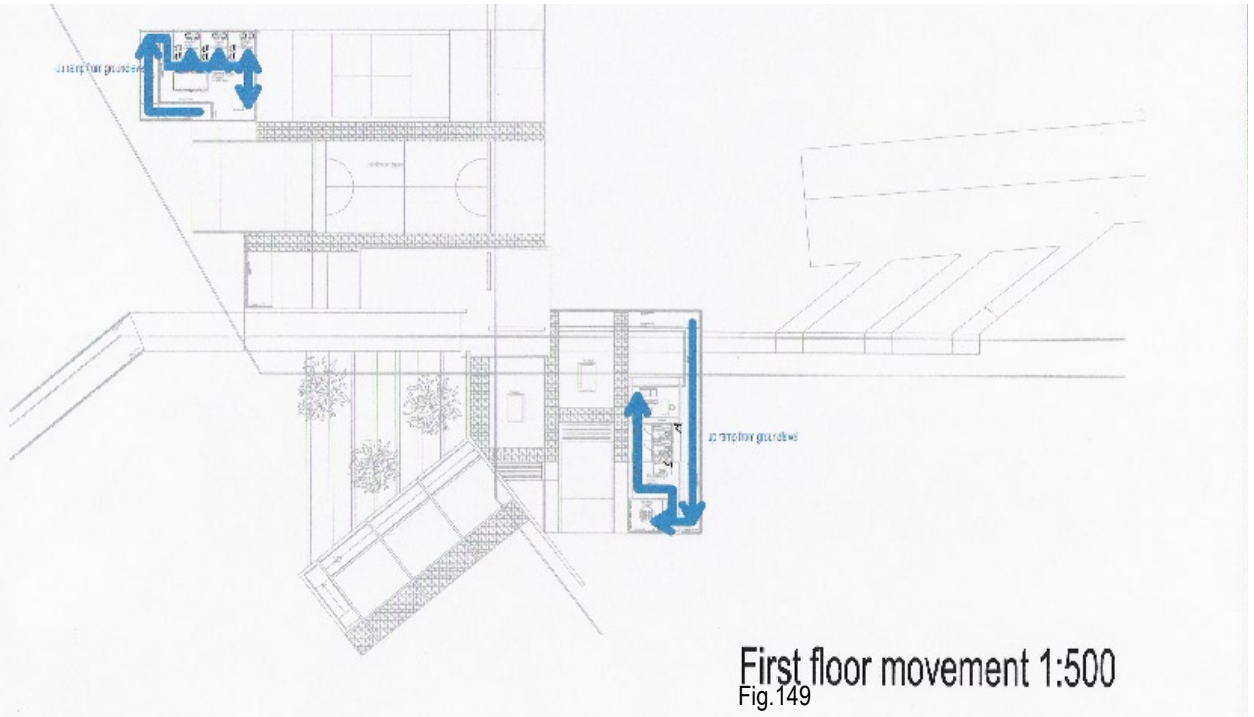


Fig.151 Materials-gravel

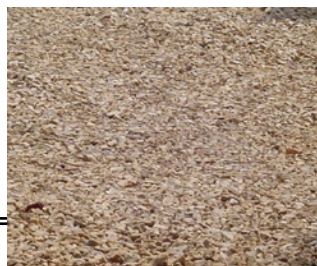
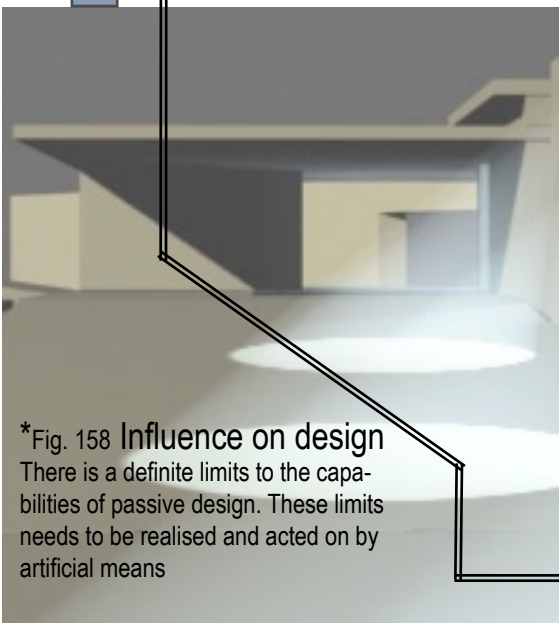
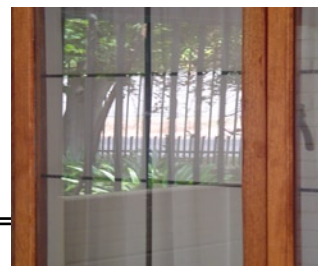
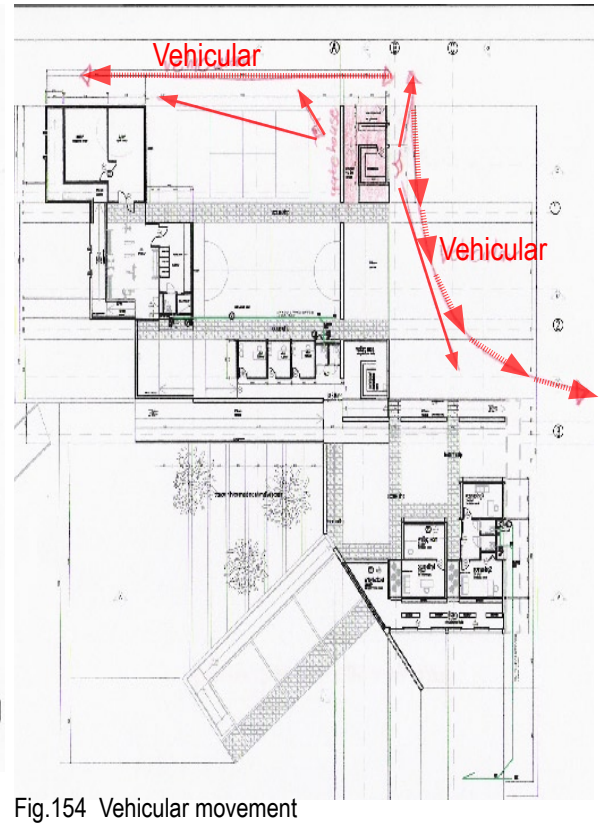
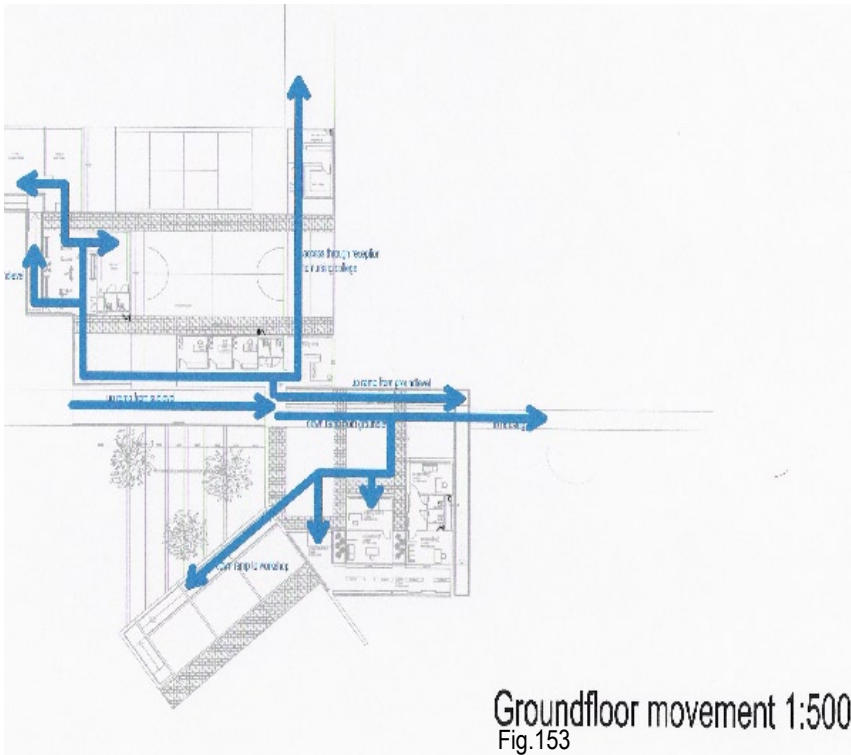


