Chapter 6 Design development

"A person is a member of a living organism that constantly reacts to its environment, changing it and being changed by it"
(Hassan Fathy, 1986)

Architectural form can be ascribed to different regions due to the specific climatic conditions of that region. In the colder regions of the northern hemisphere, the high roof pitch helps to shed the snow during winter months. In the moderate temperature regions the roof pitch is lower, but is still needed to accommodate heavy rainstorms. In hot dry climates, with minimum rainfall, the rooves are generally flat and the main purpose is to keep the hot air and sun out of the internal spaces of the building. Other forms such as window openings can also be ascribed according to climatic characteristics.

Early man built with available local materials and used natural sources of energy to create his desired microclimate. The decisions he made were influenced by his physiological needs. Behavioural studies indicate that climate shapes the rhythm of mans' life, thus contributing to the balance between his physical and divine being and the outer world.

One cannot simply discharge aesthetic quality as less relevant than the behavioural effects of design. Design needs to reflect hope and not mere subsistence. Design can give a measure of selfworth, identity and hope, even when little else exists.

6.1 Input - Output analysis

Fig. 6.1.1 is an analysis of the required input needed and output generated of the minimum requirements and responsibilities to operate the agri-tourism farm complex in a sustainable manner.

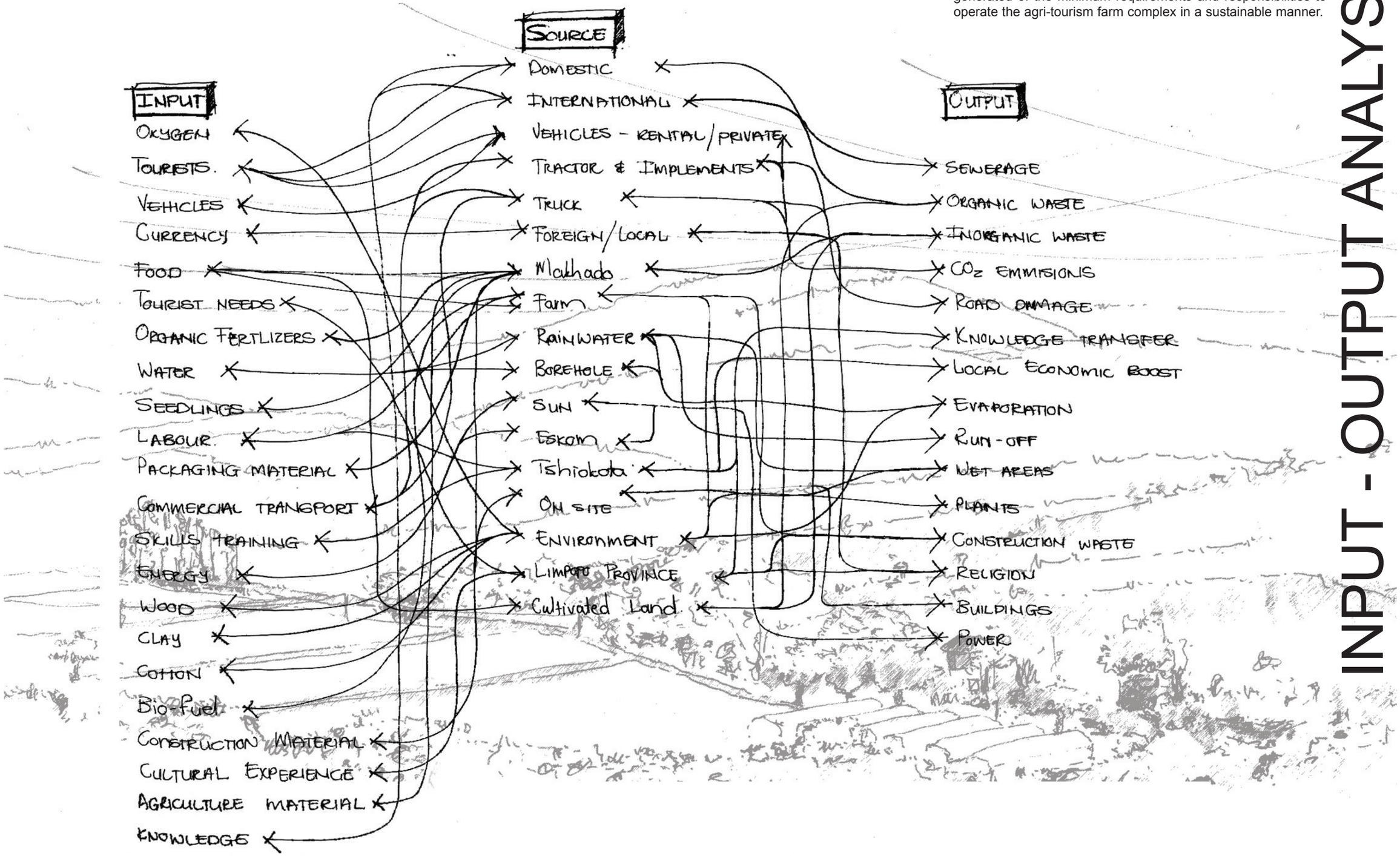
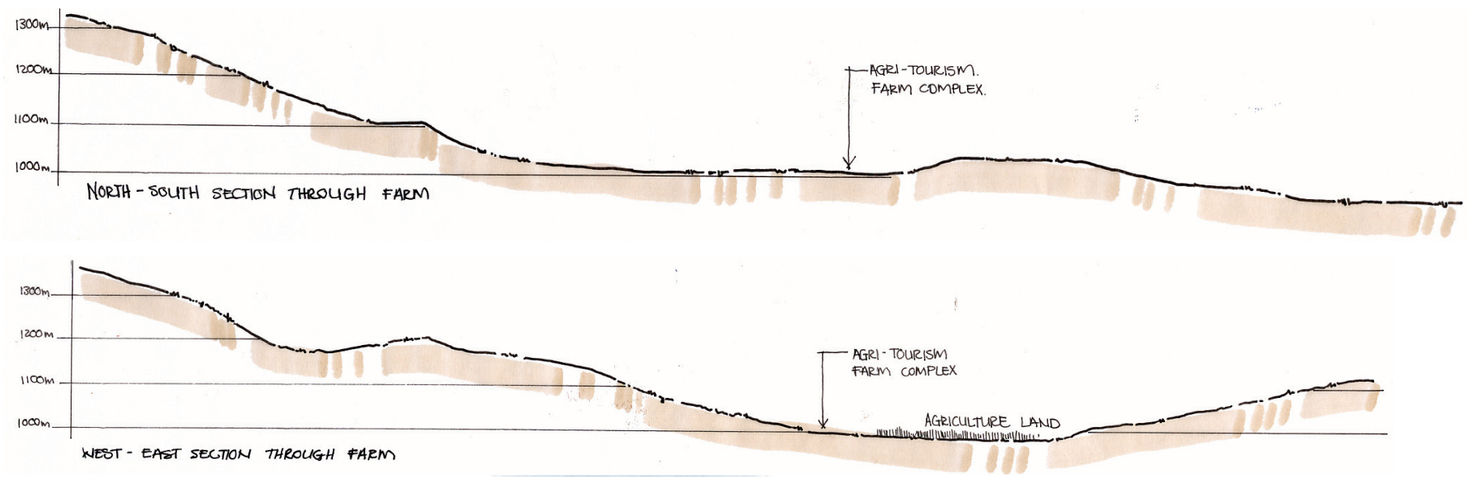


Fig. 6.1.1 Schematic input-output analysis



6.2 Site Development

6.2.1 Physical (Fig. 6.2.1.1)

The site falls from west to east and north to south with an approximate max. slope of 1:5. A ridge is present in the middle of the site that divides the site into two visual zones. This division contributes to the hierarchical organization and the zoning of the functions. The slope of the site provides the platform to lift buildings off the valley floor to enhance the viewing spectrum.

