SOLAR ENERGY IN FARM ESTATE.

KUJE, ABUJA

(POULTRY AND FISHERY)

RESEARCH AREA: PHOTOVOLTAIC MODULE (ACTIVE) FOR SOLAR ENERGY ELECTRIFICATION

M TECH. (ARCHITECTURE) THESIS

BY

OLAWOLU FORTUNE BOLA EMMANUEL

Reg. No.: - 93/4044

DEPARTMENT OF ARCHITECTURE

SCHOOL OF ENVIRONMENTAL TECHNOLOGY

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

NIGER STATE.

NIGERIA.

MARCH, Y2K.

CERTIFICATION

SCHOOL OF POST – GRADUATE STUDIES

FEDERAL UNIVERSITY OF TECNOLOGY, MINNA,

NIGER STATE

THIS IS TO CERTIFY THAT THE THESIS

SOLAR ENERGY IN FARM ESTATE (KUJE) ABUJA.

RESEARCH AREA: ACTIVE SOLAR ENERGY

PHOTO VOLTAIC MODULE (P.V.C.) FOR

1. PUMPING
2. ELECTRIFICATION.

Submitted to the School of Post – graduate Studies, Federal University of Technology, Minna. Niger state for the award of degree of Master of Technology in **ARCHITECTURE (M- TECH)** is a record of original research carried out by **OLAWOLU FORTUNE BOLA' EMMANUEL (93/4044)** in the Department of Architecture

OLAWOLU F.B.E (Mr)		11th April 2011
Student's Name	Signature	Date
DR S.N. ZUBAIRU		11/4/2011
Mentor's name	Signature	Date
DR. S.N. ZUBAIRU		11/4/2011
H.O.D's name	Signature	Date
Dean's name	Signature	Date
External Examiner's Name	Signature	Date

DEDICATION

This project is dedicated to my coming LORD JESUS CHRIST who has made it possible for me to reach this stage of my academic life. Also to the Father and Holy Spirit; trinity in operation for the fulfillment of God's will in my life.

ACKNOWLEDGEMENT.

All glory, honour and power be unto my God, the father of all life who has made it possible for me to have achieved such an enormous work like this through his human instrument and spiritual strengthening.

How an enormous work like this would not have been achieved if not for many contributions, assistance and provision from many establishments like F.C.D.A (Department of planning and Animal husbandary Department), TALCON CONSULTANT FIRM, Obasanjo farm limited, JOF Ideal family farm e.t.c.

This project would not have been completed if some important name will not be mentioned who in one way or the other are part to this project either on finance or on some other important ground toward the achievement of this project; among these group are Arc. Dele Johnson (a friend in need is a friend indeed), Miss Ramatu Abubakar (Arc) and her parent; General and Mrs Abdullahi Abubakar (the ex-head of state) who has made me homely by allowing me to have gained full access to some of the usefull information that are related immensely to this project. God bless you in Jesus name and more grease to her elbow. My thanks to Mr Are in F.C.D.A Planning, General Olusegun Obasanjo (the president of Nigeria) who has laid down a good legacy in his farm that professionals and students could carry out their project in such a secured establishment. Among the few to mention are Dr. Talabi (Talcon Consultant firm), the Liberian of the University of Lagos (Uni-Lag), the foreign information personnel on solar energy document and also my supervisor on behalf of Arc. (Mrs.) S.N. Zubairu, Professor J. Solanke (Dean of school S.E.T), Arc Bello (my 300L mentor), Arc Paul (my uncle in the profession), Mr. Akanmu and as many who there name cannot be mentioned here now, but all our name are in the golden book of success.

My profound gratitude to the God chosen sisters, Remi Olawolu, Faith Oluwatoyin Oladele, Adunbi Bukola Oluwolu, Taiwo Olawolu and Kehinde Olawolu who through prayers and their financial contribution had enhanced my course of study. Among other Olawolu's that my well rich appreciation goes to are Brother Ige Emmanuel Olawolu,

Koya Olawolu and Olarinde Olawolu; sons of good symbol just keep the light shinning. Hence the church of God as a whole.

There are some that are very special to me which need to be mentioned in this project; among them are Mrs. Ariyibi (a mother indeed), Comrade Gbogiaran, Dr. Adesunloye Bamidele (Tyndale hospital, London), Dr. Adebiyi and Dr. Lasekan Dayo (both in federal medical center, Owo), sister Ogunyase Yetunde, sister Joke Ariyibi, sister Bose Adesunloye, Mr Ajibade, Miss Makiyagbe Mopelola, Mr.Tunde Shaba, Olumide Tapere, Brother Felix e.t.c.

Among people that need to be mentioned are the great caring studios of Aso in which I will not forget Arc Toyin Omotosho (small to), Arc. Mustapha T. (the tack bearer), Arc. Efe O. (the trouble maker), Paul Akalizua, Arc. Sarafis, Arc. Fatima, Arc. Doyin (doyen) e.t.c.
To conclude this part, I will not forget those special honour are due because of their life as a challenge to me totrigger forward my ambition for greater achievement in life among them are Pastor Adejubu, Pastor Famuyide, Pastor Babatola, Brother Femi, Ali, Brother Johnson, Brother Isaac Oluwadamilare, Brother Lekan, Pastor Ojo Peters (Voice of Mercy Ministry) e.t.c. May God consider you most among the reputable ones in Jesus name.

Lastly, blessed be to the name of God and special honourable and glorious appreciation to the hand that has done this, Olawolu Fortune Bola Emmanuel (the favoured one) that I could derive this sense of patient and submission to the will of academic and success from the power of God. My greater to have achieved this. I'm among the most previledge one on earth. Once again, Thank you my LORD.

Maranatha (Jesus is coming). And God bless you all.

ABSTRACT

Solar farm estate is a settlement of place where all necessary farm operation and housing are considered as a of an estate and being integrated with the latest technology of Active Solar Energy as electrification in the farm settlement for a better high yield and to re-awakening the economic output of a nation.

Therefore the introduction of this work lay more emphasis on Solar Energy as basic means of survival and a way out of many energy problems like NEPA and the use of generator in our farm set up establishment.

Hence the chapter two of the project deal with the literature review of the whole work as regard to the history of solar energy which is sourced from the sun as one of the oldest energy supply created by God in the prehistoric days and its effect on lands, seas, environment and human cannot be valued and later being integrated to the latest technology as of passive and active means for the use of man. And the broadening views of where it going to be applied. This is with regards to all necessary farming operation and management. Poultry management and fish rearing are fully discussed in this thesis.

To add more to this, the research area, to be considered, which is the most crucial aspect of this project. Where active solar energy is more emphasized on photovoltaic system bases. This aspect deal with its types, and the type that could be used in this work as stand alone system coupled with sizing and full calculation examples when to use.

Finally, its gunt implication to Architecture when installation as mounting are considered and the best one that will save cost last and durable.

Furthermore, all these could not be achieved without a proper case studies that has affected all areas of the operation in enlightening my mind for a better thesis like this coupled with the data collection in achieving a better location that will fit in the project. This aspect includes the reason on criteria for site selection.

In solving some problems of great work like this, it needs to be implemented in design as the best approach to reality which is considered in the chapter seven of this project coupled with its services that project could achieve its aim.

To conclude this part, a project like this should serve as a means of technological awareness and challenges to most professionals especially the architect and also a reawakening to the present economic woes that has loomed the society as a whole on the approach of farm estate that our society can regain back their glory.

SOLAR FARM ESTATE (KUJE) ABUJA.

