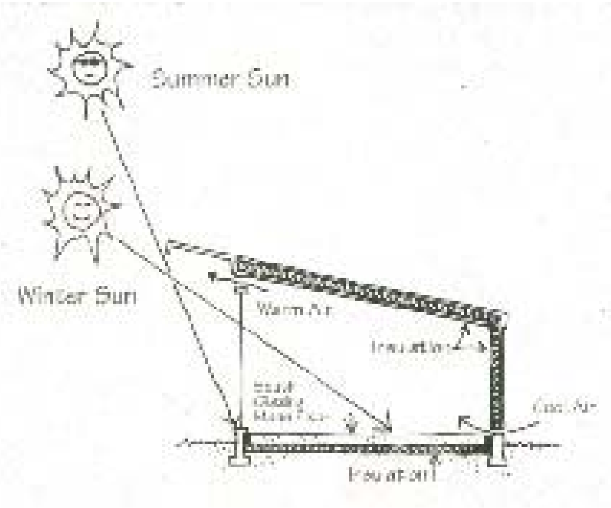

Fig.05.01

Month	Mean Daily Sunshine Hours
January	6.9
February	7.3
March	6.5
April	8.1
May	8.5
June	8.4
July	8.2
August	8.6
September	7.9
October	6.6
November	6.3
December	6.9

Table 05.01

05 BASELINE CRITERIA

05.1 SUSTAINABILITY

The design of the development should be driven to the smallest detail and on a range of different levels by sustainable principles to create a model for sustainable building practices and appropriate building technologies.

05.02 NATURAL SUNLIGHT

05.02.1 Ponds to reflect light

Ponds allow light to reflect off the surface of the water and into the interior spaces of buildings. This creates a magical effect where reflected light bounces and shimmers off the walls and ceiling. Because of more exposure to sunlight, plants placed next to ponds grow more excessively. (KENNEDY, J.F., SMITH, M.G., WANEK, C. 2002 p.259). To enhance tranquility, ponds will be placed in the central courtyard and to allow for additional natural light penetration into the interior spaces, next to the conference facility and offices.

05.03 ENERGY EFFICIENCY

05.03.1 Designing with the sun

The orientation of buildings on the site will ensure that heat gain is enhanced during winter and kept to a minimum during summer. In summer, when the sun is high, roof overhangs, trellises and other devices provide shade. Because the sun is low during winter, these devices allow sunlight to stream in below them, providing heat to the interior.

Shading on west and east faces is more challenging, since the sun is lower in the sky in the morning and evenings, lessening the use of overhangs. (KENNEDY, J.F., SMITH, M.G., WANEK, C. 2002 p.66)

05.03.1.1 Sunshine duration

Tabel 05.01 indicates the average monthly sunshine duration for Piet Retief and proves that the site has adequate amount of sun exposure for the successful functioning of solar water heaters.

05.03.2 Embodied energy

Materials used in the development are low in embodied energy as the timber, clay, straw and a portion of the stone come from Madola. Local labour will be used in the construction processes and timber furniture manufacture.

05.03.3 Solar panels (water heating)

South Africa receives around 5kWh/m²/day in mid-winter and 8kWh/m²/day sun in mid-summer. This can be utilized to great effect for solar water heating, sustaining all warm water requirements of the development.

Energy in the form of solar radiation reaches the earth's atmosphere at the rate of 1395 Joules per square meter per second. This is also known as the solar constant = 1395 W/m². South Africa has the highest solar energy availability in the world – 5-8kWh per square metre per day. A solar water heater will catch the most rays at the sun's peak hours in midday to provide the required amount of hot water at peak demand hours.
(*Engineering News*, 29 Sept – 5 Oct 2000, p.40,41)

A solar water heater will be able to pay for itself within 6 to 15 years, depending on the type of geyser installed. (class notes) The design makes use of a combined electrical and solar geyser to warm water (figure 05.03), thus saving 45% on the electricity costs of a normal geyser. A separate collector storage system is used for water heating and has an electrical booster that is used as back-up water heating system during cold weather and prolonged cloudy periods. Solar panels are installed on top of the corrugated iron roof sheeting, while the geysers are placed within the ceiling. To optimize performance, the collector should face the sun directly. As a rule, it should face true north, or less than 30° off true north. For a year-round optimum performance, it should be tilted towards the equator at roughly the latitude angle of the site plus five to ten degrees. In other words, for optimal results in the Piet Retief (27°) region, solar collectors should ideally be tilted at 32 to 37 degrees. (figure 05.02)

In designing for the worst-case scenario (mid-winter), a 200 litre solar geyser will need 10kWh in order to raise the water temperature from 17°C to 60°C. Allowing for 50% efficiency means that 20kWh will actually be needed. Thus, each cottage will need solar panels that are 4m² in size. (lecture notes)