The existing infrastructure consists of a three-metre wide gravel road that forms the eastern boundary between the existing agricultural land and the site. The nearest Eskom electricity connection point is 200m east of the gravel road running diagonally through the agricultural land in a northwesterly direction to the existing farmhouse. The main water supply is located 100m north of the entrance gate along the eastern boundary of the farm. This borehole water is pumped to the existing water reservoirs, which are situated behind the farmhouse.

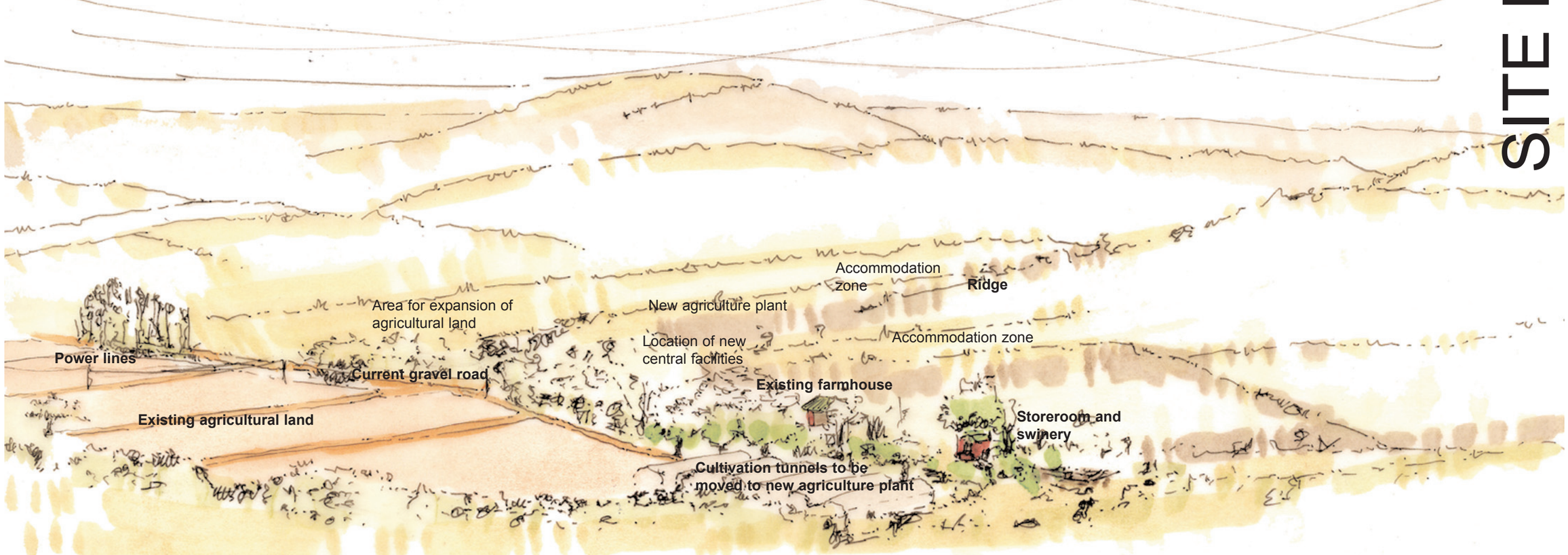


Fig. 6.2.1.1 Perspective view of existing site viewed from the north

6.2.2 Functions (Fig. 6.2.2.1)

The development consists of three main functions: agriculture, community development, and tourism. These three components consist of administration, restaurant, conferencing, skills training, ablutions, produce processing, workshop, storeroom, temporary staff, and accommodation facilities.

These facilities are grouped into three categories: public, semi-public, and semi-private areas. The public areas (being the point of arrival for visitors) are comprised of the administration section, restaurant, conference venue, and ablution facilities. The produce processing and skills training facilities are semi-public areas to make sure that productivity is not negatively influenced. (Visitors will be limited to specific areas to ensure their safety due to the use of industrial machinery.)

The temporary staff, workshop, storerooms, and accommodation facilities are semi-private areas. The accommodation component is located higher than the public and semi-public components in order to enhance the view from the buildings. These facilities contribute to the beauty and enhancement of the natural landscape in order to maximise the environmental atmosphere that is required to fulfil the psychological needs of tourists. A progression of public to private space will be visible as the elevation of the site increases.

These functions will be grouped into three zones: accommodation (tourists and staff), central facilities (administration, restaurant, conference venue, skills training, and ablutions), and the agriculture plant (produce processing, workshop, storerooms and temporary staff).

Fig. 6.2.2.1 Masterplan for new Agri-tourism farm complex

6.2.3 Circulation and relationships

The public functions for the central facility's (Fig. 6.2.3.1) arrangement are based on tourist and retail trends. On arrival, tourists' will book-in at reception after which visitors can then either go to the restaurant, or the skills training facilities, which also host the arts and craft display shop. For retail functions to be successful, one needs "feet" to pass through those specific areas. Because of the topography of the site and human preference, the visitor is not indirectly forced to go to these areas. Visitors will be able to see the arts and craft display when dining at the restaurant and vice versa. They are rather given the choice to explore by themselves. Behavioural studies indicate that by giving people the opportunity to make his/her own decisions strengthens their psychological need of being in control of their lives. This exploration is resuscitated by means of manipulative visual contact, which is achieved by the dense vegetation and the slope of the site.

The conference facility is placed close to the ablutions because the highest concentration of people will be using the ablutions at a specific time of the day. The conference facility is also used as the direct link with the agriculture plant. This facility will be mainly used for agriculture related seminars and as a formal training facility for skills development, which relates to the arts and craft area.

Fig. 6.2.3.1 Central facilities siteplan

The lower slope mainly determined the agriculture plant's (Fig. 6.2.3.2) specific location, which was indicative of the commercial vehicle usage around these structures. Turning circles for commercial vehicles was done away with due to the slope restrictions and a thoroughfare was used instead. This thoroughfare stipulated the placement of the functions along this route. The sequence of the functions relate to the operational programme of the agriculture plant. The storerooms and workshop are physically separated from the processing as they contain materials, such as toxins, that can intrude on the quality of the agricultural products. The temporary staff facility's, located in the processing plant relates to the visual management of these people by the foreman, located in the processing facility, in order to create a unity between these facilities, necessary infrastructure elements are used to physically and visually connect these facilities to one another.