TABLE OF CONTENTS

CHAPTER THREE

CHAPTER FOUR

CASE STUDIES

CHAPTER FIVE

5.0.0 DATA COLLECTION

CHAPTER SIX

CHAPTER SEVEN

CHAPTER EIGHT

8.0.0 ELECTRICAL SERVICES

CHAPTER NINE

9.0.0 CONCLUSION

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE

1.0 - INTRODUCTION

1.1 - AIMS AND OBJECTIVES OF THE STUDY

1.2 - RESEARCH METHODOLOGY

1.3 - SCOPE AND LIMITATION OF STUDY

1.4 - IMPORTANCE OF STUDY

1.5 - DEFINITION OF TERMS

1.6 - DATA COLLECTION.

" THE SUN HAD BEEN INTERMITTENTLY USED OVER MANY YEAR BUT RESEARCH AND DEVELOPMENT HAS SHOWN THAT THERE IS A DIRECT CORELATION BETWEEN THE USE OR NON-USE OF SOLAR ENERGY AND THE PRICE AND AVAILABILITY OF OTHER RESOURCES IN AREA WHERE SUFFICIENT AMOUNT OF SOLAR ENERGY IS PRESENT"

(Ralph Knowles)

1.0 INTRODUCTION

Energy has become paramount to the use of man right from the cradle of ages. It is being derived from the sun. As the scientist has written that; it is shown that our sun is a remarkably constant star. It has scarcely changed in billion of years. It is not likely to change in many billions. Life has developed on earth through the use of this wonderfully made matter by God (As it said let there be light. (Bible)) During approximately three billion years till date. The world or planet, earth we are living is becoming more meaningful along with the beautiful creature of the stars from day to day. And this is called the solar system, which is the sun.

It has transcended the initiative of local and Neolithic man that are hawker or looker of food, clothing and shelter at all courses for survival through the day. By the same sun energy as a source of light and also a means to the production of that food (through photosynthesis) and clothing with shelter they want.

It is this development of human idea toward how valuable the sun is applicable to them that led them to the revival of human race through science and technology. This great craving for survival has affected the five most important tiers of man's government to a frontline in the society e.g. family, religion (orientation of prayer or worship e.g. Moslem) law, politics (determine by time and day) and education (for technological advancement).

In all, these areas of human endeavor, the use of sun cannot be over-emphasized even toward the reshaping of human environment mostly in area of science and technology.

Among many determining features and faith of the society in area of under-development, development and over-development, the sun as a source of energy has played a greater role. Even its application at advance stage establishes the level of development and the state of development.

Hence the state of development of a country can be determined as "her per energy consumption for various countries of the world shows the higher the per capita energy consumption of that country, the more developed the nation is".

As a result of this, the developing countries of the third world are at the bottom of the scale. Hence there should be energy awareness for improved technological development in the millenium that we have approached and because of some certain needed things in the future.

Hence, as energy is the ability to do work where many improvement, advancement and technological orientation coupled with computer awareness had become the instrument of development. Therefore, energy cannot be separated from the day to day activities of life.

The use of solar energy in form of sunlight and as a source of ambient energy dated back to the advent of civilization.

SOLAR ENERGY has been used for (1) drying animal skins/clothes:

- Preservation of meats and drying crops
- Evaporating sea water to extract salt (EIC)

It plays a viable role in the survival of our planet especially in the global climate and plant photosynthesis.

Amount of solar energy (insulation) from the sun to the earth =

1.73^4 kilowatt.

1.5 x 1018 kWh/year.

- About 10,000 times more than the world's annual energy consumption (Ahmed 1994)

* Because this enormous energy resource has not been utilized fully, a lot of attention is being focused on research and development of solar energy technology.

* Also the two-oil crisis of the early and late 1970s were an important thing to observe.

- the need to develop independent solar driven power devices for space telecommunications vehicle
- powered by photovoltaic panel (1958)

Today, solar energy is being utilized at various levels (Martinez, 1992)

(1) On a small scale household level
- Watches
- Cookers
- Water heater/heating (hotels)
- Solar architecture houses
- Irrigation

(2) Community
- For vaccine refrigeration in health center
- Water pumping
- Purification
- Rural electrification

(3) On industrial scale
- power generation
- detoxification
- municipal water heating
- telecommunication
- transportation (solar car)

Solar energy technologies are modular and can be tailored to the power need for individual applications such as electric calculators, small radio, television, computer, light or electric pump.

Solar energy system can be expanded easily by adding more module and batteries (Han Kim, 1995). The technology is environmentally benign in terms of global warming or destruction of the ozone layer.

It has long life span since they have no moveable and that can wear out.

Even, among many other sources of energy, Africa has substantial new and renewable energy resources with more than 3.140 TWH of exploitable technical hydropower potential

- More than 9000 mega watt of geothermal potential
- Abundant biomass potential
- Substantial solar potential
- Wind potential
- Fossil fuel reserves.

Existing estimates of energy use in Africa indicates a significant and persistent dependence on traditional biomass energy technologies and limited use of modern renewable energy technologies.
e.g. Solar Energy, Bio energy etc.

The consumption of BIOMASS in its traditional and unprocessed form entails significant losses and inefficient end use.

Renewable Energy Technologies (RET)

- Bio Energy
- Solar energy
- Wind energy (for water pumping)
- Small hydropower.

Bio Energy (limited) – charcoal kiln made of bricks metal.

- Direct combustion for process heat
- Gasification
- Co-generation
- Biogas production of ethanol substantiate for petroleum fuel.

Bio mass - Important fuel for small-scale and medium scale industries in Eastern and Southern Africa e.g. Brick Manufacturing, Fish Smoking etc.

To consider all these forms of energy and their usefulness, we find out that, they are immeasurable to the usefulness of man. Some are dependent while some are independent. Using the hydroelectric power (NEPA) and the petro chemical energy

(which are well utilized in Nigeria) as an example. "Combined power output at full operation of these power generating stations and outlets stands at roughly 6098 MW of which only about 2470 MW is needed to serve the 38% of Nigerians that this power distribution covers – and for even that percentage many consumers still do not get regular supply of electricity thus depend a lot on alternatives lot of energy is lost through the likes of wrong choice and application of power generation technologies. Also inadequate distribution of finished product of crude oil neither to fuel generators or any other energy machine become atimes very difficult. If not just of recent, in early 1999 that situation is a bit being under control.

Failure of most of these energy set up were read to

1 Mismanagement
2 Depend
3 Distribution problem
4 Security problem
5 Maintenance etc.

Alternate energy resources could be the only way out to this unlashing solution. The most sources of energy that are very cheap to tap, undependable and very lasting. It is also applicable in all aspects of human endeavor and very durable. They are economically viable and competitively large due to their low life cycle costs and high reliability. Maintenance is low since no fuel is consumed and properly installed and very safe. It also serves a greater purpose as its implication in architecture by using it for roofing materials. (In short it reduces the cost of roofing in building material being a durable materials).

Risk electric shock or electrocution to users is very negligible and minimal because of its low system of voltages as it is opposite of hydroelectric power generation.

Hence, with this above information, solar energy could be considered as reliable and very cheap to tap without consulting anybody for billing and most suitable for this end time because of its independence and uninterrupted supply of electricity in the third world countries. This energy will even make you responsible to yourselves and not to any other body for generation and payment.

It is also a blessing that the nation is located where the climate is characterized by relatively high temperatures throughout the year. The average annual maximum temperature varies from 35^0 in the north to 31^0 in the south; the average annual minimum temperature varies from 23^0 C in the north to 18^0C in the south. Also, Federal Capital Territory (FCT) Abuja, the federal capital of Nigeria is located in the geographical center of the nation. Due to the centrality of its location, on a mountain, it becomes very attractive and easily accessible from all parts of Nigeria and also from major cities in West Africa.