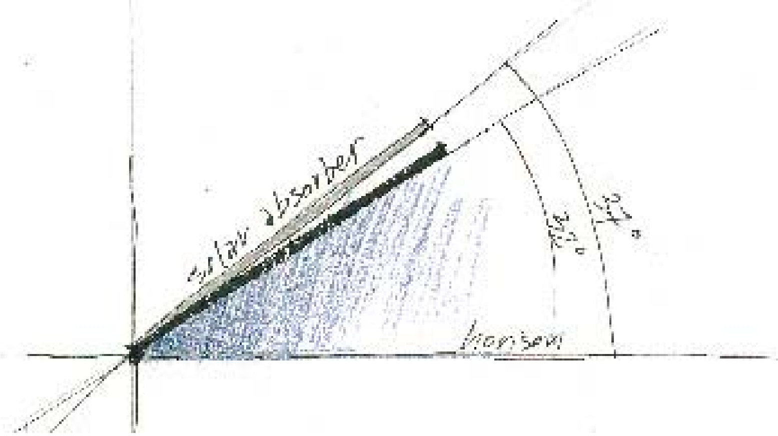

Fig.05.02

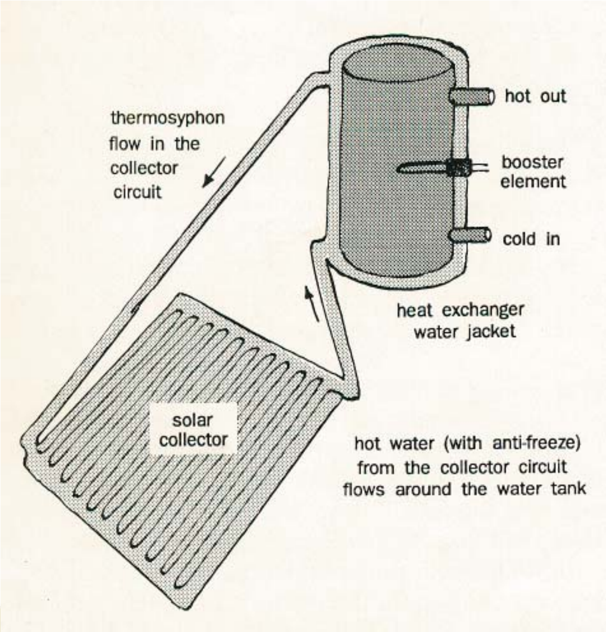

Fig.05.03

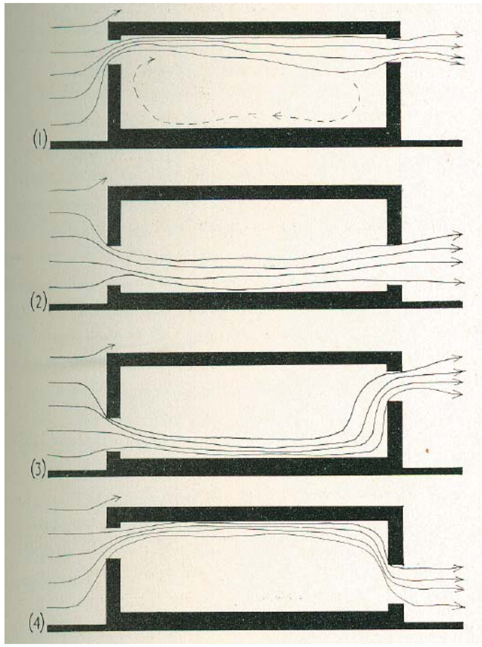

Fig.05.04

05.03.4 Heating swimming pools

Swimming pools only need to be heated to 25-30°C and at an operating temperature of 30°C, the pool will not lose heat. As the swimming pool is supplied with its own electrical pump, it is easy to circulate water through the solar collector by means of this pump. A collecting surface roughly equal to the pool surface is needed to raise the water temperature by about 1°C. A coil of black UPVC pipe laid on top of the roof structure will work efficiently. (WOLFGANG, P. 1978 p.85)

Practical considerations:

1. The electrical swimming pool pump, which is used to circulate water, should only be used during the day to minimize heat loss.
2. It will be beneficial to cover the pool to further prevent heat loss through evaporation and radiation.

05.03.5 Passive design and thermal regulations

Passive solar design is introduced in an attempt to satisfy the need for space, heating, cooling and lighting as far as possible by natural means. This uses the building itself to collect and store solar energy when it is needed, to exclude solar energy when not needed and to encourage natural cooling.

Different methods of passive temperature regulation include:

05.03.5.1 Natural ventilation

Since no mechanical system is used for ventilation, except for the extractor fan used in the main kitchen, it is important to design buildings to optimize natural ventilation patterns. Building size, form and orientation is essential. Buildings placed perpendicular to main wind directions create a natural flow of air through the building and have a cooling effect on the spaces it penetrates. Buildings are therefore long and narrow which allow north-western and eastern winds to cool down interior spaces. Window and door openings are aligned to assist in natural air flow across the span of each building. (figure05.04) The placing of buildings relative to each other onsite also helps to promote natural ventilation when there is a proper distance between adjacent buildings. Windows at ceiling level in the larger buildings provide outlets that can regulate the displacement of hot air, which is essential to maintain comfortable interior temperature levels.

Each building and function has its own specific natural air flow requirements and in all habitable rooms, air movement is required at approximately shoulder height (approx 1300 – 1700mm). In bedrooms, however, ventilation should take place at bed height (400 – 600mm). In the offices and lounge, air movement can be directed at the height or the head of a seated person (900 – 1200mm). The distribution on plan can also vary. In a bedroom, the flow must be directed to the area of the bed. In living rooms, a wider distribution over the usable area is required. Air flow related to the position of the inlet in the wall is illustrated in figure 05.04. (EVANS, M.1980 p.128, 129)

05.03.5.2 Sun angles

Sun angles should be carefully analyzed and incorporated into the design. Natural light can greatly enhance certain spaces and improve the functionality thereof. The main design requirements are therefore based on optimizing what is locally available on site.

05.03.5.3 Thermal Mass (solar walls, heat absorbing materials)

Figure 05.05 illustrates the basic priciples which should be applied when designing buildings in moderate to cool climatic conditions that are associated with Piet Retief. Rock, earth, concrete and water are common thermal mass materials that have the capacity to absorb large amounts of heat. These materials change temperature slowly, coming to equilibrium with the surroundings over a period of time. Thermal mass harnesses a few hours of intense sun in the midday to provide heat all day and night, without overheating at the peak insulation period.

No full floor carpets are used, as these insulate the high-mass floor, which they cover. It is ideal that sunlight warms the floor, where the mass of the structure lies, therefore large northern solar windows are designed to allow solar heat into the interior. Through this, the rammed earth floors and straw bale walls can absorb and store vast amounts of heat. Windows must be insulated (through shutters or thick curtains). For walls and floors, effective heat-absorbing surfaces include concrete, stone, brick, rammed earth, stucco or tile of 100 – 180mm thick. (RUCKER, D. G. 1993 p.86)

In summer, most solar radiation strikes the insulated roof and does not significantly heat the building interior. In winter, the sun is lower, warms up the thick straw bale walls and thus heats the building interior.