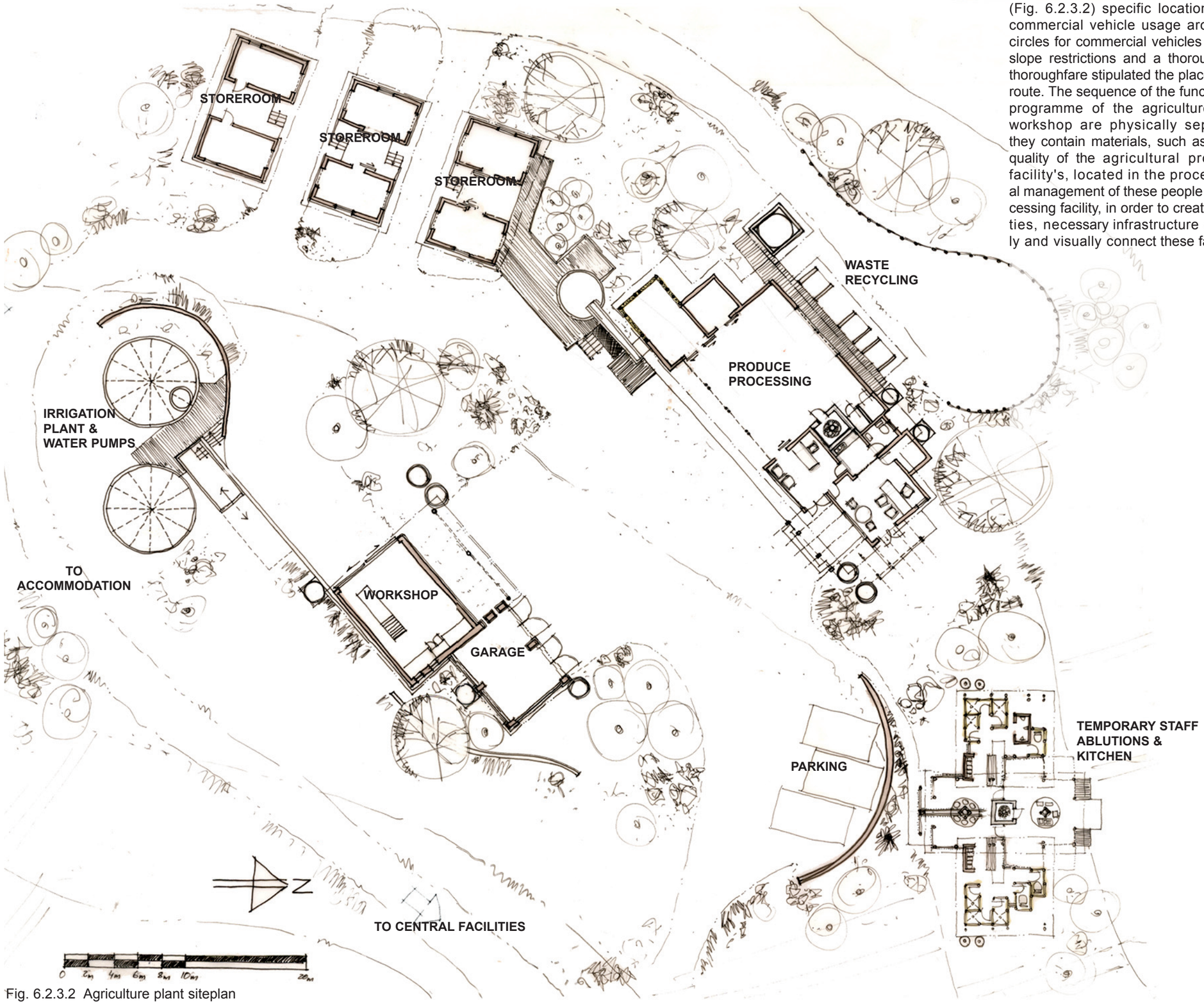


Fig. 6.2.3.2 Agriculture plant siteplan

The semi-private tourist and permanent staff accommodation comprises the accommodation zone (Fig. 6.2.3.3). The staff quarters are placed between tourist units. This configuration is a paradigm shift compared to the conventional trend of keeping staff away from tourists and out of sight. This paradigm shift evolved in order to contribute to the synergy of agriculture, eco-tourism, and community development. Another factor, which influenced this decision, is the primary pre-requisite of the tourists to experience the local contemporary culture. The staff is given an economic incentive, by sharing in the profit derived from the tourist units, which they are the hosts of.

Disadvantages of the proximity of staff quarters & tourist units could be noise pollution and the bigger footprint compared to back-to-back staff units. If the physical footprint is put into the context of the whole development, it is omissible. The noise pollution is part of experiencing the culture. By having separated staff units that are dedicated to specifc tourist units will better facilitate the interactions between staff and visitor. According to surveys done by South African National Parks; tourists will interact easier with a staff member if that person is assigned to them. This organization of the accommodation will present the opportunity for tourists to interact with the local people on a more personal note.

The tourist units consists of three different types with each designed according to the different needs of tourists expected. The units will be 2 or 4 bed units, which are the best and most economical configuration.(indicated by tourism studies)

Type 1: The four-bed unit will cater for the travelling friends or a small family. The units will be self-catering. These groups will stay for a couple of days and participate in the farm activities or use the location as a base to explore the area, thus a bigger lounge/dining area is needed.

Type 2: The two-bed unit is catering for the travelling couple. These units are self-catering. These couples will stay for a couple of days and participate in the farm activities or use the location as a base to explore the area, thus a bigger lounge/dining area is needed.

Type 3: These units are back-to-back non self-catering units. They are for the tourist who does not travel with his own food and necessities and is staying for shorter periods at a specific place.

The accommodation zone is linked to the central facilities and agriculture plant by means of interesting wondering paths, carrying through the experience of discovering. This method will encourage the preferred mode of transport (walking and not vehicular) on the farm by people.