In this thesis, (sorry to digress a little) as events are overriding events in the history of man, also all other facet of learning should be affected especially in architecture; which is considered as dynamic and being a "science and art ... as like "the renaissance days". Hence a change start from somewhere before others could tap the ideas. Therefore architecture should be at this stage aiming to be independent professionally that our position and usefulness might be greatly felt and be needed in the society as a whole. This is what has made me to incorporate full technology of solar energy (active solar e.g. photovoltaic) into architecture. The thesis might sound new, but it is the need of the day for architects' aim of beautifying and reshaping the environment in the millenium might be fully achieved.

From this thesis, it will not sound well if solar energy is being discussed without considering its usefulness through the application and how it can be achieved in architecture.

To consider the area of its application; the need for man was put into consideration in the area of FOOD, CLOTHING, and SHELTER; where food is the first thing man will desire before any other thing. It is most important basic need of man. Among this need is meat production.

Therefore, the thesis is based on FARM ESTATE with respect to poultry and fishery.

In a broader view, the word food is highly embraced by any breathing human on earth. It is because man desired his survival from it. All food desired by man is secured from Agriculture in farming operation.

The synopsis is based on APPLICATION OF SOLAR ENERGY (ACTIVE PVC) IN FARM ESTATE. And since farm estate is a place where similar things are been managed and related.

Among the operation in farm estate is multi-farming system;

(i) Livestock barns and shelters e.g. goat, sheep, beef, cattle, horse, bees, poultry, cheese, turkey, rabbit e.t.c

(ii) Agriculture – fish farming

(iii) Machinery and supply – storage building

(iv) Building and facilities for crop storage e.g. rice yam, cassava, and grains e.t.c.

(v) Vegetable and horticulture etc

With these types of farming practiced, I considered poultry and fishery to be relevant in this thesis where the solar energy is going to be used in the farm.

The thesis is going to solve the problem of lighting and pumping water into the farm i.e.

(i) LIGHTING – supply of electricity with the use of photovoltaic cells as means of independent lighting.

(ii) Pumping of water

(iii) IMPLICATION IN ARCHITECTURE.

Generally active solar energy implication cannot be over-emphasized in the area of using part of the modules for roofing materials because the materials used to build the cell is very durable than any other roofing sheet.

To conclude this aspect, the usefulness of active solar energy will be looked into as application to farm estate (solar farm estate) in broader view.

1.1 AIMS AND OBJECTIVES

(1) Effective alternatives energy utilization for the solution of economical and environmental problems in our society.

(2) To serve as an immediate resurgence of means of survival for agricultural and farming set up in the third world country even in the whole developed country as a whole.

(3) To improve the high yield of farm product growth and processing by meeting the latest technology in the farm estate for the satisfaction of the common man and the society as a whole.

(4) To improve the technology of the country.

(5) Serve as a place and means of research for any organized establishment or private individual.

(6) To contribute to the supply of meat/animal production of food for consumption required in the Federal Capital Territory.

(7) To design a functionality and aesthetically balanced facility that is capable of enhancing the production of hygienically qualitative animal food items.

(8) Being independent and shock free, it reduces fears and bring confidence to the farm estate for full operation without stopping unless to maintain.

(9) It improves and shed more technological light to the profession of Architecture where the panel can be applied as roofing materials.

1.2 RESEARCH MOTHODOLOGY

The method adopted to achieve the good result in this project was carried out in the following ways and to establish a base from which the project aims and objectives could be realized.

- Consultation with allied professionals who are specialized in the field with some years of experience.
- Acquisition and analysis of data and information obtained from journals published materials, encyclopaedia, books and personal data through direct interview.
- Design conceptualization: this involved the evolution of the architectural basis for the solar energy application to suite the tropical climate concept analysis, design consideration in relation to solar energy.

1.3 SCOPE AND LIMITATION OF STUDY

This thesis shall comprise of required facilities for the keeping of both poultry and fisheries with the use of solar energy for pumping of water and lighting in the farming estate.

Among the units in the thesis are

1. Administration
2. Poultry
3. Fisheries
4. Processing unit
5. Feed unit
6. Staff facilities
7. Storage or warehouse
8. Cold room
9. Maintenance
10. Accommodation

AUXILLIARY FACILITIES

- solar panel
- water tank
- incinerator
- security gate
- car parks

LIMITATION:

I shall be limited to the real farming operation, which is production, administrative, and recreation like:

(i) Administrative and recreation

(ii) Poultry shed

(iii) Fisheries unit

(iv) Processing unit

The reason why I could not achieve the design of other unit at this stage is that:

(1) Most of them are not needed for the starting operation and some that are needed have been designed up with some other unit and in a larger scale. As soon as the farm estate begin to advance, consideration for designing other units can emerge.

- Especially, the feedmill area. It will be possible for the goods to be purchased outside or any factory that is competent and has a good product for the feeding of animals and Hatchery of birds (chicks) could be purchased.

1.4 IMPORTANCE OF STUDY

1. Solar energy is a high graded and clean form of energy, available at predictable rates, widely distributed and not subject to import quotes, resource depletion or international policies and being used as independent renewable energy that will no doubt lead to accelerated development and growth in the technological or energy set up.
2. It goes to reduce the demand for conventional forms of energy like electricity and other crude oil product which are not always readily available
3. To increase the output of farm products and improve the workers' operation without any power failure. i.e. productivity will be increased.

Mostly, lighting and water are the most important needs of poultry farm for quick productivity, especially the layers, brooders (a day one old to the rearing stage). This will make them to be active and productive.

1.5 DEFINITION OF TERMS

PHOTOVOLTAIC CELLS – SILICON- made strips that allow show of electron to convert sun energy to electric energy directly.

PHOTOVOLTAIC MODULES: consists of silicon solar cells laminated onto a sheet of glass or structural backing usually metal or plastic

INVERTERS: electrical device that converts direct current (DC) from the PV modules to alternating current (AC) to be used by the output appliances.

DEEP CELL BATTERIES: electrical current storage device with high percentage of discharge cycle.

MINS CIRCUIT BREAKER: electric protective device that trips power off, when there is a fault.

STAND ALONE PV SYSTEM: a system of photovoltaic that works by absolute dependence on power supply from the sun and supplemented by battery bank which are recharged by the sun itself.

PHOTOVOLTAIC: the technology that uses the energy of the sun directly to produce electricity.

UTILITIES INTEGRATED (UI) FOR SYSTEM: partial supply from solar and supplemented by fossil fuel sources.

CHARGE CONTROLLER: is an electric device that is connected to that PV modules to send charge either for the batteries recharge of batteries or for the inverter.

MOTIVATION

This thesis is principally motivated out of the desire to create awareness for the architecture of solar energy planning, attaining and illustrating the comprehensive design procedure and consideration in solar energy. Application in farm estate and demonstrate the mutual compatibility of the environment and architecture. That is, green architecture.

CHAPTER TWO

2.1 ORIGIN OF SOLAR ENERGY

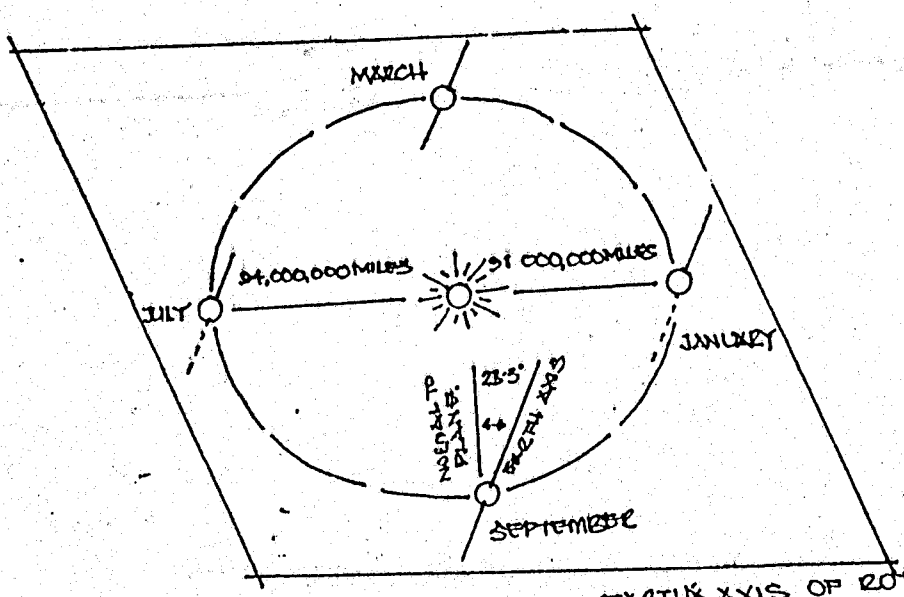
SUN

At present the most widely accepted theory for the origin of the sun is that it was formed from a cloud of gas composed chiefly of hydrogen.