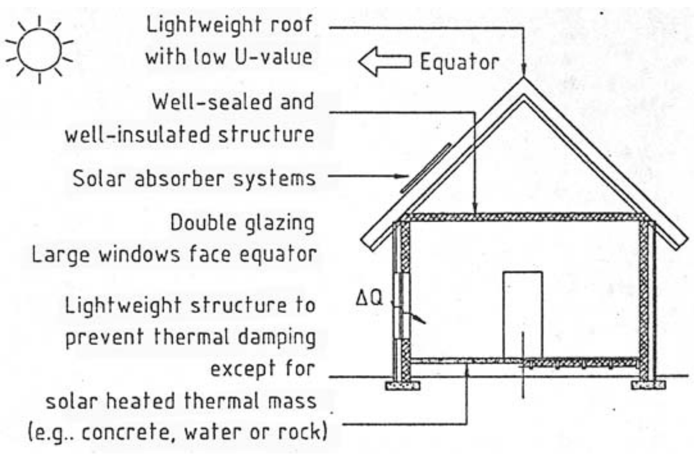

Fig.05.05

05.03.5.4 Western facades (orientation and size)

The orientation of a building should be decided according to climatological factors to maximise the use of natural lighting and heating, thus keeping the building comfortable throughout the seasons with little need for artificial intervention. The more a building design mimics nature, the more it functions like an organism, and organisms are adaptable to the climate.
(Green 2004 p.9)

When both sunlight and prevailing winds come from the west, it is difficult to prevent the sun from entering a space when windows need to be opened to allow for natural ventilation. Since compromise is not easy, the choice is between both sun and wind, or neither. When solar radiation enters through a west-facing window it may easily increase the internal air temperature by 5 degrees and will cause an even greater discomfort if direct radiation falls on the occupants. The effect of good air movement will be equivalent to a reduction in temperature of about only 2.5 degrees. It is possible to exclude direct solar radiation from west-facing windows by the use of shading devices, but these will be heated by solar radiation and may heat up the air before it enters the room. Shading devices on west walls that exclude the sun will inevitably severely limit any view from the window and deflect air movement in directions where it may not be effective. (EVANS, M.1980 p.62)

The main development excludes west-facing windows as far as possible, but where there is no alternative, the design incorporates these windows with large overhangs to maintain western views but minimize heat gain. The farm factory will need western windows to ensure the necessary ventilation in rooms on that side of the building. These windows, however, will be smaller and placed higher than normal in order to minimize solar heat gain.

The design of the cottages is more complex. Despite all the thermal warnings against west-facing windows, the view from the bedroom is regarded as main priority and a window will be incorporated. As straw bale construction has good thermal insulation qualities, it allows for the cottages to have west-facing windows that will only be used for ventilation purposes at specific times in a day. A large roof overhang will ensure minimal western solar heat gain while the window provides the bedroom with a view. The view will mainly be experienced when lying in bed, which means that, although the roof overhang is large, one will still be able to enjoy the view in the mornings when the western sun is not a problem.

05.03.5.5 Insulation of building structures

Generally, Piet Retief has a mild climate, but careful attention should be given so as to insulate cottages from extremely cold winter nights. This can be done by applying the following climatic design principles:

05.03.5.6 Building form & orientation

The optimum design for the climate of Madola will be a moderately dense one-storey layout, with main openings to the north and south. Dwellings facing onto fairly generously proportioned courtyards with greater dimensions in an east-west direction and terraced dwellings facing north and south are also appropriate. The northern spaces will receive sun in the winter, while an overhang or creeper plants can be used to shade these in summer. (EVANS, M.1980 p.71) Clerestory windows will allow for additional northern sunlight into larger buildings.

In designing the cottages, the two most important factors influencing the orientation are: Firstly, to provide the main living space within the cottage with a north-facing window and verandah so as to maximize thermal comfort. Secondly, the roof will need to slope in a northern direction to provide a surface onto which the solar heat collectors could be fixed.

05.03.5.7 Sizing and location of windows

Windows on the eastern and southern sides of a house should each represent no more than 4% of the house's floor area, while maximum recommendations for windows on the west wall is only 2% of the floor area. To capture heat from the sun, the square footage of north-facing glass should be a minimum of 7% of the floor area and the maximum should not exceed 12%. This method of sun tempering is especially good for hot climates. When north-facing glass is above the 7% threshold, it must be balanced with an increase in heat-absorbing materials. Clerestory windows allow natural sunlight to penetrate buildings and provide interior spaces with the required level of natural lighting. (figure 05.06) It also enhances the interior quality of spaces. In winter, these windows improve the effectiveness of thermal mass elements.

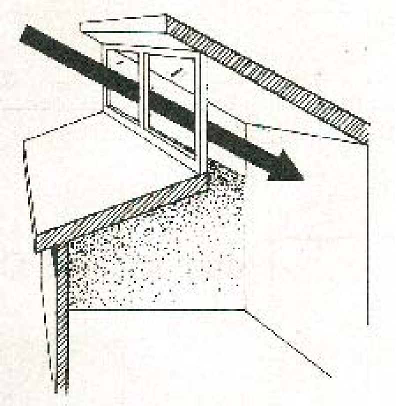

Fig.05.06

05.03.5.8 Roof overhang

Northern windows are to be shaded from the summer sun but should allow the low winter sun to penetrate far into the house. Western windows should be protected against harsh western sun and, where possible, completely avoided. Roof overhangs are important in terms of protecting straw bale walls from rain. On Madola, rain hits buildings from a north-western and slightly eastern direction. It is therefore beneficial to the for roof overhangs to be increased by up to 1000mm on western and eastern facades. It would be beneficial to combine roof overhangs with a strip of grass or vegetation at ground level around the various proposed buildings as to prevent surfaces from heating up.

05.03.5.9 Active systems

Active systems use components to pump and store heat as desired, eg solar heat collectors for the swimming pool and hot water in kitchens and bathrooms.

05.04 OCCUPANT COMFORT

All interior spaces will be provided with sufficient windows that can be opened to allow for natural ventilation. The user will therefore be able to control the immediate surroundings according to his or her personal needs. In the same way, selected windows will be provided with timber shutters that can be operated manually, preventing harsh sunrays from hindering interior activities.