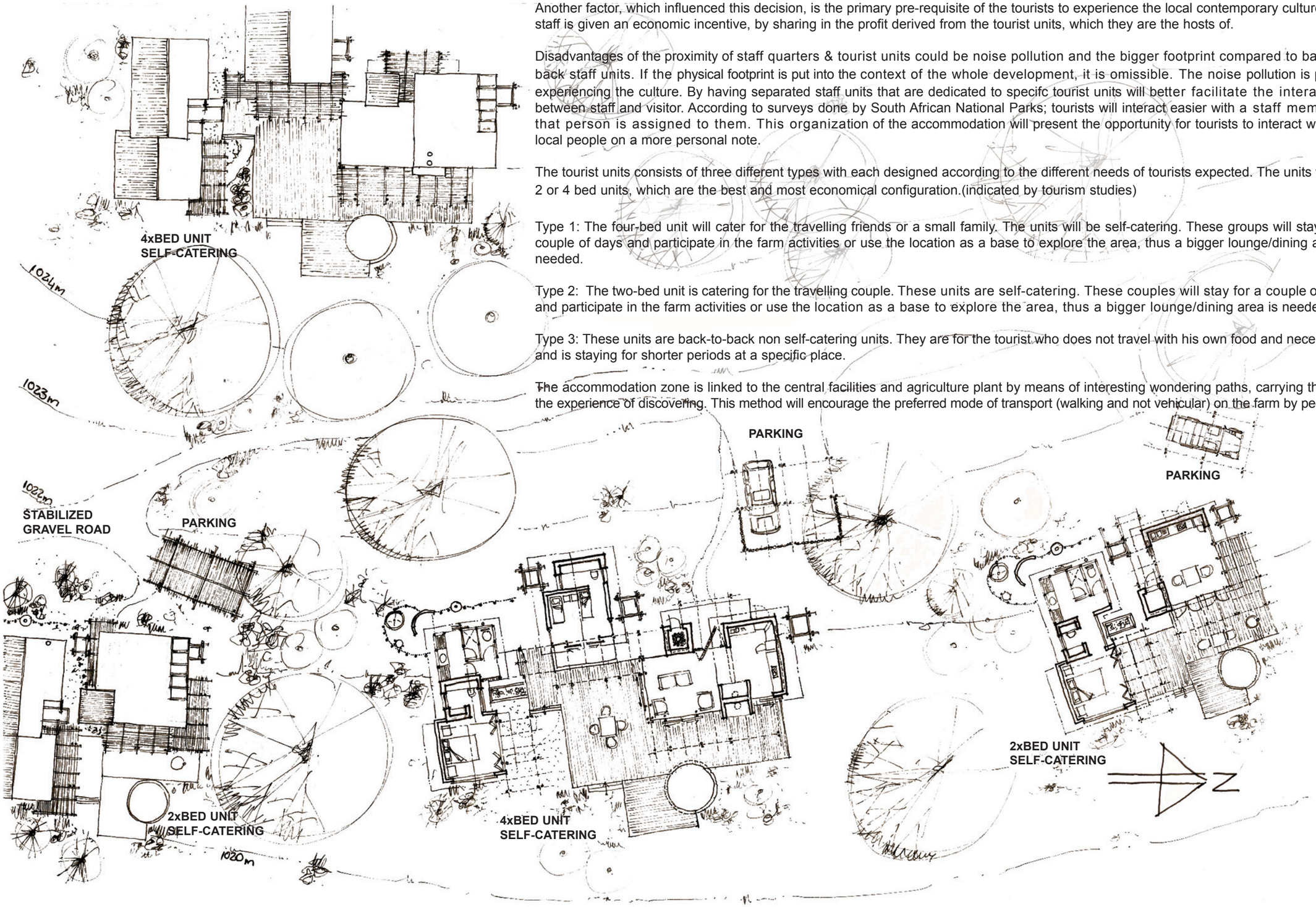


Fig. 6.2.3.3 Part of Accommodation siteplan

6.3 Hierarchy

A hierarchy in the site layout, which is manifested in the traditional Venda culture, is applied to create a coherence of progression. The Venda's arranged their 'kraal' in such a way that the most important person, the chief, was positioned on the highest point with the rest of the people located below him. This configuration was applied in every subsequent family. The head of the family was positioned higher than the rest and the same applied to the building functions. The bedroom units had a higher priority than the kitchen that were above the courtyard. According to these layouts the more private spaces were higher than the semi-private and subsequent public spaces.

Fig. 6.3.1 Section through Agriculture plant

The location of the semi-private section and the people using this zone of the agri-tourism farm complex, are the most important contributors in making sure that the development is sustainable. The semi-public (Fig. 6.3.1) areas provide the base for the semi-private and public (Fig. 6.3.2) areas, and the public areas fulfil the inauguration of the visitor

The hierarchy is applied on two levels. Firstly, as discussed above, on a vertical platform according to the topography of the site, and secondly, by using the visibility of vertical elements to increase the legibility throughout the development. These characteristics play an important role in the progression through the site and the circulation thereof.

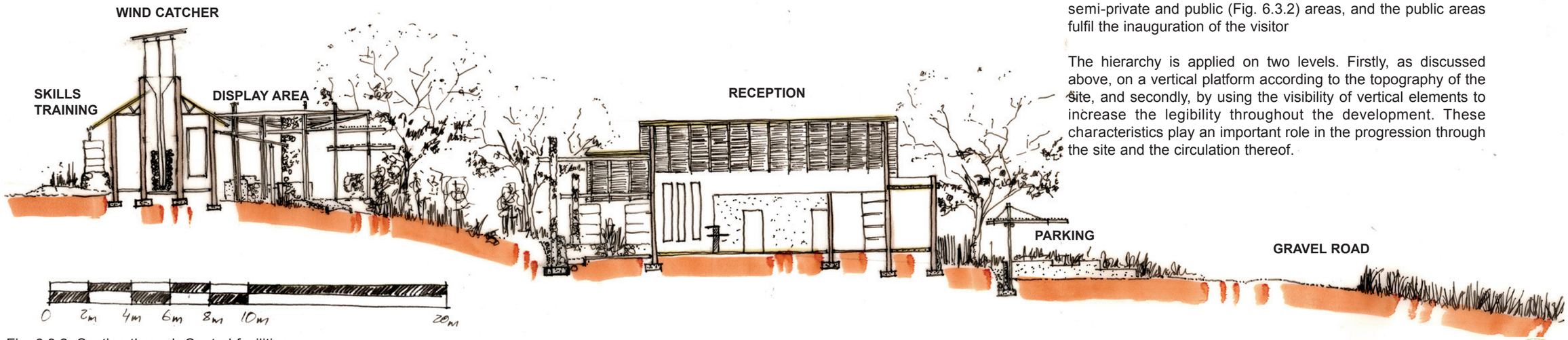


Fig. 6.3.2 Section through Central facilities

6.4 The "barn" as generator

Agriculture comprises one third of the proposed development and the physical requirements associated with vegetable processing constituted the driving force behind the creation of architectural form. The strong presence of an agricultural language in the context of the site enhanced the choice of departure for form. Agriculture and 'barn' are synonymous in the context of a rural language. The conventional 'barn' is enveloped with the contextual culture from the surrounding areas.

Re-interpretation of the barn (Fig. 6.4.1) is needed in order to accommodate the different functions relating to the whole development. The decisive criteria being the physical dimensions associated with the structure: a rectangular plan, with varying size, which is accessed via the longitudinal axis of the building. This axis was used because of the height provided by the gable wall of the pitch roof. This height was needed for commercial vehicles to enter and for bulk storage. A lean-to roof was attached to the longitudinal sides of the structure that were used for secondary storage space.

An aspect that has a big influence on the re-interpreted 'barn' is the local climate. The derived architectural forms compliment and manipulate the climate in order to achieve the best microclimate inside and around the buildings by making use of intruding and protruding boxes and surfaces. These elements enhance the articulation of the compositions.