The first step in the sun's development was the gravitational contraction of hydrogen particles. At some point, when the gravitational contraction of the cloud caused violent collisions between hydrogen particles, enough heat was generated to fuse the hydrogen nuclei and release energy. The fusion or union of hydrogen nuclei produced helium. The mass of the new helium atom was less than that of original hydrogen atoms, since mass was converted into energy in the fusion process. The resulting release of energy oppose any gravitational contraction of hydrogen. The first fusion reaction in the cloud was the birth of the sun.

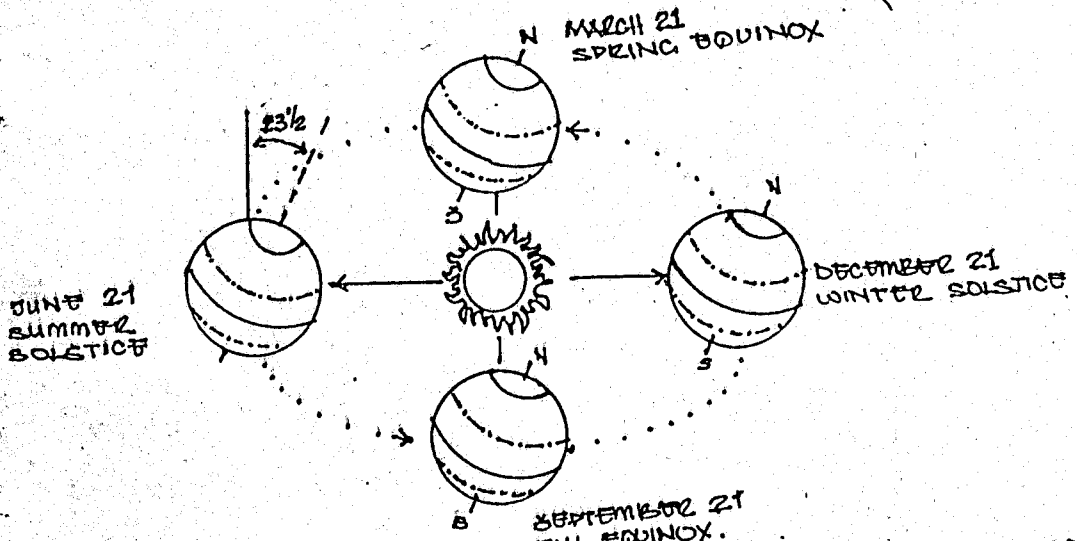
The energy output of the sun requires the burning or conversion of mass into energy at the rate of 4.5 million tons per second. Assuming that the sun has been in the hydrogen-burning stage for 6 million years, this seems at first glance like a great loss. A closer look shows that the total mass of the sun is 2200 000 000 000 000 000 000 000 000 000(2.2×10^{30}) tons, so that the sun loses only 2.0×10^{-19} of its mass each second. At this rate, the sun can be expected to continue radiating energy for billions of years to come.

ELLIPTICAL ORBIT OF THE SUN —



EARTH'S AXIS OF ROTATION IS TILTED TO THE PLANE OF THE ELLIPTICAL ORBIT

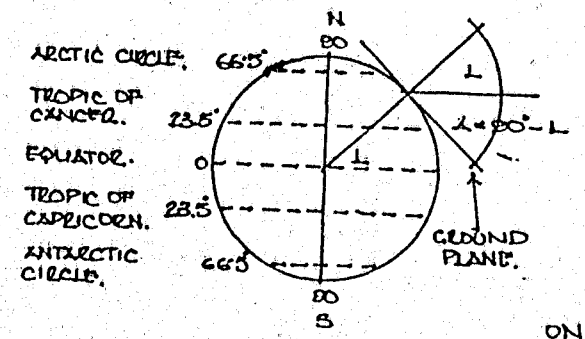
TILT OF THE EARTH'S AXIS

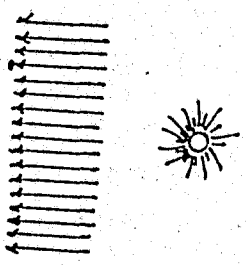


THE SEASONS ARE A CONSEQUENCE OF THE TILT OF THE EARTH'S AXIS OF ROTATION.

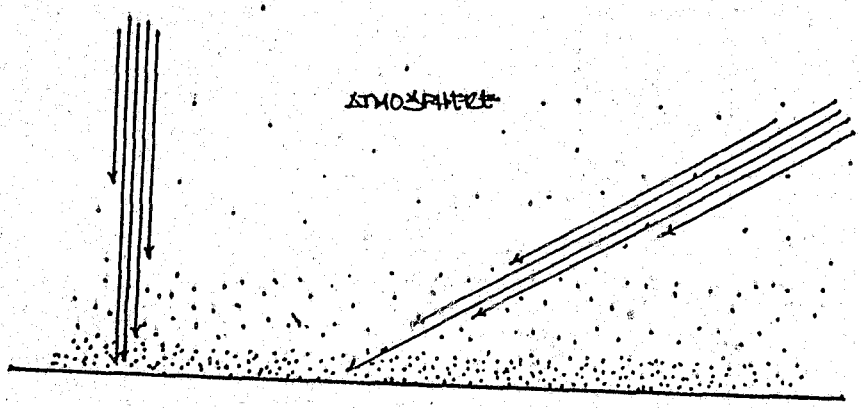
Fig 1a

CONSEQUENCES OF THE ALTITUDE ANGLE.

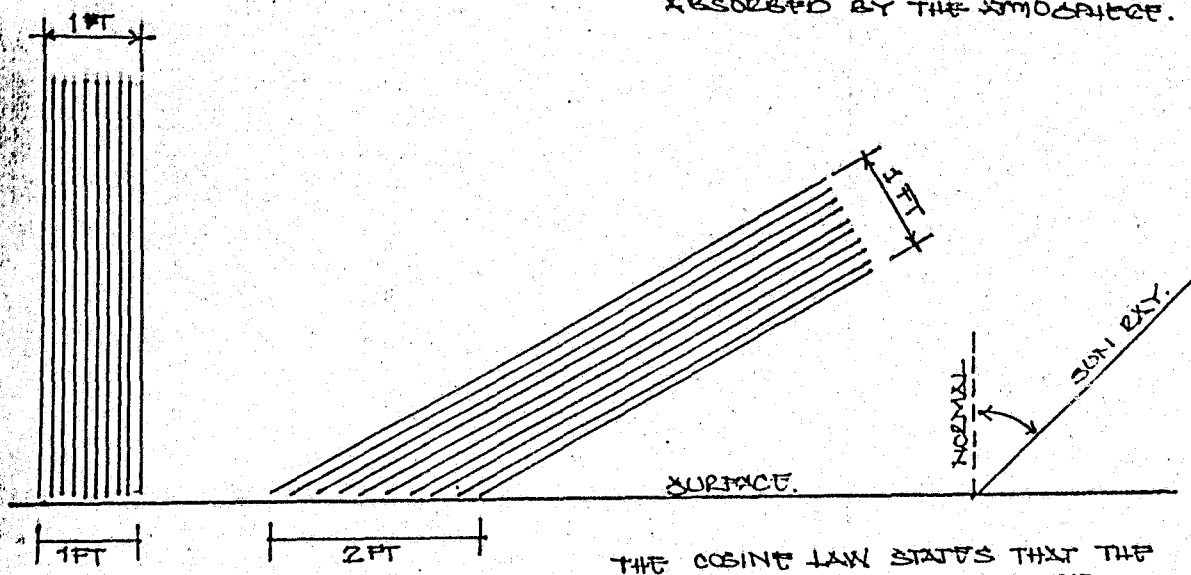




ON THE EQUINOX THE SUN ALTITUDE(x) x = 90° − LATITUDE(L).