Floor finishes of outside social areas are to be made from materials that only partially absorb heat from the sun, making it not too hot to walk on and which is not too light in colour to ensure minimal glare. Materials that are used include: Timber decking and cobblestone paving blocks laid in rammed earth. Vegetation should greatly be incorporated. This ensures that the user is constantly reminded of his/her surroundings and closeness to nature.

05.04.1 Foot comfort

Some people may walk barefoot, particularly in bedrooms and bathrooms. Floors with high admittances may feel uncomfortably cold. When walking on a cold floor, the foot will only be in contact with a particular part of the floor surface for a few seconds and therefore the heat flow from the foot to the surface will be dependant on the floor finish and not the sub-floor.

In summer, when temperatures are generally above 25°C, concrete floors, terrazzo tiles and other hard and 'cold' materials become comfortable. These floor finishes will not be too hot for comfort until temperatures in excess of 45°C are reached, which is unlikely on Madola. However, outside paved areas that are exposed and heated by the sun could become uncomfortable and therefore the designed will mainly incorporate gravel. When floor temperatures drop below 19°C, the choice of comfortable floor finishes becomes more limited. At 18°C, softwood boards make for efficient flooring materials. (EVANS, M.1980 p.103) A timber deck absorbs less heat than thermal floors and is therefore a good solution for outdoor spaces that need to be cool during daytime when it receives most of its traffic.

05.05 WASTE MANAGEMENT

05.05.1 Grey water recycling

The design will, from inception, include integrated systems for grey water recycling. In both the main building's kitchens and cottages, grey water from hand basins will be led to perforated geopipes placed beneath gardens to ensure slow release for irrigation purposes. Grey water from hand basins in public bathrooms will join black water from the water closets to ensure the efficient flushing solids. For the same reason, the grey water from baths in cottages joins the black water from water closets in each cottage. Water which is discharged by the kitchen should go through a grease trap before being recycled as grey water or being fed to the septic tanks.

05.05.2 Storm water management

Good site drainage is extremely important throughout, as excess water left unattended may penetrate the buildings, which can be detrimental to straw bale construction. Each building (in both the main and private developments) will therefore include a slightly sloping hard surface around the perimeter of each individual building that allows water to efficiently drain. Trenches will be dug to channel surface and subsurface runoff to carry water around or away from the buildings.

As the site is terraced, the overall flow of water during rainstorms is slowed down, thus limiting possible erosion and maximizing water intake through vegetation, which covers each terrace. Indigenous species have low water requirements and therefore the design promotes the planting thereof in an effort to conserve water resources.

The most northern part of the development (Mushroom cultivation area) will include drainage trenches that catch and eventually lead water runoff to the adjacent dam. All the drained water and runoff on the southern part of the dam will penetrate the subsoil and move downwards. There it will eventually, after passing through plantations, end up in the river at the lowest point of the site. In the private development, rainwater will naturally be drained away from each cottage, as the natural ground level slopes from each cottage towards the forest and river.

05.05.3 Rainwater Collection

In determining the sizes of water tanks it is necessary to design for the worst case scenario. Rainfall on farm Madola reaches a maximum during summer months to provide a summer average rainfall of 125mm, with December being the highest month. It has been recorded that a single rainstorm can deliver up to 75mm of rain in one storm.
Average rainfalls per month are as follow:
October – 75mm
November – 125mm
December – 150mm
January – 125mm
February – 75mm
The design includes 3 000 and 5 000 litre water tanks that are able to contain the summer average rainfall of 125mm per month, depending on the various roof areas of the proposed buildings.

Collected rainwater is intended for human consumption and is therefore placed close to the kitchens and bathrooms. Down pipes that lead water into the tanks are taken below the level of the inlet pipe with a plug in the bottom of the down pipes. This ensures that the rain's first foul flush is diverted away by removing the plug after the rainstorm.

05.05.4 Septic tanks/ sanitary drainage system

Sewage will be collected by a large septic tank specifically designed to hold the amount of waste produced by the entire development. Waste from public bathrooms and individual cottages will therefore be channeled to join in a single septic tank at the lowest point of the site, from where it will drain into a French drain that feeds the surrounding plantations.

05.05.5 Organic waste

Organic matter produced during daily farm operations is to be collected at a central point to be turned into compost. The result is a soil product that can be reworked into the landscape. Timber off-cuts and waste produced by the sawmill on site can be worked into strawberry patches and vegetable gardens. This helps to inhibit the growth of unwanted species that affect the productivity of these plants. Cut grass is worked into gardens and placed on the ground surface of plantations to generate compost, which will increase soil fertility.

05.05.6 Water provision on site

Water used within the main development area is pumped from Dam 2 into the main settling tank which is the only tank that will need management and regular cleaning. Water is then distributed from this tank to 5 other water tanks which serve the various sections of the main development area. Therefore, should a particular section require more water on a specific occasion, it can be pumped back from other sections or water tanks to the main settling tank. The main tank will then provide the relevant section with additional water.

The private section of Mkhonda Lodge will receive its water from Dam 1. Two water tanks are provided to serve the various cottages and water from Dam 1 will be pumped directly into the tanks. Both tanks will therefore need management and regular cleaning.

05.06 ACCESSIBILITY AND CIRCULATION

05.06.1 Legibility

Routes between buildings are strategic to fit into the existing landscape. Public and exposed routes are highlighted through the use of landscape elements (stone walls, gardens and trees) and are intended for use by daily visitors. Private roads and walkways only used by guests are less visible. Service roads have separate entrances and are situated away from the central development.

05.06.2 Persons with disabilities

All levels and buildings are wheelchair accessible. Depending on the height difference, the slope of the ramps varies between 1:8 and 1:12.

05.06.3 Accessibility between different buildings

Within the main development, accessibility between separate buildings is important. Four main functions are distinguished, namely lounge and restaurant, conference facility, production area and private accommodation area. Each has their own separate entrance, but guests will be able to freely move between them by means of open and covered walkways or ramps.

Fig.05.07

Fig.05.08

Fig.05.09

05.07 EDUCATION, HEALTH AND SAFETY

One of the key objectives of the project is to inform all users and individuals of a new vernacular and approach to design where economic, social and environmental sustainability and sensitivity towards a site would be the main design criteria in building their own homes and dwellings.