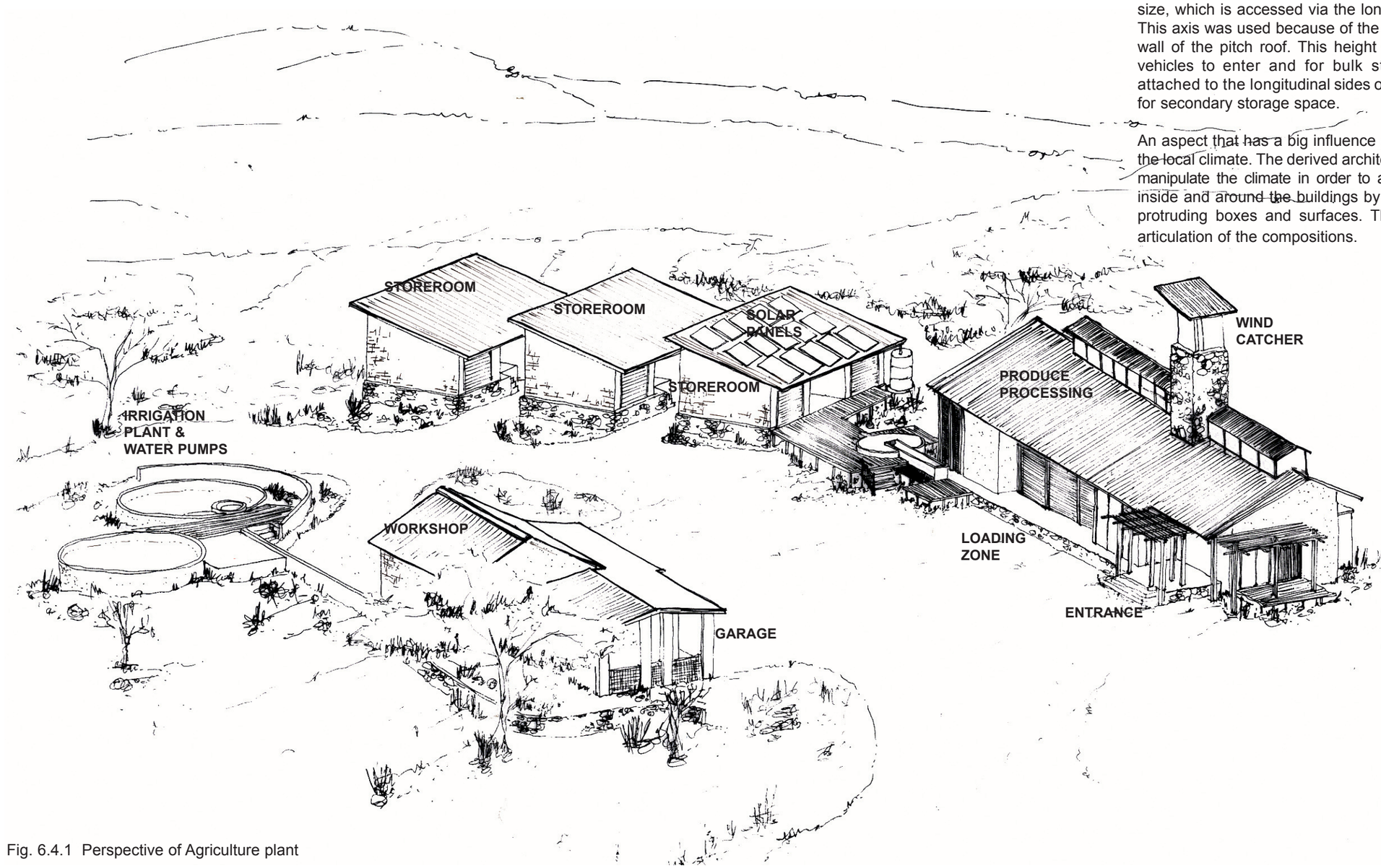


Fig. 6.4.1 Perspective of Agriculture plant

6.5 Passive solar design (Fig. 6.5.1)

6.5.1 Orientation

The best orientation is for a building to be longer east-west than it is north-south, with most windows facing north and a few facing south, east or west. This orientation is best utilized when hot summers and very cold winters are present. The orientation of the structures will mainly be influenced according to the day lighting requirements and the topography of the site because natural cooling is needed during the hot summer months. The chosen site has very hot summers and moderate winter months. No solar heat gain is needed during summer and the heat needed during winter can be obtained by making use of direct and indirect solar gaining methods.

6.5.2 Day lighting

Natural light instead of artificial lighting is provided for internal spaces. By not using artificial lighting the energy demand is reduced. Studies indicate that natural light has healing properties and also improves productivity at work. People respond to the apparent lightness of an environment and its visual interest. This is created by illuminating surfaces and by providing areas of light and shade appropriate to the environment's application with reference to the form and shape of the interior and to the hierarchy of adjoining spaces.