Fig.152 Materials-glass



*Fig. 158 Influence on design
There is a definite limits to the capabilities of passive design. These limits needs to be realised and acted on by artificial means



12.2 Materials used:

The materials used to construct this building are of a very basic nature. The materials (steel, concrete, brick, glass and galvanised steel sheeting) can also be found in the surrounding buildings, forming the physical context.

The most prominent building in the vicinity of the centre is the College of Nursing building erected and designed in 1965 by Joubert, Owens & van Niekerk. This particular building is a fine example of the Brazilian architectural influence in South Africa as well the Pretoria regionalism to a certain extent. A reaction to physical context should thus include a response to the materials used by the Pretoria regionalists.

Footings:

The nature of the substrate of the site differs from the higher levels to the low lying levels of the site. The low lying substrate is of an active nature which thus necessitates the use of raft foundations for the single storey building elements. The footings that support upper levels must be pile foundations due to the larger load having to be carried.

Due to the possibility of movement in the substrate, it became necessary to provide a movement section between the two segments of the physical therapy block. The passage between the gym and the physical therapies serves this purpose.

The segments of the building on the upper levels of the site will be built on ordinary strip foundations due to the more inactive nature of the substrate there.

Fig.155 Materials-galvanised steel



Fig.156 Materials-brick



Fig.157 Materials-concrete



Roofs:

The shapes of the portal frame roofs are derived from the required movement over them (gravity lifts) as well as the need for maximum exposure to the sun (needed by solar water heaters)

The use of portal frame roofs provides a large amount of flexibility since it allows for fixtures to be fastened to it in future. The roofs of the segments of the building that houses all day activity like the physical therapy and the counseling block, must also be flexible in terms of housing airconditioning and service ducts without taking up too much headroom.

Floors:

The use of fibre cement infill floors in the physical therapy segment was due to the fact that large open floorspace is needed for the particular functions housed on the different floors (conference centre on sublevel and physio on ground-floor). The spans of the large open spaces to be spanned are kept to a maximum of 8m. The floor in the counseling segment differs from the above due to the presence of adequate floor support in the form of dividing walls.

The floor of the admin block is re-inforced with re-inforced concrete ribs due to the elevated nature of the floor.

The floors of the entire sublevel is re-inforced due to the active nature of the substrate.

Dividing walls and basement treatment:

The partial subterranean nature of the sublevel of the building, spelt out the need to treat the walls against the penetration of moisture. The most economical way to waterproof a one level basement would be by means of the tank method. The basic structure of the wall consists of the 400mm outer dividing wall with openings to let moisture through, a 50mm cavity and a 230mm brick wall with sealant to the side of the cavity.

Details:

The design of details for the centre was done while bearing in mind that South African craftsmanship is not always up to standard. Details were consequently kept very basic in terms of material use and construction method. Basic details have the added bonus that maintenance will be easy and limited.

The more intricate details like the sliding doors can be reverted to a more basic (manual) operating option. The gravity lift as well as the lighting structures will be manufactured in the centre's workshops which has the advantage that the centre users will be able to repair and service these elements themselves.

12.3 The working of the facades-heating and lighting:

The northern facades were all treated in the same manner which is to shield the selective translucent glass surfaces with a system of 150mm wide treated wood louvres that can be manipulated from the inside of the building. There is a 100mm ventilation gap between the glass surface and the louvres to facilitate the removal of excess heat from the glass surface.

Seeing as the heat absorption of a glass surface increases when dirt accumulates on the surface, it is of utmost importance to keep the outside window surface as clean as possible. Cleaning the outside surface of the window can be done by the use of the cleaning wipers that are operatable from the inside.

Counseling block thermal movement and ventilation:

The mini greenhouses between the two segments of the counseling block serves the purpose of heating the rooms of the block that face south. The air in the greenhouses heats up, provided the shading structures overhead is retracted.

Fig. 159 Final concept model



Fig. 160 Final concept model



*Fig. 158 Influence on design

There is a definite limits to the capabilities of passive design. These limits needs to be realised and acted on by artificial means

The heated air can then be routed into the rooms adjacent to the greenhouse in order to heat up the southern rooms. The added bonus that the presence of plants have for a space used for counseling is that it has a calming effect on people. The rooms directly adjacent to the greenhouses also receive natural lighting through the glass surfaces.

The lighting of the back rooms next to the library is done naturally by means of small, east oriented full-length windows. These windows are shaded by the ramp on first floor and the roof respectively. This window configuration can also be found in the conference centre where the only difference is the western orientation.

The ventilation through the block is from east to west, or right to left as on the sketch. The width of the block segments is restricted accordingly.

12.4 Lighting for the workshops and admin block:

The window heights above ground level is very important if one strives to achieve the best possible natural lighting within a building. Some calculations have been done in order to determine what the guideline heights will be for optimal daylighting.

The use of natural lighting differs in function from building segment to building segment. The segment of the building that houses practical work like the workshops, lecture halls and the admin block as well as the counseling block, will have natural lighting as an alternative to artificial lighting rather than the only source of lighting since the lighting qualities required by different users will vary.