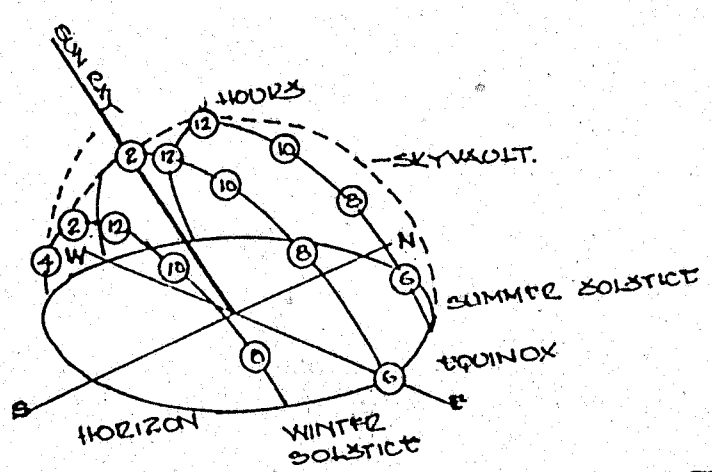


ALTITUDE ANGLE DETERMINES HOW MUCH OF THE SOLAR RADIATION WILL BE ABSORBED BY THE ATMOSPHERE.

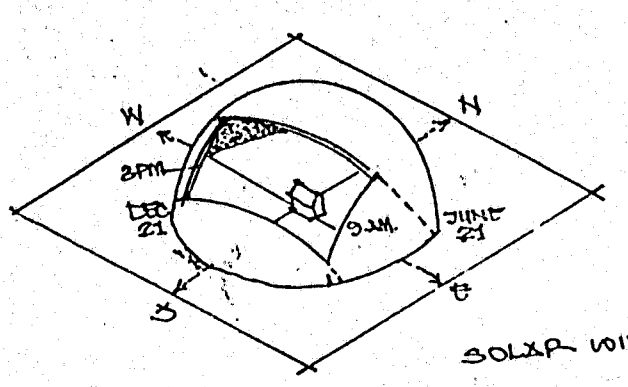


THE COSINE LAW STATES THAT THE AMOUNT OF RADIATION RECIEVED BY A SURFACE DECREASES AS THE ANGLE WITH THE NORMAL INCREASES.

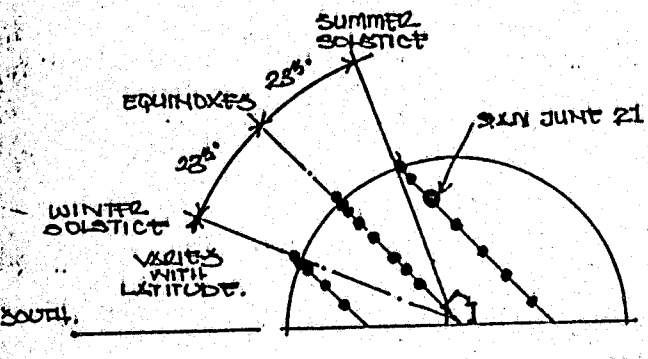
Fig 16



THE SKYVAULT AND THREE SUN PATHS.



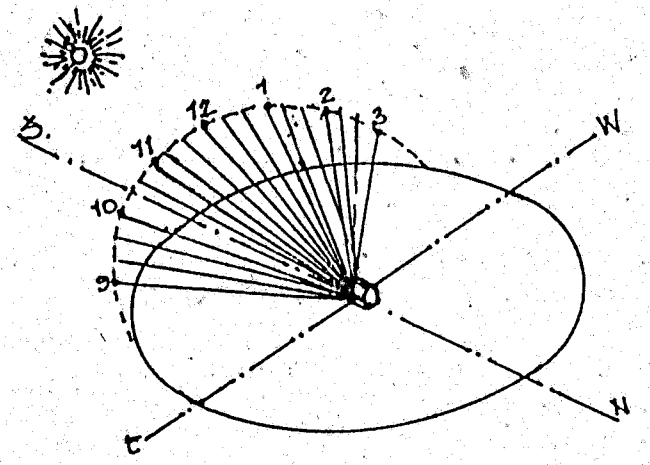
SOLAR WINDOW FROM 9.AM—3PM.



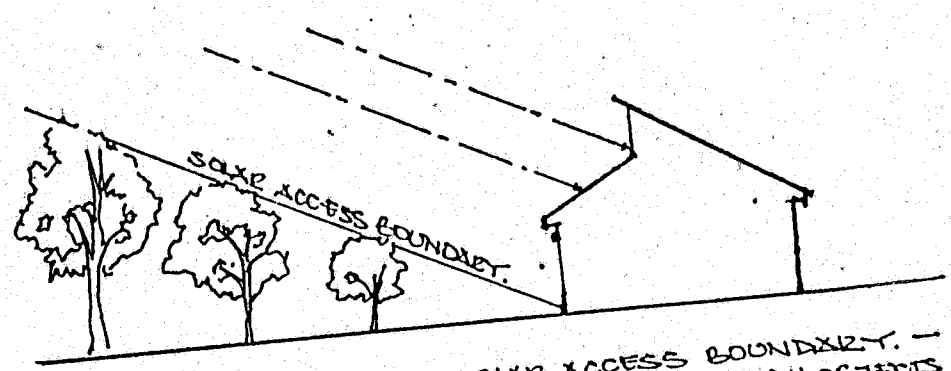
EAST ELEVATION OF A SKYVAULT.

Fig 1c

SOLAR ACCESS.



SUNPATH (DAILY MOVEMENT).



SOLAR ACCESS BOUNDARY. — DETERMINES HOW HIGH OBJECTS MAY BE BUILDER THAT OBSTRUCT THE SUN.

(FIG 2)

Source ?

2.1.1 SOLAR RADIATION

The thermo nuclear fusions at the core of the sun release energy in the form of light frequency electro magnetic ration radiation. The theory which currently is the most accepted states that electro magnetic radiation can be as either a combination of rapidly alternating electric and magnetic field {or waves} or energy particle called protons. This definition of radiation is difficult to understand and visualize, but the theory behind it allows us to describe and predict how radiation will act. Radiation energy is produced at the solar core at temperature estimated between 18,000,000° to 25,000,000°F. (10,000,000° to 14,000,000°C). The average temperature at the surface of the sun is only 10,000°F (5500°C).

The energy travelling through space is made up of radiation in different wavelength. Electromagnetic radiation is classified according to its wavelength, the more energetic the radiation, the shorter its wavelength. Radiation is emitted from the surface of sun in all wavelengths, from long wavelength radio waves to very short X rays and gamma rays.

Although the sun radiates energy in many wavelengths, it radiates proportionally more energy in certain wavelengths.