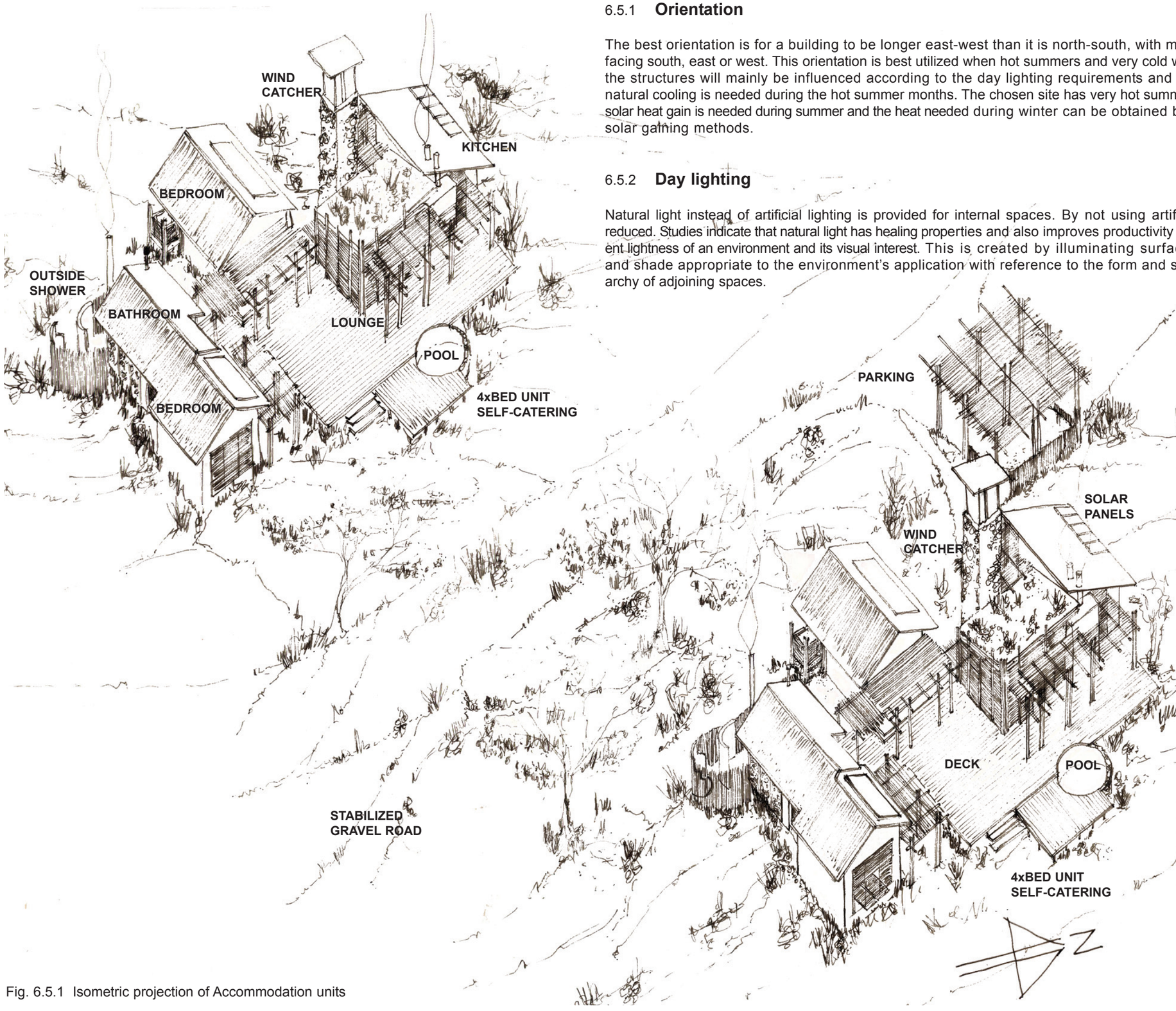


Fig. 6.5.1 Isometric projection of Accommodation units

6.5.3 Direct and indirect solar gain

Direct solar gain is whereby the sun's heat directly heats up the building. Heat is stored in the building's thermal mass, such as the concrete and stone floor slabs.

An indirect gain system positions the thermal mass between the sun and the space to be heated. The sun's heat is collected and trapped in a narrow space between the window and the thermal mass. The air in the narrow space is then heated which rises and spills into the room through vents at the top. Cooler air replaces the hot air from the vents at the bottom. The heat circulates throughout the room by convection. The vents can be closed to prevent warm air from escaping. This will be achieved during the winter months when the lower sun angles are allowed beneath the roof overhangs.

A reversal of these systems will be applicable in order to keep the heat out during the summer months. The thermal mass will be prevented from receiving direct sunlight while absorbing the heat in the room, helping to keep the internal temperature cooler.