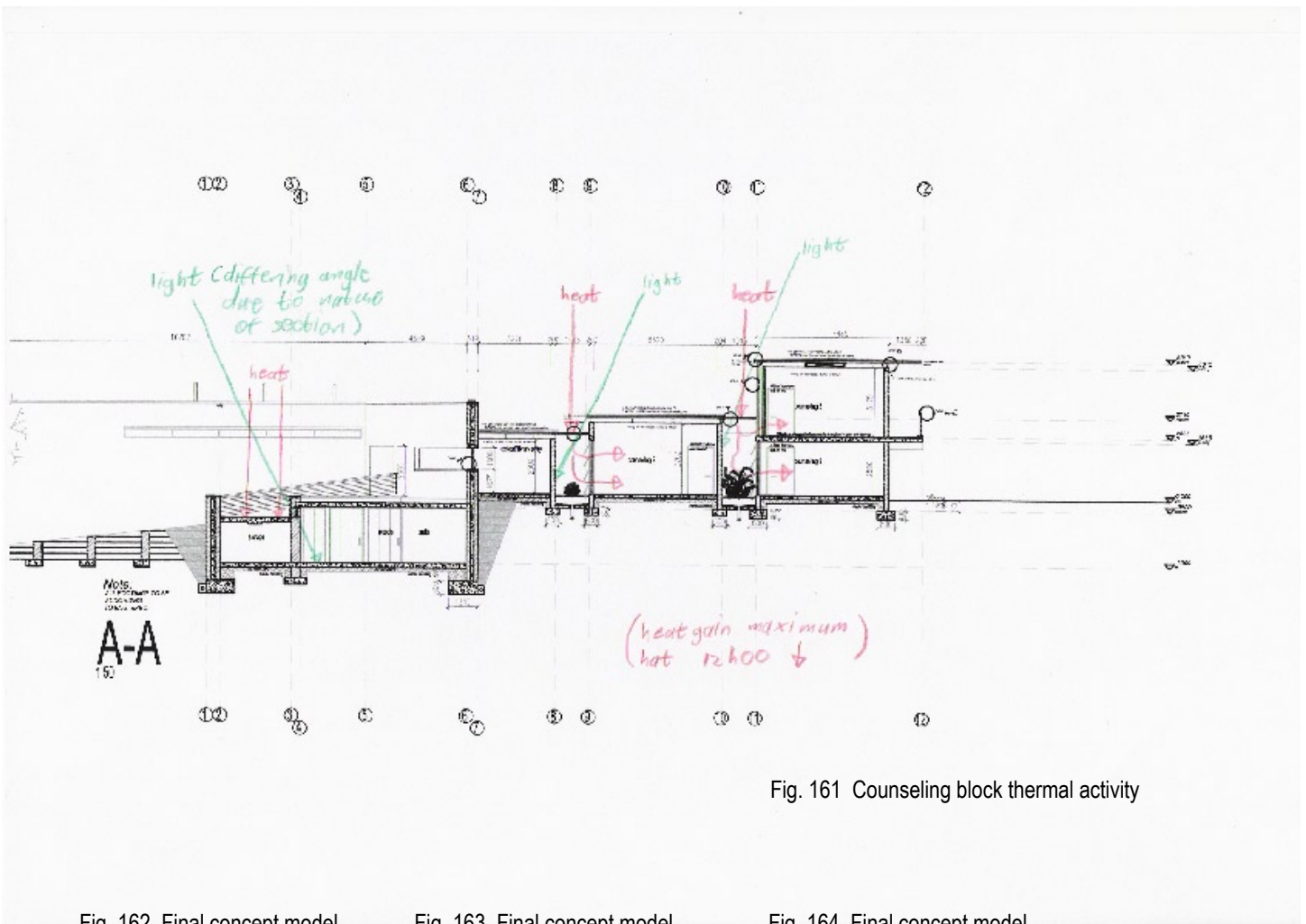


Fig. 161 Counseling block thermal activity

Fig. 162 Final concept model

Fig. 163 Final concept model

Fig. 164 Final concept model



12 Technical Investigation

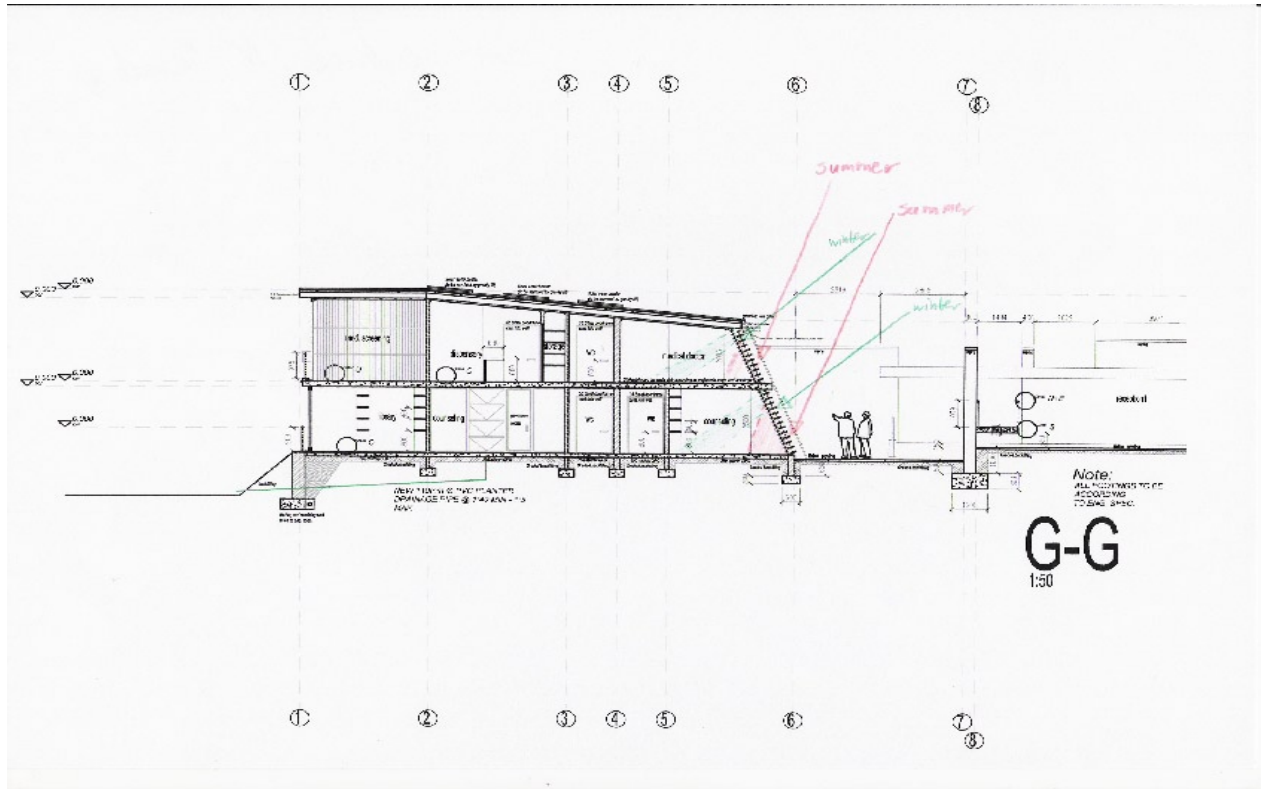
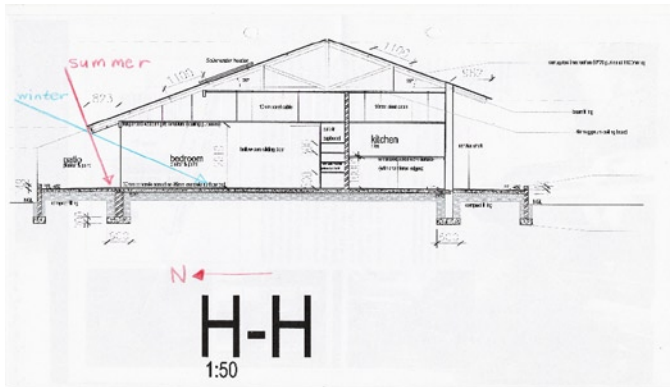