With the development having an educational undertone, compost heaps were designed to be exposed to the public. Guests will be made familiar with the route organic matter travels throughout the development. Trellis work, timber counters and table tops, as well as window and door frames will be locally produced to provide the community with skills that will be of great value to them in future. In the central courtyard and restaurant area, timber trellises will showcase the cultivation of certain vegetable species. The education aspect will be further explored when dealing with water. The aforementioned water recycling implements will be placed strategically to display proper rainwater management.

05.08 FLEXIBILITY

The proposed development is flexible in terms of material usage. Buildings are able to decompose completely and return to their natural state of raw materials, once the development has completed its life cycle. Materials used therefore need to be biodegradable, whilst elements like metal roof sheeting and timber windows and doors can be reused in other applications.

Interior spaces have flexible layouts and forms with no fixed furniture, except for balustrades and counters. Spaces are able to adjust and conform to different needs and functions throughout the lifecycle of the buildings as the demand for additional accommodation and production facilities arises.

The design is also flexible in the range of accommodation options. Generally, accommodation facilities need to provide for people in groups of 8, 12, 16, 24, or 45 to 60 (one busload of tourists). Although a number of units are available, they are dispersed over the entire site. For example, the private kloof area includes 12 cottages. Six of these units can accommodate four people while the rest sleeps two. However, the arrangement of cottages in relation to each other makes it possible for groups of 2, 4, 8, 16, 36 or even 60 people to stay in the private section of Mkhonda Lodge. The main development focus on the accommodation needs of larger tourist groups and therefore the proposed 18 cottages can, in total, provide 48 to 60 people with accommodation. Therefore, through the grouping of different types of cottages, a greater flexibility in accommodation combinations is created. Later design sketches illustrate the different types of cottages (Units A, B, C, D and E) and their relationship on site. Units A and B are in the private kloof area, while units C, D and E form part of the main development.

Available accommodation within each unit is as follows:

1. Unit A – Sleeps 4, fixed layout, private
2. Unit B – Sleeps 2, sleeper couch in lounge to accommodate additional 2 persons, private
3. Unit C – Sleeps 2, fixed layout, private
4. Unit D – Sleeps 2, sleeper couch in lounge to accommodate additional 2 persons, semi-private
5. Unit E – Sleeps 4, largest, family unit, sleeper couch in lounge to accommodate additional 2 persons

05.09 LOCAL LABOUR AND PARTICIPATION

In the surrounding area, the taxi industry is expansive and a large number of workers are currently making use of this transport system. Therefore, staff will be able to move between the lodge and their homes with ease. Occasionally, it will be necessary to provide accommodation for workers that are working night or early morning shifts. The design of the lodge will therefore include four rooms with a shower and toilet, linked with the staff quarters next to the kitchen.

05.10 COMMUNITY INVOLVEMENT

Community involvement plays a dominant role throughout the project and ensures the empowerment, skills transfer and long-term sustainability of local communities. In accordance with Crafford&Crafford Architects' view on the construction of eco-tourism projects, Mkhonda Lodge ensures that locally available materials, craftsmen and customs are utilized in the design and construction. (Blouberg Cultural Village 2004 p.96-97) This enables the development to provide direct benefits to the local community. Through job creation, people will be encouraged to embrace opportunities for small emerging businesses. Residents of Madola and surrounding farms will therefore be used in the construction of Mkhonda Lodge, where their techniques can be demonstrated and supplemented by the technical expertise of professionals. In this way, skills transfer can take place and the community is enriched socially and economically.

05.11 LOCAL PRODUCTION OF FOOD

Mkhonda Lodge will make use of locally produced products as far as possible in an effort to increase overall sustainability. Not only does this reduce operating expenses, but local people are also educated in managing their own production of food. Locally produced food include cow and goats milk and cheeses, vegetables, fruit, poultry, mushrooms, wine and preserves. (figures 05.07-05.14)


Fig.05.10


Fig.05.11

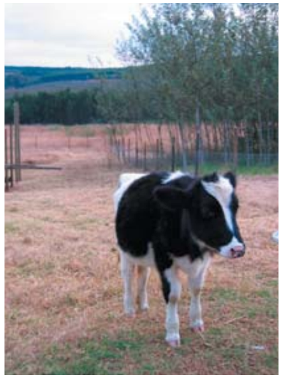
Fig.05.12


Fig.05.13


Fig.05.14

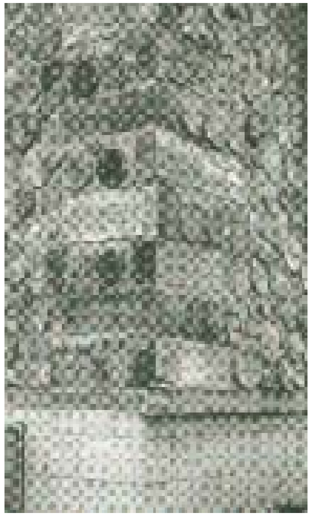

Fig.05.15

05.12 BUILDING MATERIALS AND COMPONENTS

"We can create a comfortable environment with primarily natural materials by simply orienting our homes to the sun and combining exterior insulation with interior thermal mass. Understanding the properties of natural materials and how they can complement each other will lead to healthy and energy-efficient built environments that nurture human life."
(KENNEDY, J.F., SMITH, M.G., WANEK, C. 2002 p.65)

05.12.1 Use of local materials

To ensure low energy expenditure, materials that need little processing and are locally grown is used in the overall design. Madola, in itself, has a rich diversity of natural materials (stone, grass, clay, sand, straw, timber planks and poles) and where other, non-local materials are required, it can easily be obtained in town or the immediate surroundings.

05.12.2 Renewable materials

Traditional materials that are broken down completely and reabsorbed into the natural cycles of the environment once their use as a building material is over should be used. These materials include clay bricks and floors, timber products (eucalyptus poles, doors, window frames, etc), straw bales, grass and stone. Additional building materials that are cannot decompose completely, such as steel profiles and iron roof sheeting are recyclable and reusable for later applications.