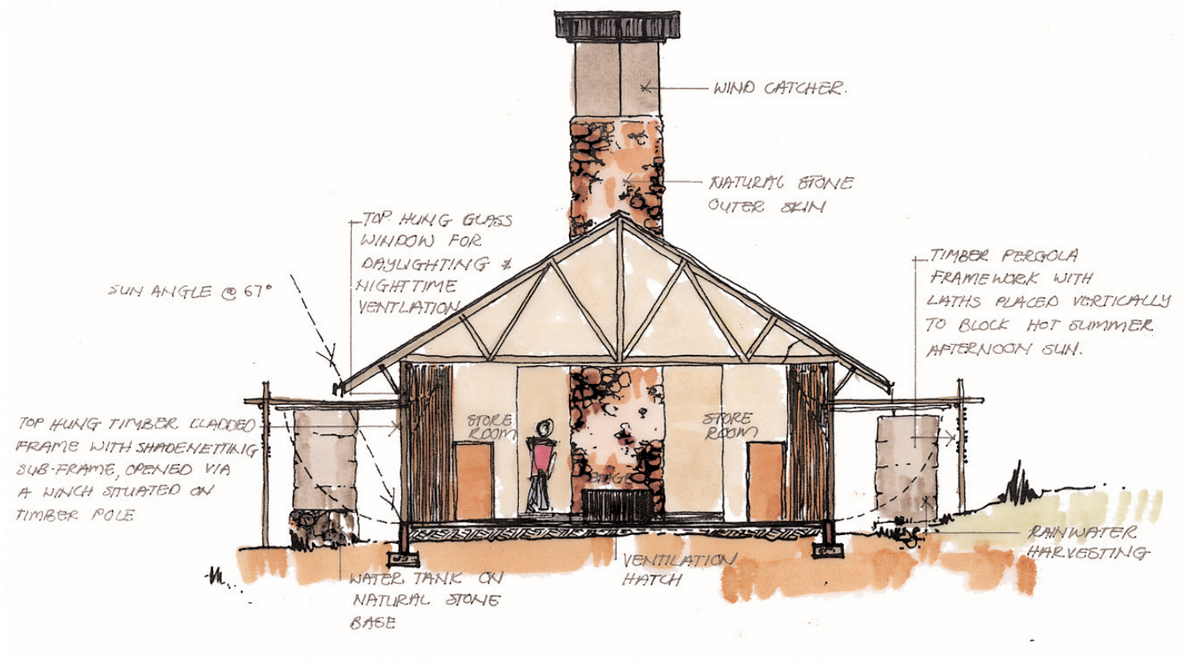


Fig. 6.5.4.1.1 Cross section of conference facility

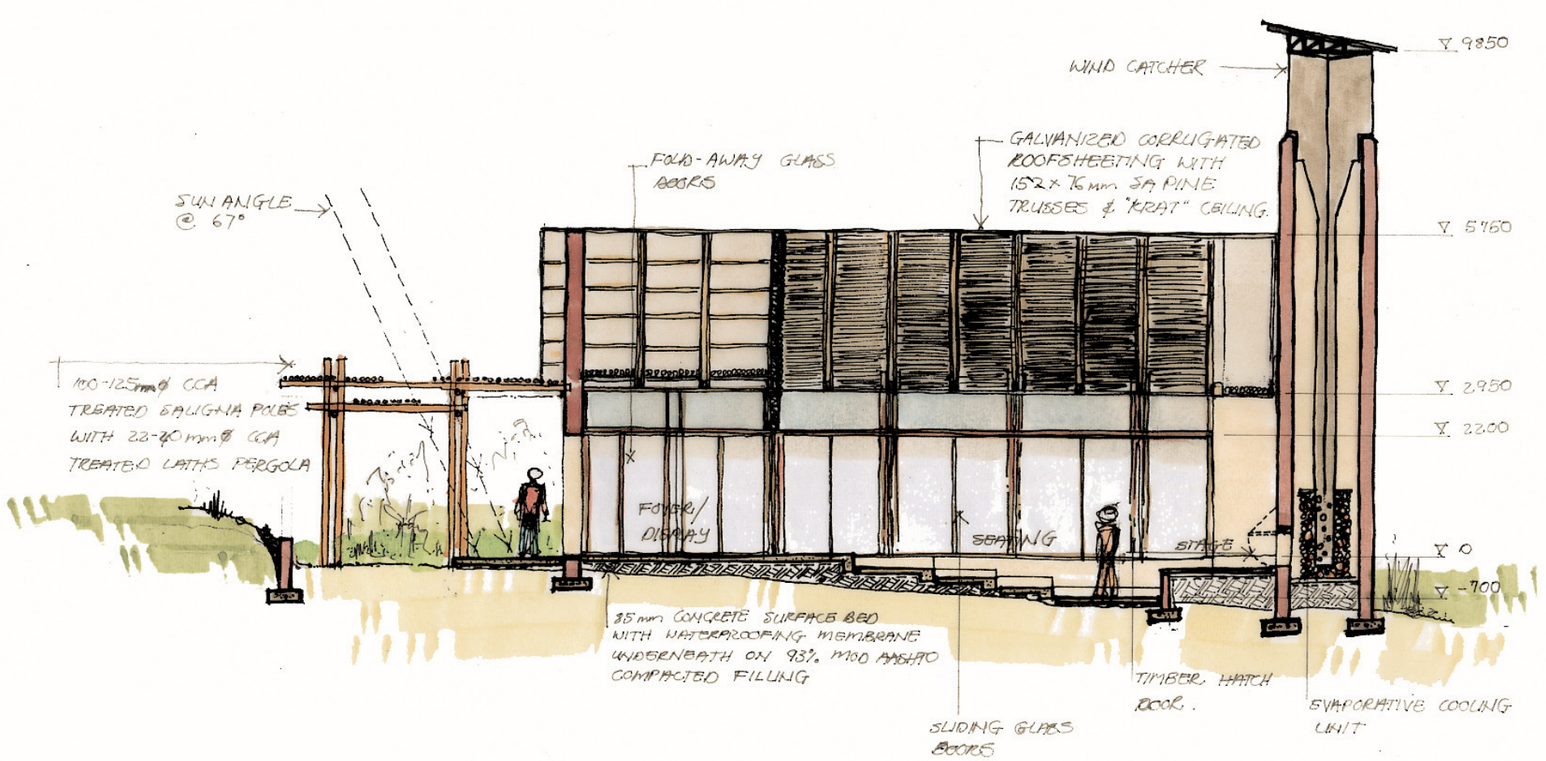


Fig. 6.5.4.2.1 Longitudinal section of conference facility

6.5.4 Natural cooling

6.5.4.1 Ventilation (Fig. 6.5.4.1.1)

There are three major sources of unwanted summer heat: direct solar impacts on a building through windows and skylights; heat transfer and infiltration, of exterior high temperatures, through the materials and elements of the structure; and the internal heat produced by appliances, equipment, and inhabitants.

Panels that open provide ventilation of these buildings. These panels normally consist of two parts, a permeable and a transparent section. During daytime both sections can be opened and during nighttime the permeable section is kept closed to keep insects out but still allow ventilation.

The thermal mass, which is present in the buildings, is kept in full shade, especially between 11:00 am and 15:00 pm during summer months. This is accomplished by making use of the lean-to roof that is associated with domestic farm buildings. Longer roof overhangs are used elsewhere to shade the full height of external vertical planes. (The above-mentioned panels are utilized to ventilate buildings at night, which will remove any heat build up from humans or appliances, in order to have cooler buildings in the mornings).

6.5.4.2 Evaporative cooling (Fig. 6.5.4.2.1)

The simplest way of evaporative cooling is when water evaporates it absorbs a large amount of heat from its surroundings. The most familiar of this is the cooling effect of evaporating perspiration on the human skin. The evaporation rate is raised as air movement is increased. The first manner of obtaining this evaporative cooling is using ponds around the permeable buildings. They are positioned on the north-western (main wind direction) side of the buildings in order to be in the direct path of the wind.

The second method is a combination between the "malgaf" (used extensively in hot arid regions) and the local historical farm "fridge". This application makes use of a wind catcher to direct air movement through a wet permeable surface. To adhere to the requirements of the system a high vertical element in the landscape evolved. The height is needed to catch enough wind above the roof structures and vegetation. These elements are incorporated into the design to facilitate in the legibility and the hierarchy of the development.

6.6 Alternative Energy Sources (Fig. 6.6.1)

6.6.1 Solar power

Our five billion year old nuclear reactor accounts for 99.9% of the total mass of our solar system. Each second about 700 000 000 tons of hydrogen is converted to 695 000 000 tons of helium and 5 000 000 tons of energy in the form of gamma rays (Add reference) Because of the large distance between the earth and the sun, the intensity of the solar energy received by the earth is a lot lower. The energy that reaches the earth's surface is reduced about 30% by the atmosphere so the direct solar radiation that reaches the earth's surface is about 1 kWh per square metre.

The utilization of this renewable resource would satisfy all our energy requirements. Photovoltaics are used to transform sunlight directly into electricity. The photovoltaics are inter-connected to make up a module or solar panel. These panels are solid and have a specific size with a thickness. In order for them to function properly, they must face due north. These criteria are taken into account when incorporating these panels into the design of the facilities.

Given these panels' solid characteristics, they are used to shade wall and floor surfaces in the summer months. These panels have their own sub-frame that attaches to a structure in order to be oriented due north. They are visible to the users as is the other entire climate controlling system. The visibility of these systems emphasizes the importance of environmental consciousness.

6.6.2 Direct solar heating

Water bodies can be used for heating during the winter months. The roof structure is used as the structural support for the water containers. Black polypropylene pipes are the water containers. They are placed in the roof structure, which is in full sunlight during the day. The sections of the roof, which will host these pipes, are elevated above the rest of the structure to better define the allocated areas.

These pipes run down into the surface beds of the spaces that need heating at night. Under floor heating will occur during night time in the bedrooms of the accommodation units. This system is manually operated, again giving the choice to the occupant to make use of the facility or not.