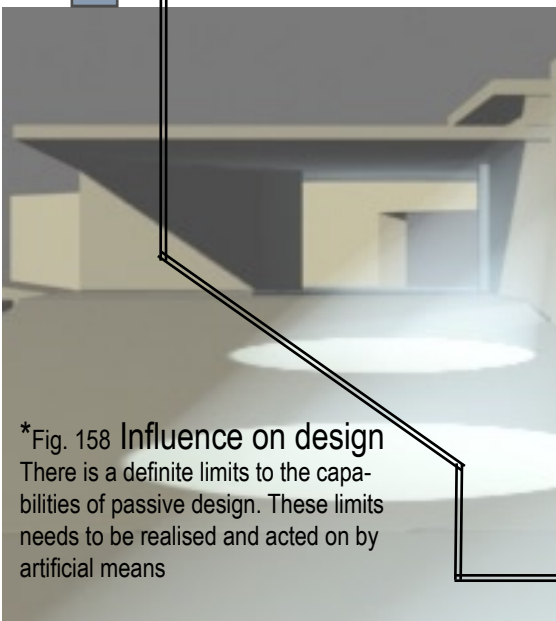
Fig. 165 + 166 Northern facades working



The building segments housing functions that requires little or no light in order to function will have natural lighting as primary light source and artificial light sources as backup.

The presence of trees on the site will have a profound influence on the working of natural lighting in the building. Natural lighting as well as heating will diminish due to the shade cast by trees in the summer. The re-planting of trees must done while bearing this fact in mind.

Trees that shed their leaves in winter must be planted in places where natural heating is necessary and where natural lighting does not play a very demanding role.



*Fig. 158 Influence on design
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Calculating window height for lecture halls in order to achieve the correct daylighting

$$\begin{aligned} DF &= \frac{\sqrt{\text{int}}}{\text{Vext}} * 100 & \text{EOBF} &= 0.4 \\ & & \text{GF} &= 1.1 \\ & & \text{VHF} &= 1.4 \\ &= \frac{160 * 100}{14953} & \text{ODF} &= \frac{DF * GF * VHF}{\text{EOBF}} \\ &= 1.07 & &= \frac{1.07 * 1.1 * 1.4}{0.4} \\ & & &= 4.12 \text{ take as } 4.5 \end{aligned}$$

$$\% \text{window} = \frac{\text{window length} * 100}{\text{length of wall}}$$

$$= \frac{2488 * 100}{10000}$$

$$= 25 \text{ take as } 30\%$$

For ODF of 4.5 , 30% window and 10000 room:

$$\text{Roomdepth} = 4.5$$

Windowheight

$$\underline{5.4/4.5=1.2\text{m above floor level}}$$

Calculating window height for rooms and workshops in order to achieve the correct daylighting

Workshops:

$$\begin{aligned} DF &= \frac{\sqrt{\text{int}}}{\text{Vext}} * 100 & \text{EOBF} &= 0.5 \\ & & \text{GF} &= 1.1 \\ & & \text{VHF} &= 1.4 \\ &= \frac{160 * 100}{14953} & \text{ODF} &= \frac{DF * GF * VHF}{\text{EOBF}} \\ &= 1.07 & &= \frac{1.07 * 1.1 * 1.4}{0.5} \\ & & &= 3.3 \text{ take as } 3.5 \end{aligned}$$

$$\% \text{window} = \frac{\text{window length} * 100}{\text{length of wall}}$$

$$= \frac{2488 * 100}{10000}$$

12 Technical Investigation

=25 take as 30%

For ODF of 3.5 , 30% window and 10000 room:

Roomdepth =3.5 **5.4/3.5=1.5m above floor level**
 Windowheight

Rooms:

$DF = \frac{V_{int}}{V_{ext}} * 100$ $EOBF = 0.4$
 $GF = 1.1$
 $VHF = 1.4$

$= \frac{160 * 100}{14953}$ $ODF = \frac{DF * GF * VHF}{EOBF}$

=1.07
 $= \frac{1.07 * 1.1 * 1.4}{0.4}$

=4.12 take as 4.5

$\%window = \frac{window\ length * 100}{length\ of\ wall}$

$= \frac{1500 * 100}{6200}$

=24% take as 30%

For ODF of 4.5 , 30% window and 10000 room:

Roomdepth =4.5
 Windowheight

5.4/4.5=
1.2m above floor level

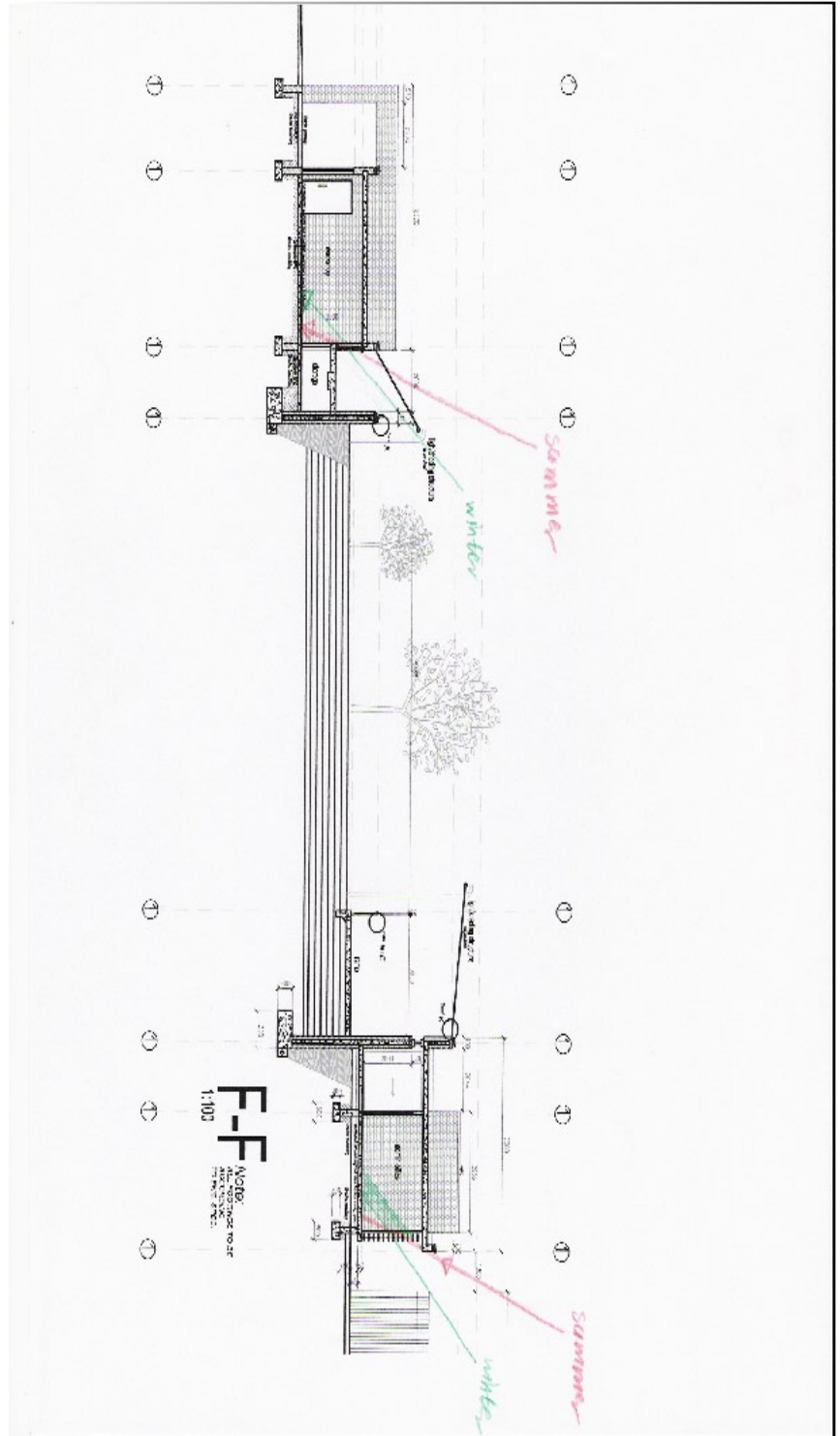


Fig.167 Lighting of workshops and admin

*Fig. 158 Influence on design

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12.5 Acoustics between segments:

The openings or divisions created by the need for raft foundations and provision for movement, could pose a problem if the acoustic behaviour of the building is not properly understood. Take for instance the possibility of sound movement through the greenhouse area towards the library and even to the next door offices. The confidential nature of the conversations being held within the counseling block needs an environment that makes the user feel safe and private.

The calculations done is an emulation of a very similar situation as that of sound movement between the workshops and the library. It is very obvious that the acoustic qualities of the workshops must be of an insulating nature or at least a diverting nature in terms of sound movement.

The conference facilities need special attention in terms of acoustic qualities. The nature of the rooms necessitates the use of reflective materials on the first half of the wall nearest to the stage, and absorptive materials at the back of the room. A reflective screen might be placed behind the speaker in order to aid those hard of hearing (in hearing what is being said.)

The objective is once again to achieve the best possible acoustic qualities by the simplest and least expensive means. The most important requirement to which insulative materials must adhere is that of robustness. Wheelchairs moving past the wall can easily damage the materials on it.

12.5.1 Classroom acoustics:

Room: 10000*5400*3000

Floor: smooth concrete

Walls: plastered brick

Roof: flat concrete

Windows: 2* 4mm glazing dimensions: 2488*949

Door: hollow core (1.0*2.0)

Pupils: take 10 seated on hard chairs as average.(amount of pupils and chairs will vary)

| Octave band | | 250 | 500 | 1000 | 2000 |
|-----------------------------------|----|--------|--------|--------|--------|
| Workshop sound power levels at 6m | LW | 29.4dB | 23.5dB | 19.8dB | 17.6dB |

| | | 250 | 500 | 1000 | 2000 |
|--------------------------------|--------------------|--------|---------|---------|---------|
| Absorption coefficients | | | | | |
| Floor | | 0.01 | 0.01 | 0.02 | 0.02 |
| Walls | | 0.02 | 0.02 | 0.02 | 0.03 |
| Roof | | 0.15 | 0.08 | 0.04 | 0.07 |
| Windows | | 0.25 | 0.18 | 0.12 | 0.07 |
| Door | | 0.004 | 0.00425 | 0.00425 | 0.00425 |
| Pupils | | 0.25 | 0.38 | 0.30 | 0.35 |
| Air | | 0.001 | 0.003 | 0.006 | 0.011 |
| Absorption areas | | | | | |
| Floor | 54m ² | 0.54 | 0.54 | 1.08 | 1.08 |
| Walls | 77.3m ² | 1.546 | 1.546 | 1.546 | 2.319 |
| Roof | 54m ² | 8.1 | 4.32 | 2.16 | 3.78 |
| Windows | 4.7m ² | 1.175 | 0.846 | 0.564 | 0.329 |
| Door | 2m ² | 0.008 | 0.0085 | 0.0085 | 0.0085 |
| Pupils | 10 | 2.5 | 3.8 | 3 | 3.5 |
| Air | 162m ³ | 0.162 | 0.486 | 0.972 | 1.782 |
| Total absorption | | 14.031 | 11.55 | 9.33 | 12.8 |
| Total room surface | 192m ² | | | | |

| | | | | |
|--|----------|----------|----------|----------|
| Reverberation times= $0.161V/-2.3S\log(1-\text{average absorption coefficient})$ | 0.17s | 0.31s | 0.41s | 0.39s |
| Average absorption coefficients =total absorption/total surface area | 0.07 | 0.06 | 0.05 | 0.067 |
| Room constant | 14.45 | 12.25 | 10.10 | 13.8 |
| LW -Lp(from table) | 6.2 | 5.5 | 5.2 | 6.0 |
| Given sound power level | 29.4 dB | 23.5 dB | 19.8 dB | 17.6 dB |
| New level | 23.5 dB | 18 dB | 14.6 dB | 11.6 dB |
| A-weighting | -8.6 | -3.2 | 0.0 | 1.2 |
| dBA- noise levels @ 6m from source | 14.9 dBA | 14.8 dBA | 14.6 dBA | 12.8 dBA |

12.6 Air conditioning:

The problem that physically disabled people have with controlling their body temperature is one that was addressed from the start of the project. There are various mechanisms in place that enables the centre users to control their own environment. These mechanisms include movable louvres, manipulatable openings, greenhouses, shading structures, cross-ventilation and correct orientation.

It is however a fact that passive means for heating and cooling is not always sufficient and should thus be complemented by artificial means like airconditioners. The possible placement and working of airconditioners were looked at in the following diagrammes.

The use of airconditioners is very important in the conference centre since the underground locality of the centre will make it a place with temperatures in the lower ranges . This fact is advantagous in the summer but might prove problematic in winter when the conference facilities still need to be cool but not cold.

The rooms underneath a portal frame structure might also become very hot and uncomfortable since cross-ventilation might not function well enough on wind still days.It is this very fact that justifies the occasional use of airconditioners.

Aircon dependence:

The airconditioners will all be powered by the solar panels and the backup energy they generate in order to prevent the exaturated use of airconditioning. The airconditioners could also be connected to the main power supply in order to facilitate further usage.