05.12.3 Straw bales

Straw bales form the key wall construction material of the entire development and therefore a thorough study needs to be made of straw bale construction specifications and design guidelines. Straw is available locally and will be baled during the winter when the straw is at its driest and there is no main farm activity that requires an intensive labour force. (see appendix 08.01.8)

ENERGY ACCOUNTING OF STRAW BALES

Primary processing of straw bales take place at its production site with low energy inputs, no required water and minimal pollution. Since it is grown locally, cost of transportation is kept to a minimum. Straw bale requires little installation energy or energy-intensive companion systems. It saves heating and cooling energy over the life of a building and releases no toxic materials. At the end of the life of the building, straw can be composted back into the earth. As more energy conservation codes are adopted and lumber becomes more expensive, straw-bale construction will become even more financially attractive. (Lecture notes)

05.12.4 Wood

Piet Retief has a flourishing local timber industry and the use of timber will reflect the local context. High availability of timber and treated timber poles will alleviate transportation fees and consequently minimize building costs. It would therefore be viable to concentrate on timber as main structural element throughout the design. Timber is very strong in compression and tension and can be used for posts, beams, floors, roofs, ceilings, lattice work, windows, doors and furniture. All these products will be manufactured locally at the existing sawmill in an effort to create jobs and to educate the local community through skills development.

Lattice work will be done with timber that is cut and reworked on site. A large number of wattle and eucalyptus slats are produced during regular trimming of plantations, therefore making it a viable option as the slats usually become waste material.

05.12.5 Cord wood

Walls are constructed of entirely natural materials where short logs are laid transversely in the wall in the same way that firewood would be stacked with a cob mixture in between. (figure 05.15) The walls are able to breathe along the end grains of the timber, which allows for quick drying after rainstorms. (KENNEDY, J.F., SMITH, M.G., WANEK, C. 2002 p.143-148) Any available wood can be used, but poplar and pine is preferred as they are lighter with better insulation value and less prone to shrinkage. Currently there are a few poplar forests that need to be removed from Madola, making the use of poplar for cordwood walls a viable option. (KENNEDY, J.F., SMITH, M.G., WANEK, C. 2002 p.145)

05.12.6 Stone and pebbles

Stone will be utilized as a structural material, as its density makes it good thermal mass. This means that it absorbs heat or cold from the surrounding air and, as the air temperature changes, it slowly equalizes to match it, releasing the stored heat or cold. Thermal mass materials absorb heat most effectively when it is dark in colour and the sun hits it directly. (KENNEDY, J.F., SMITH, M.G., WANEK, C. 2002 p.63) A large portion of the stone that will be used in the development will come from rocks dug out during excavations on site. The type of stone generally used is sandstone, soft sedimentary rock that is fairly easy to shape to the desired size. The remaining stone requirements will be met by acquiring stone from the quarry situated within 10km of Madola. In this way, the mountain on the farm is kept in its natural state.

05.12.7 Earthen Plaster & floors

EARTHEN PLASTERS

Plasters protect straw bale walls from wind and rain, seal bales from birds and rodents and add structural strength to the wall. A thick plaster on straw bale interior walls adds up to provide a significant part of the thermal mass that is required for effective solar design.

These plasters will also moderate humidity inside homes, providing the perfect range for human health. (KENNEDY, J.F., SMITH, M.G., WANEK, C. 2002 p.191) Walls will be left in its natural state and colour, for paint keeps the wall from 'breathing' properly and inhibits the wall's ability to transpire moisture. Earthen plasters, on the other hand, absorb moisture but dries out again without creating major moisture problems. (KENNEDY, J.F., SMITH, M.G., WANEK, C. 2002 p.219)

EARTHEN FLOORS

Earthen floors are easier to install and repair than brick, tile or concrete and, if built correctly, can withstand heavy traffic. Different coloured clays can be added for variety.

05.21.8 Sand & Gravel

Sand is an essential ingredient in the construction of Mkhonda, especially in the mixing of cob that is used for plastering the straw bale walls. The sand will be transported from the riverbed on the adjacent farm. Gravel, obtained at the local quarry, will be used for service roads and to fill drainage trenches, as it allows water to gradually seep through topsoil layers.

BASELINE CRITERIA

01 INTRODUCTION
02 DESIGN DISCOURSE
03 CONTEXT
04 PRECEDENT STUDIES
05 BASELINE CRITERIA
05.01 SUSTAINABILITY
05.02 NATURAL SUNLIGHT1
05.03 ENERGY EFFICIENCY
05.04 OCCUPANT COMFORT
05.05 WASTE MANAGEMENT
05.06 ACCESSIBILITY AND CIRCULATION
05.07 EDUCATION, HEALTH AND SAFETY
05.08 FLEXIBILITY
05.09 LOCAL LABOUR AND PARTICIPATION
05.10 COMMUNITY INVOLVEMENT
05.11 LOCAL PRODUCTION OF FOOD
05.12 BUILDING MATERIALS AND COMPONENTS
05.13 AESTHETICS
05.14 LANDSCAPING VEGETATION
05.15 NATIONAL BUILDING REGULATIONS
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05.19 ACCOMMODATION SCHEDULE

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05.12.9 Corrugated iron roofs

A corrugated iron roof resembles traditional Transvaal farm architecture and is therefore used as the main roofing material. In addition, iron roof sheets are much more practical and have several advantages, including durability, ability to collect rainwater and acting as a surface to secure solar panels. In the Piet Retief region, solar panels need to be fixed at a slope of preferably 32–37 degrees and corrugated iron sheets can be fastened at the required pitch.

Most heat loss and gain take place through the roof of a building and therefore the appropriate ceiling insulation is essential. Any cracks or openings, especially the connection between walls and the ceiling, need to be properly sealed off. Any exposed surface has to be plastered with cob, which acts as a fire-retardant.

05.12.10 Glass

Although glass is not available on site, it can very easily be obtained in Piet Retief.

1. East and west facades should not be more than 20% glazed
2. Reflected glass should be avoided in spaces that will be negatively affected by direct solar radiation and reflection
3. Guests should be able to see activities in the lodge to enhance social interaction

05.13 AESTHETICS

05.13.1 Architectural character

The aesthetic and architectural character of all the buildings should represent Mpumalanga as a South African province, but should be careful to not become another stereotypical design added as an afterthought. South Africa and its diversity should clothe the interiors and exteriors of buildings in an innovative way.