Fig. 6.6.1 Eastern elevation of Central facility

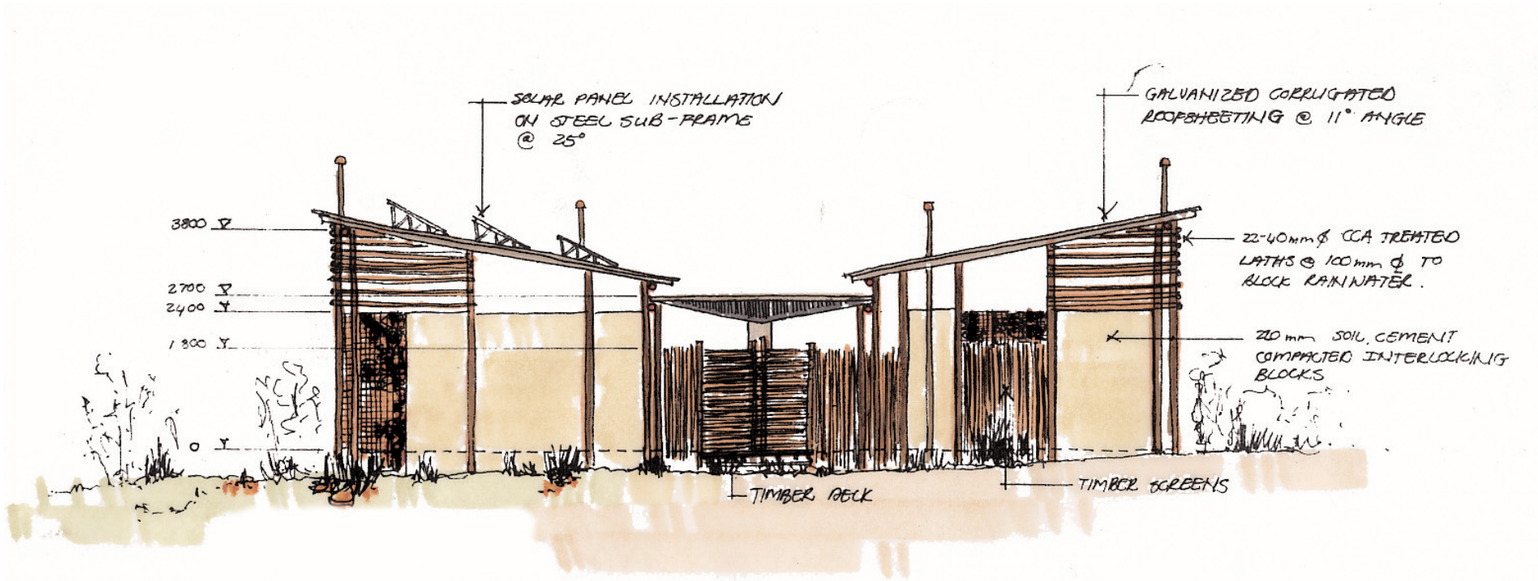


Fig. 6.7.1 Elevation of public ablutions

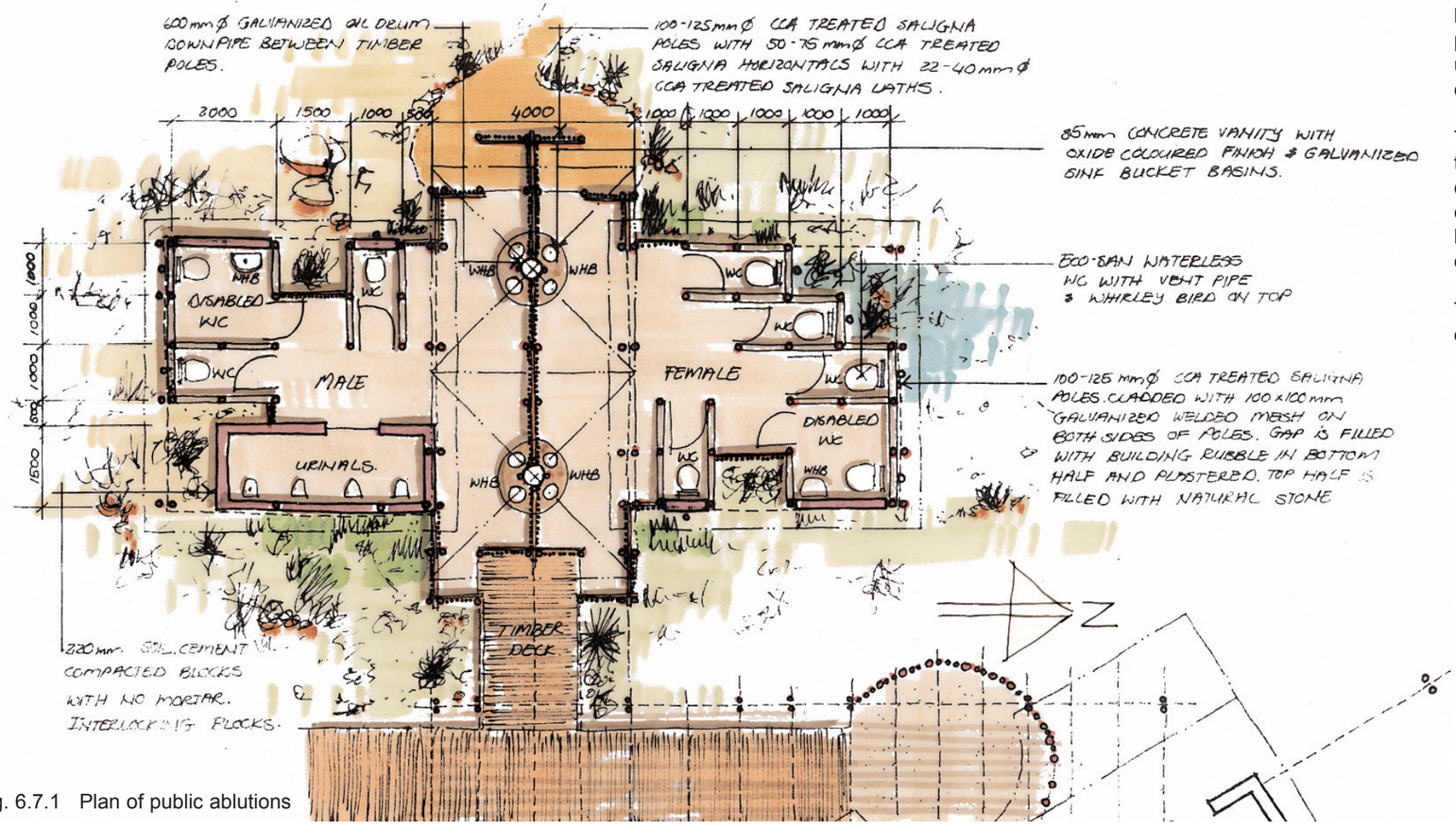


Fig. 6.7.1 Plan of public ablutions

6.7 **Materials** (Fig. 6.7.1 & 6.7.2)

The main characteristics of materials used for structure is its natural ability to give stability to a structure within its context. The story of the " three little pigs" suggests some simple differences in firmness as a function of materials.

Use of materials in the design will have a huge influence on its inhabitants. We are currently living in a plastic world of contradiction and untruthful visual relationships. Products today have plastic linings that make it difficult to distinguish between the fake and the real. How are we supposed to teach our children ethical values if the materials we use have a quality surface appearance while the inside is actually compressed sawdust covered with plastic pretending to be something that its not. Honesty should always be considered more beautiful than deception.

The process followed in choosing the materials to be used for construction was by establishing which materials the site can offer without having a negative impact on the environment.

Soil and natural stone are materials that are in abundance due to the cutting that will take place. The soil is used as compacted earth blocks, which has excellent thermal qualities, and with additives the required strengths can be achieved for structural elements. The stone was chosen to enhance the psychological connection with nature. The stone has a natural strength that can be used for structural elements and its properties will assist in the passive solar design principles. All the other materials that were used were selected according to its physical and thermal properties.

Timber is used extensively throughout the design, including its thermal and psychological characteristics; it is used to create a collective harmony between the buildings and nature. The recycled materials, such as oil drums, sandbags, tin cans and glass bottles are used for the articulation of elements and re-interpreted function of surfaces.

The manner in which these materials are used according to each other is more important that the types of materials used.