*Fig. 158 Influence on design

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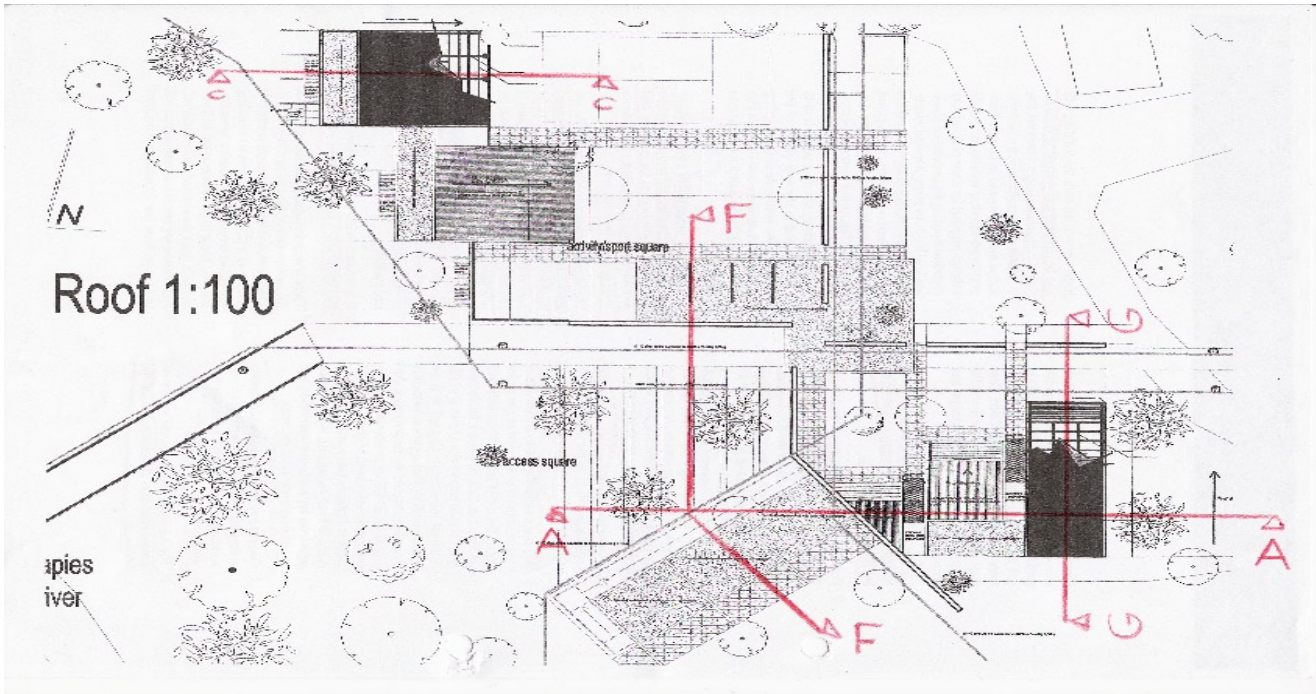


Fig.168 Key section for aircon discussion

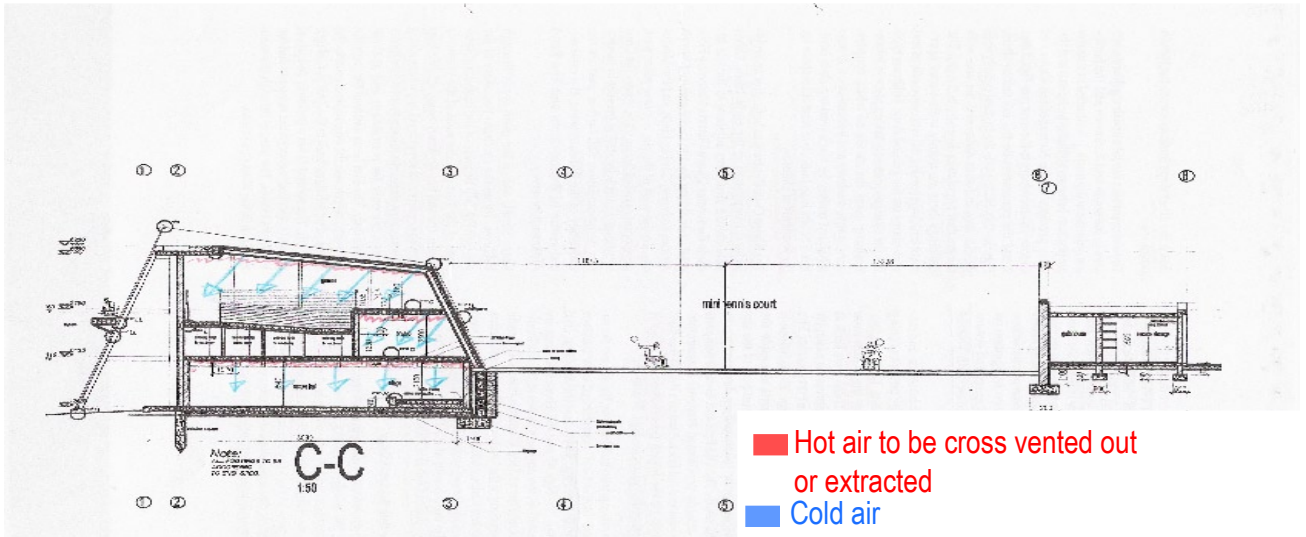
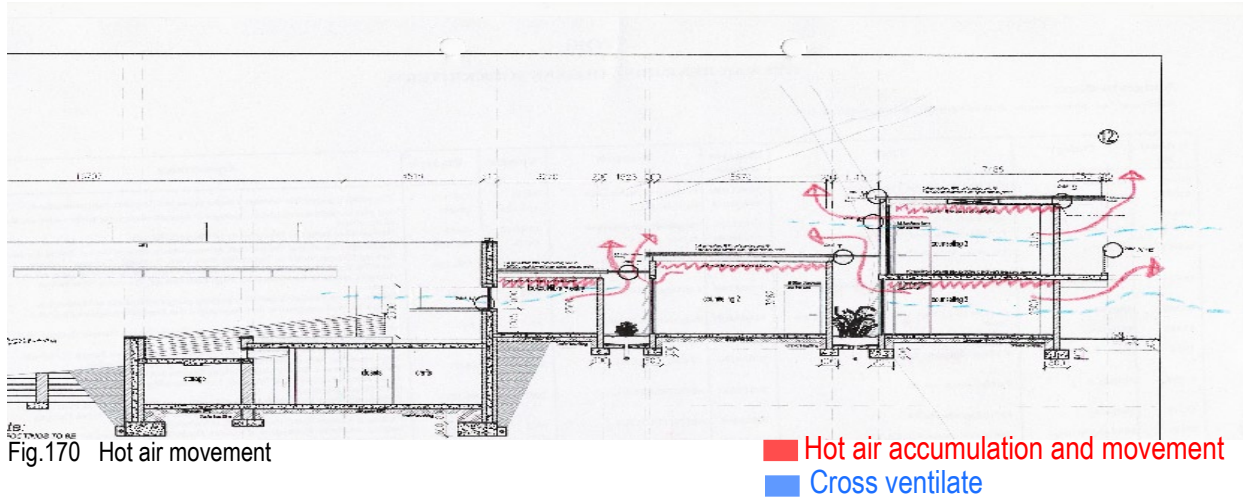
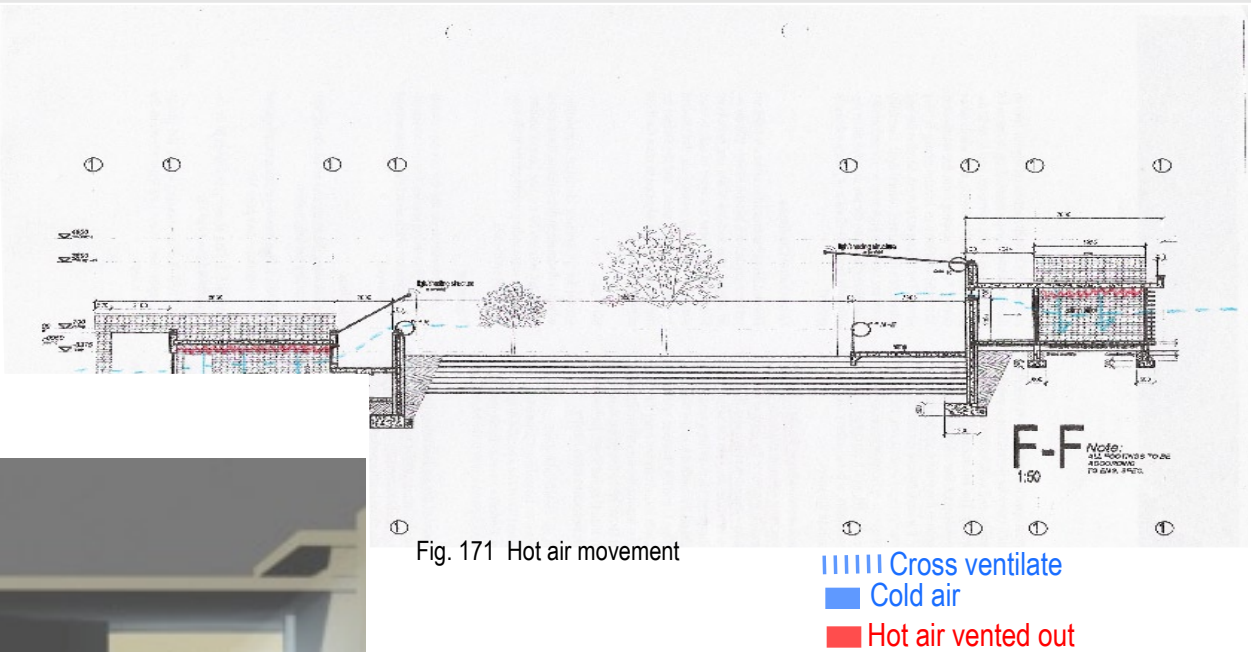