05.13.2 Representing local culture

Certain elements used in the local buildings on Madola will be incorporated into the design, reflecting the local culture and its importance to the design. These elements include timber pole roof structures, walls plastered in natural earthy colours, corrugated iron roofs and natural earth floors. Traditionally, floors are made of clay rubbed with a mixture of dung and water with hand-drawn patterns as decoration. As the cow dung dries out, it forms a strong layer, which keeps the surface together, and dust free.

05.14 LANDSCAPING & VEGETATION

Only indigenous species will be used in the design of terraces, gardens and interior planters, except for particular species used in the herb garden. Deciduous trees will be strategically placed to screen off areas prone to sunshine during summer and allow the winter sun to heat up spaces through shedding their leaves. Western facades will additionally be protected by the planting of trees that will be carefully placed as not to limit the view. Landscaping will be informally arranged (except for the central courtyard) and allowed to freely grow and spread out between buildings and on lattice work.

05.15 NATIONAL BUILDING REGULATIONS

All the buildings should comply with national building regulations as set out by the National Building Code, which should guide structural integrity and enforce minimum standards and at all times be designed to cater for physically disabled persons. All buildings and spaces are to comply with legislative bylaws.

05.16 RATIONAL FIRE DESIGN

All timber poles that are not exposed to weather conditions will be treated with Flambor for better fire resistance. Plastered straw bale walls in themselves are extremely fire resistant (see addendum). As the overall design is informal and spread out over the entire landscape, there is no need for specific fire escape routes. Each building has sufficient exits and users will be able to move freely outwards when a fire breaks out.

FIRE RESISTANCE OF STRAW BALES

Concern about fire is often the first reaction to the idea of building with straw. This is ungrounded. While loose straw burns, when densely packed it is remarkably fire resistant, for this tight packing limits the available oxygen needed for combustion. Furthermore, the high silica content in straw (3-14%) is said to impede fire -as it begins burning a layer of char develops which insulates the inner straw. (www.BuildingGreen.com) However, it is important to remember that walls need to be plastered on both sides to seal out oxygen.

05.17 ELECTRICAL INSTALLATIONS

The electricity needs, which include lighting, water and interior heating, will be met by Eskom power already used on the farm.

Lighting requirements of cottages within the main development area of Mkhonda Lodge will be met by an underground 24V electrical supply. This enhances the aesthetic quality of the development by eliminating the need for large power lines to penetrate forest areas on site. Energy efficient lights are to be used. Where it may be necessary to provide stronger electrical currents (eg the use of electrical shavers, hair dryers, etc) inverters will be incorporated into the electrical design that provides the required 220V alternating current.

Cooking will be done using gas throughout. Cottages are supplied with two-plate gas stoves and the main kitchen will make use of gas stoves and ovens as well as outside food-fired clay ovens.

Solar **water heating** systems will meet the necessary warm water needs, but will make use of a backup system in the case of cloudy days. These backup systems include:

1. For the main development - an electrical booster, which functions in the same way a normal geyser element does.
2. For the private development – as it is difficult to provide these remote cottages with electricity, the backup system consists of a traditional direct-fired heater, also known as a donkey.
3. It is important to note that, in both cases, the solar heaters will continue to operate in conjunction with the backup systems and therefore serve as pre-heaters to water contained in each geyser. In this way, much less energy input is needed to heat water to the required 60°C.

Interior heating will be achieved through effective insulation methods and central heating by means of solar energy collectors situated underneath floors. Additional heating will be produced by stoves and fireplaces located within buildings.

05.18 PARKING REQUIREMENTS

FUNCTION	NUMBER OF PARKING BAYS NEEDED
Manager's cottage	1
Mushroom cultivation area	3
Farm factory	4
Restaurant	20
	1 bus stop
Conference facility & Meeting room	40
18 Cottages (Main development)	6 x 1 at family units
	12 x 1 separate parking
12 Private cottages (Kloof)	12 x 1 at each cottage
Staff parking	5
TOTAL	**103**

Table 05.02

05.19 ACCOMMODATION SCHEDULE

ACCOMMODATION SCHEDULE FOR MKHONDA LODGE

		DIMENSIONS	NUMBER	AREA	NOTES	FLOOR FINISH	VENTILATION	TEMPERATURES
FARM FACTORY (phase 2)		(m)		(m^2)				(°C)
Store room		6 x 6	1	36 m^2	store of finished products, highly accessible	tiles	natural	ambient
Packaging Room		13 x 17	1	221 m^2	highly accessible	tiles	natural	ambient
Fermentation Room		4 x 10	1	40 m^2		tiles	natural	ambient
Cooler Room		4.5 x 5	1	22.5 m^2	inner insulation layer of isowalls - 100mm	tiles	a/c	1 to 4
Freeze Room		4.5 x 5	1	22.5 m^2	inner insulation layer of isowalls - 150mm	tiles	a/c	-8
Maturation room		5 x 7	1	35 m^2		tiles	a/c	16
Display room		7 x 8.5	1	59.5 m^2		timber	natural	ambient
Marketing office		3 x 6	1	18 m^2	linked with coffee shop	timber	natural	ambient
Coffee shop		7 x 8	1	56 m^2	should open up onto a deck area	timber	natural	ambient
Large Kitchen		6.5 x 15	1	97.5 m^2		tiles	natural	ambient
Services & waste area		4 x 4	1	16 m^2	next to kitchen, highly accessible, close to store & packaging roo	gravel	n/a	ambient
Public toilets:						tiles	natural	ambient
Male	(2WC, 2HWB)	3 x 4	1	12 m^2				
Female	(2WC, 2HWB)	3 x 4	1	12 m^2				
Staff toilet	(1WC, 1HWB)	2.5 x 1.5	1	3.75 m^2				
Deck		9 x 22	1	198 m^2	elevated to capture views	timber	n/a	n/a
TOTAL AREA				**850 m^2**				
MUSHROOM CULTIVATION AREA (phase 2)								
SPAWN LABORATORY		10 x 13	1	130 m^2	very thorough insulation needed	r / earth	natural	ambient
GROWING ROOMS		5.5 x 19.5	3	322 m^2	very thorough insulation needed	r / earth	mechanical	ambient
SOLAR DRYER		5 x 25	1	125 m^2	face north, placed open in landscape	n/a	natural	ambient
TOTAL AREA				**577 m^2**				
MANAGER'S COTTAGE (phase 2)								
Lounge/dining area		5 x 8	1	40 m^2		cob	natural	ambient
Kitchen		4 x 5	1	20 m^2		cob	natural	ambient
Bedroom		5 x 5	1	25 m^2		cob	natural	ambient
Bathroom (1SHW,1BATH,1WC,1HWB)		3 x 5	1	15 m^2		tiles	natural	ambient
Verandah		3x15 + 3x11	1	78 m^2		timber	natural	n/a
Parking (1 bay)		2.5 x 5	1	12.5 m^2		n/a	n/a	n/a
TOTAL AREA				**210.5 m^2**				
12 PRIVATE COTTAGES (KLOOF) (phase 3)								
Lounge/dining area		6 x 6	1	36 m^2		cob/timber	natural	ambient
Kitchen		3 x 3	1	9 m^2		cob/timber	natural	ambient
Bedroom 1		4 x 4	1	16 m^2		cob/timber	natural	ambient
Bedroom 2		4 x 4	1	16 m^2		cob/timber	natural	ambient
Bathroom (1SHW,1BATH,1WC,1HWB)		3 x 4	1	12 m^2	wet core separate entity, outside shower	tiles	natural	ambient
Verandah		4 x 3	1	12 m^2		timber	natural	n/a
Parking (1 bay)		2.5 x 5	1	12.5 m^2		n/a	n/a	n/a
TOTAL AREA FOR 12 COTTAGES				**113.5 m^2**				