At an average temperature of 10,000°F sun radiates most of its energy at very high frequencies (short wavelengths) visible light makes up 46% of the total energy emitted from the sun. Visible light, or the wavelength to which the human eye is sensitive, extends from 0.35 to 0.75 micron (The unit used to measure wavelength is the micron or micrometer which is equal to a million of a metre of a meter or 00004 of an inch). It is made up of all the familiar colours from the shorter wavelength violet (0.35 microns) to blue, green, yellow, orange, and the longer wavelength red (0.75 microns). 45% of the radiation emitted from the sun is in the infrared (below red) band. Infrared radiation, which we experience as heat, is radiation at wavelengths longer than the red end of the visible spectrum (greater than 0.75 microns). The remaining portion of the sun's radiation is emitted in the ultraviolet band at wavelengths shorter than the violet and of the visible spectrum (smaller than 0.35 microns). All electromagnetic radiation leaving the sun travels through space at a uniform rate, in the form of diverging rays is assumed to be a parallel beam. At a

distance of 93 million miles from the sun, the earth intercepts approximately 2 billionths of the sun's radiant output or the equivalent of about 35,000 times the total energy used by all people in one year.

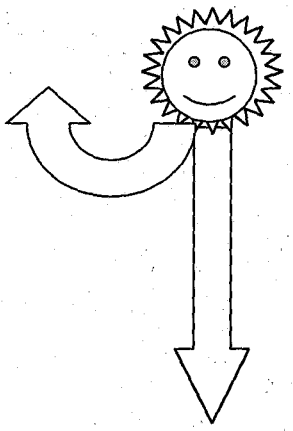
The solar constant, which defines the amount of radiation or heat energy reaching the outside of the earth's atmosphere, is 429.2 Btu's per square foot per hour (1.94 calories per square centimetre per hour).

In other words, if we located a square foot of material just outside the earth's atmosphere and perpendicular to the sun's rays, it would intercept 429.2 Btu of energy each hour. There are slight variations in the numerical value of the solar constant because, which the earth's orbit around the sun is almost perfectly circular, within this orbit the sun is slightly off centre. This difference is important to scientist's doing detailed calculations out in space, but on the earth's surface the variation is so slight it has little effect on the solar heating of buildings.

2.1.2 RADIATION AND THE EARTH ATMOSPHERE

Of all the solar radiation intercepted by the earth (Including the atmosphere) as much 35% of it is reflected back into space. The reflection of energy from an object is called the albedo of the object. The albedo of the earth taken as a whole is 35 – 40%. Most of this energy is reflected back into space from clouds and atmosphere dust but some reflection occurs at the surface of the earth from surface such as water, snow and sand.

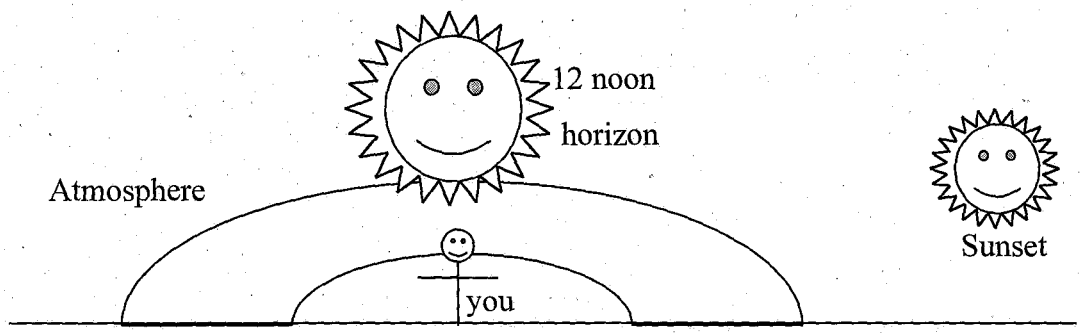
Parts of the remaining portion of solar radiation while passing through the earth's atmosphere, is scattered in all directions as it interacts with air molecules and dust particles. As a result, some of this scattered "diffused" radiation comes to earth from all points of the sky dome. Scattered radiation, primarily in the blue portion of the visible spectrum, is responsible for the blue colour of the clear sky.



What happen to solar radiation intercepted by the earth atmosphere?

While the clouds and dust scatter and reflect approximately a third of the incoming energy, the water Vapour, Carbon dioxide and Ozone in the atmosphere absorb another 10 to 15%. In the upper atmosphere, ultra-violet radiation reaching the earth's surface. This is essential since ultra-violent radiation can cause skin burn and eye damage and it can be lethal even in moderate doses. Water Vapour and Carbon dioxide in the lower atmosphere absorb portions of the radiation, primarily in the infrared band. Besides, the composition of the atmosphere, the most important factors in determining the amount of solar radiation reaching the earth's surface is the length of atmosphere the radiation must pass through.

During the day when the sun is directly overhead. Radiation travels the last amount of atmosphere in route to the earth's surface.



As the sun moves closer to the horizon (Sunset). The path of the radiation through the atmosphere lengthens. The more atmosphere or air mass that radiation must pass through, the less its energy content will be due to the increased absorption and scattering of the radiation. At sunset the radiation content of the solar beam is

sufficiently low to enable us to glance directly at the sun. As the height above sea level increases. Therefore, the energy content of solar radiation at high attitude locations will be somewhat higher.

Because of the earth's tilt and rotation, the length of atmosphere that solar radiation passes through will vary with the time of day and month of the year.

The path of the earth around the sun is a slight ellipse, barely distinguishable from a circle. As the earth orbits the sun, it rotates once a day on an axis that extends from the North Pole to the South Pole. This axis is tilted $23^{1/2}$ ° exactly $23.47^{o)}$ from a vertical to the plane of the earth's orbit around the sun. fig. 1c

The earth's tilt is responsible for the seasonal variations in weather. The tilt is constant as we orbit the sun, so that in the summer month the Northern atmosphere is slanted towards the sun. During this Northern atmosphere receives more hours of sunshine and the incoming radiation is closer to perpendicular to the earth's surface. During the winter months the situation is reversed, and the Northern atmosphere receives fewer hours of sunshine at a lower angle, while summer prevails in the Southern atmosphere.

2.1.3 APPROACH TO SOLAR ENERGY

There are basically two distinct approaches to the solar heating of building.

1. Active
2. Passive

In general, active systems employ hardware and mechanical equipment to collect and transport heat. Flat plate or focusing collectors (usually mounted on the roof of a building) and a separate heat storage unit) rock bin, water tank or combination of the two) are often the major elements of the system. Water or air pumped through the collector, absorbs heat and transport it to the storage unit. This heat is then supplied from the storage unit spaces in a building by a completely mechanical distribution system.

2.1.4 PASSIVE SYSTEM

On the other hand, collect and transport heat by mechanical means. The most common definition of a passive solar-heating and cooling system is that it is a system in which the thermal energy in the system are by natural means such as radiation, conduction and natural convection. In essence, the building structure or some element of it is the system. There are no separate collectors, storage units or mechanical elements. The most striking difference between the systems is that the passive system operates on the energy available in its immediate environment and the active system import energy, such as electricity, to power the fan and pumps, which make the system work.

There are two basic elements in every solar-heating system: south facing glass (or transparent plastic) for solar collection and thermal mass for heat absorption, storage and distribution. Popular belief has it that a passive building must incorporate large quantities of these two elements.

In passive systems, three concepts is applicable:-

1. Direct gain
2. Indirect gain
3. Isolated gain

} they all have fervent relationship with sun, heat storage and living space.

2.1.5 ACTIVE SOLAR ENERGY

Of recent, the direct conversion of solar energy into electricity by the use of photoroffail cell is on the threshold of becoming a major energy source.

In one year the amount of solar energy that reaches the surface of the earth is 10000 times greater than all the energy of mankind used by man in one year.

Why then are we not utilizing solar energy? The answer can partly be traced to the fact that there are technical problems involved. This includes the diffuseness of the sunray, intermittent availability and uneven distribution of the energy. Also there is the problem of people believing that solar is unconventional, unreliable and near fantasy. But then, of all the above, the least of problem with this is climate condition

based on the availability and need of alternative sourcing of energy. The technique employed for solar collection and storage is more economical in almost all situations.