Fig. 169 Aircon

(The warm air that accumulates at the ceiling levels of the different floors can either be cross-ventilated out of the building or removed and recycled by the air conditioners. It is because of this reason that the air conditioners will be installed along the roof and floor lines. The use of a larger aircon system is proposed since the spaces within this block will house larger numbers of people on a scheduled system. The occupants will thus have more collective thermal needs)



(The openings in the facades ,at ceiling level,works in conjunction with cross-ventilation to remove the accumulated hot air from the building. The stack effect is thus used towards the outside of the building)



(The width of the building segments was kept to a 6m maximum to facilitate cross- ventilation)

*Fig. 158 Influence on design
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■ Hot air to be cross vented out
■ Cold air

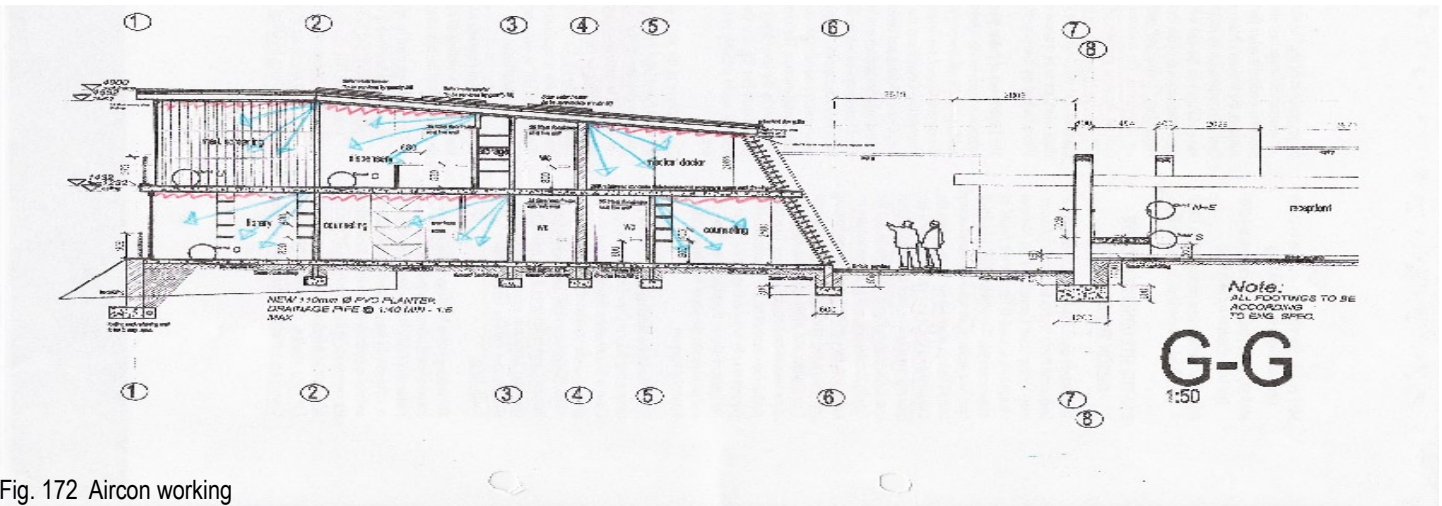


Fig. 172 Aircon working

(The use of localised airconditioners is proposed for use in the Counseling Block since it will house a wider variety of occupants during different times of day, all of which will have different thermal needs.)

12.7 Solar Panels and heating

The solar water heaters on the roofs of the trial housing and the Counseling block will provide warm water for use in the wc's and the kitchens of the centre respectively. This system will once again serve a complementary function seeing as it will work in conjunction with a conventional water heating system that could be used on days with little direct sunlight.

The location of the solar heaters is very important. They should be oriented in such a way as to receive maximum exposure to northern light. The roof of the counseling block is especially suited for this as it's roof has a large surface exposed to northern light. This roof can also be used to install multiple solar heaters in order to feed the rest of the building. The water from these heaters will be distributed to the rest of the centre by means of additional pipes that are added to the lighting structure piping.

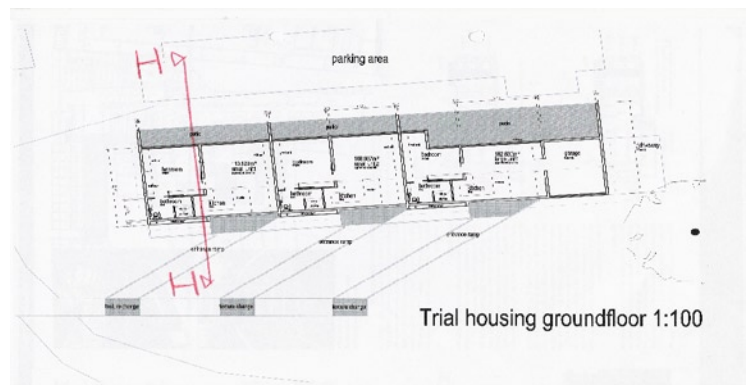
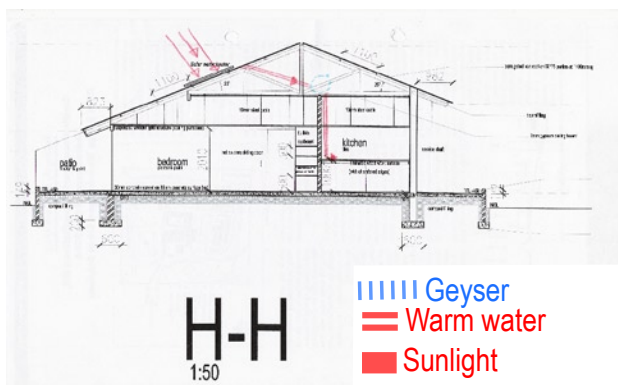