LODGE / MAIN BUILDING (phase 4)									
RECEPTION & OFFICES:									
	Office 1		9 x 5	1	45 m²	should open onto private garden area	r / earth	natural	ambient
	Office 2		5 x 5	1	25 m²		r / earth	natural	ambient
	Foyer / Reception / Waiting area		9 x 22	1	198 m²	suffient windows	r / earth	natural	ambient
	Safety unit		2.5 x 4	1	10 m²	doulbe wall construction, steel door	r / earth	natural	ambient
	Storage		3.5 x 5	1	17.5 m²	area least exposed to direct sunlight	r / earth	natural	ambient
	Public Bathrooms:					placed central to serve restaurant & reception	tiles	natural	ambient
	Male		3 x 4	1	12 m²				
	Female		3 x 4	1	12 m²				
	Disabled		1.8 x 2	1	3.6 m²				
COMPOSTING AREA			7.5 x 12.5	1	94 m²	should be visible from courtyard	n /a	natural	ambient
VEGETABLE GARDEN			7.5 x 12.5	1	94 m²	should be visible from courtyard	n /a	natural	ambient
RESTAURANT			14 x 21	1	294 m²	linked with kitchen	r / earth	natural	ambient
KITCHEN									
	Food preparation area		10 x 10	1	100 m²		tiles	natural	ambient
	Pantry		2.5 x 3.5	1	8.75 m²		tiles	natural	ambient
	Freeze room		3 x 3	1	9 m²	inner insulation layer of isowalls - 150mm	tiles	a/c	1 to 4
	Cooler room		3 x 3	1	9 m²	inner insulation layer of isowalls - 100mm	tiles	a/c	-8
	Services area		3 x 5.5	1	16.5 m²	next to kitchen, highly accessible	tiles	natural	ambient
	Clay oven area		5 x 7.5	1	37.5 m²	linked with kitchen, opens up onto restaurant	tiles	natural	ambient
STAFF QUARTERS & LAUNDRY						activities arranged around central courtyard			
	Staff lounge		6.5 x 10	1	65 m²		tiles	natural	ambient
	Staff Bathroom (2SHW,2WC,2HWB)		4 x 4.5	1	18 m²		tiles	natural	ambient
	Staff accommodation		2.6 x 4.5	4	12 m²		r / earth	natural	ambient
	Laundry		6.8 x 6.8	1	46 m²		r / earth	natural	ambient
	Storage		6.8 x 6.8	1	46 m²		r / earth	natural	ambient
LOUNGE			6.8 x 24.5	1	167 m²	views to enjoy high priority	timber	natural	ambient
CONFERENCE FACILITY						in close proximity of kitchen			
	Main function hall		14.3 x 30	1	430 m²		r / earth	natural	ambient
	Pump room		3 x 3.5	1	10.5 m²	sufficient space for alternative layouts	r / earth	natural	ambient
	Service kitchen		6.5 x 6.8	1	44 m²	linked with conference facility, separate entrance	tiles	natural	ambient
	Storage		4 x 6.8	1	27 m²	linked with conference facility, storage of equipment& furniture	r / earth	natural	ambient
	Public toilets:		7 x 13.5	1	94.5 m²	separate building to serve various blgs, central HWB	r / earth	natural	ambient
	Male	(4WC,)							
	Female	(5WC)							
	Disabled	(1WC, 1HWB)							
MEETING ROOM			6.8 x 10	1	68 m²	formal layout, good ventilation essential	carpet	natural	ambient
ACCOMMODATION (COTTAGES)						wet core separate entity, outside shower			
6 FAMILY UNITS				6	310 m²	has own parking bay, sleeps 4 - 6	r / earth	natural	ambient
6 SEMI-PRIVATE UNITS				6	200 m²	sleeps 2 - 4	r / earth	natural	ambient
6 VERY PRIVATE UNITS				6	200 m²	sleeps 2 only	r / earth	natural	ambient
PUBLIC SWIMMING POOL AREA				1	600 m²	serves public & semi-private cottages	r/e & stone	natural	ambient
PRIVATE SWIMMING POOL AREA				1	500 m²	serves private cottages only	timber	natural	ambient
PARKING			2.5 x 5	95	237.5 m²	separate access road to serve accommodation units	gravel	n/a	n/a
TOTAL AREA					**7611 m²**				

Table 05.03