Besides, been renewable, solar energy also has other important advantages, it is exceedingly lenient to the environment. There is no air, water or land pollution it is safe to use. And the decentralized sourcing makes the maintenance minimal. This is an application in day lighting sunspace and active use of solar can add special delight to architecture because it promises not only to benefit the nation's energy supply but also to enrich architecture.

2.1.6 SOLAR ENERGY CONVERSION

The term 'SOLAR ENERGY' originally referred to the application of the sun's energy to hot water and space heating. But it is non-widely recognised that this extend to direct conversion of solar energy into electricity generation is the main focus of the design proposal because it's the only applicable way of utilizing this form of energy in the tropical climate.

Although energy generated might not be used at large scene presently, the scope for the project allows for an appreciable expression of this form of energy in forming estate design.

The conversion process involves the use of P.V cells. They are made of one of the most common materials on earth, silicon. A phetoroffaic system usually consist of PV cells batteries, and a power controller/inventor. The batteries store energy collected by the cells. Most modern batteries can last up to 20 years with minimum maintenance. While the power controller/inventor both controls the flow of electricity and converts it from direct current (D.C) to alternating current (A.C).

In this project the decentralized PV power plants are been employed, that is, the building would produce its own electricity. Oriented at an ideal position the PV cells collect sun radiation through the hours of sunshine and then store it in the batteries, in which can then been converted into electricity by the controller inventor. Other conversion processes are available for solar radiation.

History has shown that the worship of the sun by people of the past illustrates their understanding of the importance of sunshine to life.

Thus, in recent time, advancement in technology and the accompanying disappointments has persuaded us to reconsider our relationship between nature and technology. There is growing conviction that progress will come mainly from technology that is in harmony with nature.

The growing interest in "natural energy" illustrates this in altitude. Architecturally, this point of view is represented by building utilizing the sun (sunshine in winter, and shading from the sun in summer). This approach to architecture requires an understanding of the natural world, central to this understanding, is the relationship of the sun and the earth.

This project outlining the thesis problem seeks to define the meaning, concept and planning, procedures of solar energy in farm estate and its form of utilization as regard the climate (Tropical) of the proposed work.

2.1.7 CONCEPT OF SUN/EARTH RELATIONSHIP

This illustrates the sun and earth's relationship as regards the emission of solar radiation and factors of the resulting effect on the earth.

2.1.8 THE USE OF SOLAR ENERGY IN BUILDING

Early form of solar energy use in building. The role of energy in building has always been significant, but had largely been ignored (as it is now) in recent history until the energy crisis of 1973. A tradition study of the history architecture for instance, would not mention the word ENERGY in a discussion of ancient Greek architecture. And yet the beautiful rugged land in which the Greek build their monuments as a sacred eroded land cleared of trees to heat their building. The Greeks were aware of their plight, for Pluto said of his country "All the richer and softer plants have fallen away and the mere skeleton of the land remains.

The Greek responded to the heating problem partly by using solar energy. Socrates thought to this was important enough to compel him to explain this method of designing buildings. According to Xerophan, Socrates said "In housing that look towards the south the sun penetrate the portion in winter, with the summer part of the sun is rightly over our heads and above the roof so that there is shade"

Socrates continued to talk about a house that has a two-story section "the section of the house facing south must be lower than the northern section in order not to cut off the winter sun. Although there are numerous examples of early solar planning, several cultures have utilized the sun. Cities that are clearly organised in relation to the sun, in the early times include the city of Knossos in Crete 2500 – 1400BC, the city of Teetchualam, Mexico 100BC – AD 700, the ancient Greek of Prience, Asia Minor

(Turkey) 4th century B.C cliff, dwelling of the Anasazi Midian at Mesa, Verde Colorado and the Chinese capital city of Chang-an and during the tang dynasty.

The greatest palace of Knossos was built and rebuilt during the Minoan civilization. (it is oriented slightly West of South). Although it was built to a facility high density most of the individual units were oriented to receive sunlight.

The city Testlihuean was located in South Mexico. It dates between 100BC – AD 700. There are architectural monuments paying homage to the sun and mid moon. The main city avenue ran in the north-south direction (called avenue of the death) connecting the major's pyramids and temples. The paths and street were organised on a grid on the cardinal point. Here again most of the building receives sunlight.

The ancient Greek city of Prience was built in the heuenistic period around the 4th century. Because of continual feeding, the original city was abandoned for a site that was located for a higher ground near Mycelia, a promontory that had varied topography sloping to south and south west. Despite the varying topography, the city was laid out on a grid on the cardinal points and the street were oriented similar to the earlier olynthianc street plan which axis and minor street along the north-south axis running up the hills. This allowed for good solar access to almost all buildings.

Many solar oriented cities built over a vast period of time in China. The entire city of Chang-an, which has the capital of China during the Tandy dynasty in the 5th century, was built on a rectangular grid oriented on the north-south axis. This plan demonstrates the importance of solar planning at the planning level.

An example of solar architecture in Greece is the Corinthian house. Olynthian illustrates how solar architecture theory translates into practice. The houses mere rectangular in shape and the north wall has few window openings. The main rooms occupied the north wing. They faced area is the south side of the building called pastas which extended east-west across the entire width of the building and the centre section consisted of a collocate which led into an open courtyard.

Each of these cities demonstrates a profound organisation in response to the orientation of the sun. But city plan and architectural designs reflects this awareness.

PASSIVE SOLAR USE ON BUILDING

The ancient people used the sun to heat their homes the benefit were modest because much of the captured heat escaped again through opening. It was the efficient and practices Romans who first solved that problem by using glass in their windows sometimes-about 50 A.D. The glass is what we now call the greenhouse (effect). The idea worked so well that the roman found a variety of uses for it. The upper classes often added a sun room (helrocaminus) to their villa Breen houses produced fruit and vegetables year round. The latter "modern" version of the roman baths usually faced the winter sunset (south west) where the solar heat is. The use of solar energy then decline along with Rome almost as if it were a sign of civilization. Later during the renaissance architects such as Pallcidio read and appreciated the advice of vitruvias. Pallcidio utilized such classical principles as placing summer rooms on the north side and winter rooms on the south side of a building. Unfortunately, northern Europe only uses the style and the principle that guided pallcidio.

The seventieth century in Europe saw a revival of solar heating but not for people. Exotic plant from newly discovered lands and the appetite of sizeable upper class created a need for greenhouse with the invention of the better glass making techniques. The eighteen-century became known as the "age of greenhouse" eventually those greenhouses that were attached to the main building became known as the conservatory.

2.2.0 FARMING AND AGRICULTURAL TECHNOLOGY

In spite of the often-concentrated industrialization of many parts of the world, the ancient calling of agriculture continued in the late 20th century to draft into its service more of the world's aggregate manpower than all other occupation combined.

This part discusses modern agriculture as a practical art, as a commercial enterprise and as a science.

Historical aspects are covered in the article AGRICULTURE. The academic disciplines that study, develop and teach scientific techniques of farming are discussed in Agricultural sciences. The processing and distribution of agricultural commodities are treated in FOOD PROCESSING and BEVERAGE PRODUCTION.

Economic and sociological aspects of farming are discussed in RURAL SOCIETY AND AGRICULTURE.

2.2.1 FARM BUILDINGS

The basic unit of commercial agricultural operation, throughout history and world-wide is the farm. Because farming systems differ widely, there are important variation in the nature and arrangements of farm facilities. The buildings on a farm generally consist of the farm family's house, the dwellings of any resident hired workers, and the various structures and facilities for farming operations. This section deals with farmhouses and service buildings that can be classified as follows:

- Livestock barns and shelters
- Machinery – and supply – storage buildings
  Building and facilities for crop storage
  Fodder; and special purpose structure.