Fig. 173 Solar panels working

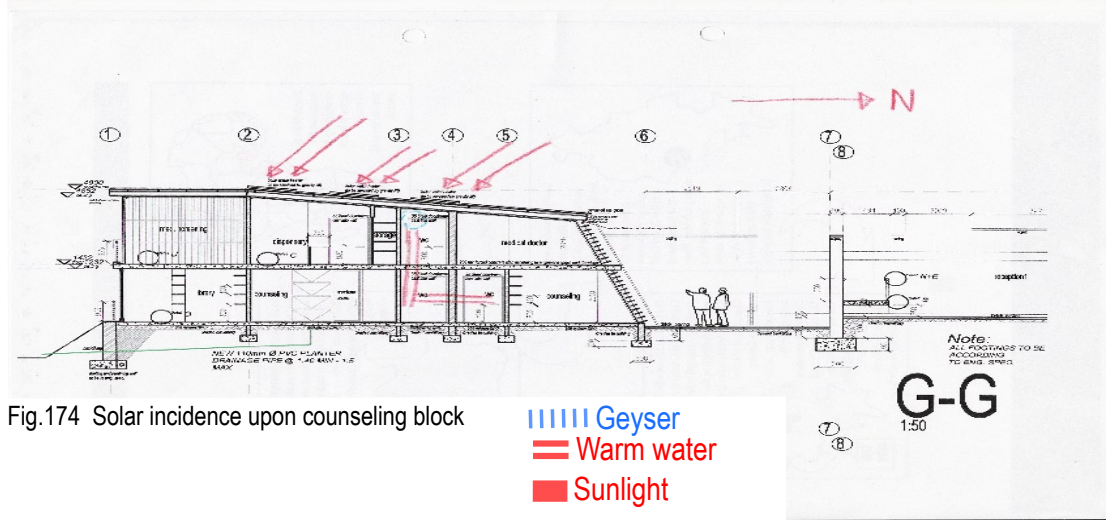


Fig.174 Solar incidence upon counseling block

||||| Geyser
= Warm water
■ Sunlight

12.8 Water movement:

The ramps will largely be kept clear of water by means of the shading structures. The ramps will however have a very slight cross sectional slope towards a gutter that flows along the length of the ramp.

The downpipes from the fullbores is located on the outsides of the particular wall that supports the lowest end of the roof structure. The downpipes will run along the support structure of the louvres in front of the windows in places where the pipes run in front of windows.

The location of the downpipes is done in such a way that the disabled users of the centre will be able to fix or replace the pipes if problems should arise. The downpipes was designed to be integrated with the respective facades.

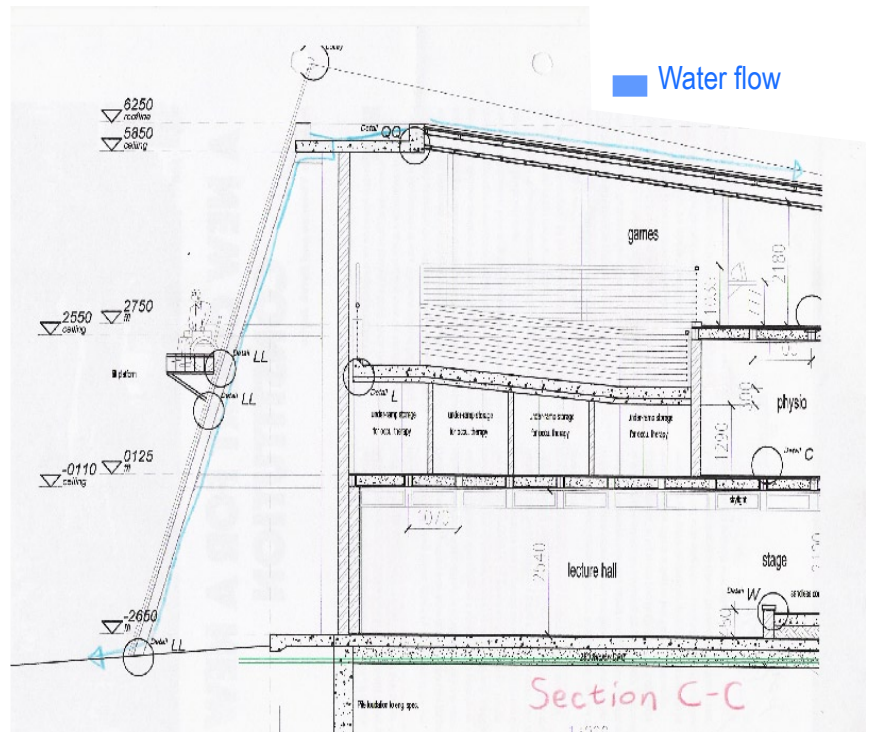


Fig.175 Water flow from sport segment roof

*Fig. 158 Influence on design

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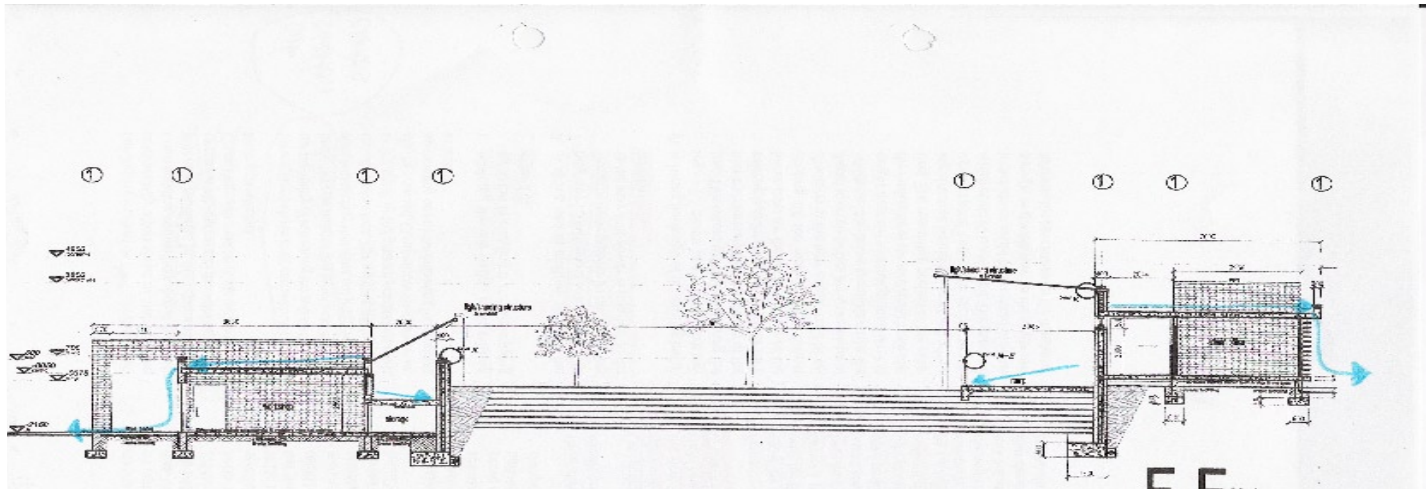


Fig.176 Hot air movement

■ Water flow to gulleys and fullbores

F-F
1:50
Note:
ALL DIMENSIONS TO BE
ACCORDING
TO ENR 5700