The location of farmstead and the relative position of its different buildings are influenced by several factors, External and Internal. Among the external factors, mainly natural are soil conditions, climatic conditions and access facilities to the main road and to the fields.

Internal factors depend on the type of business enterprise the farm is suited for. Among general principles that must be taken into account are the necessity of some partition between the farmhouse and the service building, the possibility of enlarging buildings and security against fire. Four general layouts may be defined: large crop farms, large stock farms, farms in underdeveloped areas and small to medium mixed farms.

2.2.2 LARGE CROP FARMS

Independently owned farms of this types, mainly cash-grain farms, are numerous in North America. The layout is simple, for there are generally two types of service buildings, one for storage and the other for machinery. The layout is similar in the communist collective farms mainly harvesting cereals (KOLKHOZ) and SOVHHOZ in the Soviet Union; cooperative and state farms in Eastern Europe). Large farms specializing in fruit production have a shed for the conditioning and storing of products. The other main building being a machinery and simply shelter. Some large farms specializing in vita culture include buildings that are equipped with wine cellars.

2.2.3 LARGE STOCK FARMS

Two types of large stock farms, Extensive and Intensive, may be distinguished. The cattle ranchers of U.S exemplify the extensive type. At the extreme, there are no buildings, only equipment. In Australia and New Zealand, dairy cows are kept without housing. The only building houses the milking parlour and the milk room, in the centre of the pasture. In the western United States, the most important beef ranches have several thousand heads, entirely free on the range. The only building is the elevator with the milling and mixing machinery. For the animals there are only troughs and fences. Among intensive stock farms are the big dairy units – with several hundred cows – in the United States in western Europe (France, north Italy) and in Eastern Europe and the Soviet Union. There are three major layouts: parallel buildings; monobloc building (Hungary, East Germany) and circular layout, with the milking parlour in the centre (United States, north Italy). The covered feedlots for fattening beef in the United States, middle West and elsewhere, feed from several hundred to several thousand head and are generally built with a shelter for the animals and with tower or bunker silos. Large units for hog productions often have many buildings, partly to reduce disease risks and partly to separate the various animals – e.g. the suckling sows, in-pig sows, fattening pigs and boar. Some systems, however, use only one or two types of buildings, large poultry units, specialized either for egg or for broiler production, use large identical buildings, the number depending on the unit size.

2.2.4 FARM IN UNDERDEVELOPED AREAS

In the underdeveloped areas two types of buildings are found: those of the LATIFUNDIA or large plantation – type farms, and those of the small-owner or tenant farms. In these, buildings are generally small and scattered, the construction of a single large building being too expensive.

2.2.5 MIXED FARMS

The small and medium farms, which characterize European agriculture and which exist in many other parts of the world, are managed on the traditional mixed farming and animal husbandry system. Consequently, this type of farm normally has several service buildings: one for machinery, one for hay and cattle, another for hogs, another for sheep. In the mountain areas however, there often is a single building, including the house. With the increase of the farms' average size in these areas, there is relative specialization and the number of building in the newly built farm is decreasing.

2.2.6 BUILDING TYPES

These include homes (farm houses), livestock barns and shelters, buildings for machinery and supplies and crop storage and special-purpose structures.

FARMHOUSES: The basic requirements for the farmer's family are about the same as those of the urban family, but certain features of the farmhouse depend on the farm life patterns. Because the farmer generally comes directly from the field on the service building, with soiled clothes and boots, it is necessary to provide a rear entrance with a washroom or lavatory and clothes-storage space. For the same reason, many farmers prefer a dining place close to the kitchen or included in it. The house must include an office and a large food storage place with ample refrigeration, including a freezer in many countries, as most farm families are large. There are usually three or four bedrooms.

Satisfactory modernization of old farmhouses is difficult in some cases, but if the available surface is important and the main wall strong, renovation can give good results. The lost of a new house must be proportionate to the farmer's income; for this reason, farmhouse in underdeveloped regions has a smaller surface with a main

room (kitchen and dining room), two or three bedrooms, a large washroom and storage place.

2.2.6a LIVESTOCK BARNS AND SHELTERS

These tend to become the most important elements of the farm layout. Two general animal shelters may be distinguished: the multipurpose type, a single-story building with clear-span roof construction, useful food feed storage and machinery, as well as for livestock, and the specific type, designed for a particular type of animal.

There are two major cattle-housing methods, the stall barn (or stanchion barn) and the loose-housing system. In the stall barn, each animal is tied up in a stall, for resting, feeding, milking and watering. The typical plan has two rows of stalls. In older buildings, hoe and straw are stored in an overhead loft, but in modern layouts adjacent buildings are generally used.

In cold and moderate climates, the barns need insulated walls and ceilings, as well as ventilation systems, either natural or power-operated. In mild and hot areas, the barns are open on one or two sides.
The loose-housing system, developed in the United States after World War II is now employed throughout the world. Basically, it includes a wood – or metal framed shelter, arranged so that the animals can move freely inside and sometimes also between the shelter and an outside yard. Depending on the bedded areas, four types can be distinguished: loose housing on permanent litter – i.e. straw, corncob, sawdust, loose housing in free stalls or cubicles: Loose housing on slatted floors; and loose housing on sloped concrete.

For hoarsen and ponies it is customary to use individual stalls, where the animals can move freely, even though this requires more space.

Males may be kept together in large pens. In mild climate, sheep and goats live on pastures without any shelter. The facilities include fences, waterers' corrals, dipping vats and lambing and shearing sheds. In moderate and cold climates, the flock

wintered in sheds. In moderate and cold climates, the flock is wintered in sheds. The trend is toward clear-span buildings, with large alleys so that trailers can distribute food into racks and troughs. Ewe is housed by group (50 to 100 each) and special pens are kept for lambs. Feed racks and fence partitions are generally movable. For the daily ewes, there are special milking parlours.

Goats are housed either in tie stalls, for small flocks under to head, with milking on the spot, or in pens, for larger flocks housed by groups, with milking in a special milking parlour.

Pigs housing varies for sows and fattening pegs. The sow lives with its litter for four to eight weeks according to the weaning age chosen. During this period there are two types of housing: movable, individual houses (generally of wood) located on or close to pasture and fixed in place and central farrowing houses. A sow may farrows and lives with its piglets in a single pen or farrows in a special stall, to avoid possibly crushing the piglets, or may farrows tied up by a chain or a harness. The pregnant sows live either free in groups of six to twelve or tied up or blocked up inside individual stalls. In cold climates, the house is heated; in all modern practice infrared lamps or tubes are used to keep the piglets warm.

Fattening pigs, like fattening beef cattle, may be kept either in a simple feedlot, in large groups with a wide surface per head and a simple open shelter, a system widely used in the United States Corn Belt, or penned in a closed building, isolated and ventilated, each pen holding seven to fifteen pigs. This is the most common system in Europe. Size of the pig units varies all the way from five sows or twenty pigs to large farms of up to 100,000 pigs.

2.2.6b MODERN BROILER HOUSES

Poultry is the most industrialized type of animal (livestock) production. Some of the breeding phases no longer take place in farms but in specialized plants. The farmer buys either chicken for broilers production or young layers for egg production. The typical modern broiler house holds from 10 – 100,000 birds, with automated feeding. Two types of facilities can be used. The broiler can be put on ground on a deep litter

of wood savings on wire mesh above a pit or on a combination of these two floors. Alternatively, the broiler can be housed in metal cages, on three stories, each cage holding three to ten animals. In this case feeding and cleaning are mechanized and the density is higher. The typical laying house holds several thousand hens. The same facilities as for broilers are used, but use of the cage is more common layers.

There are several types of cages, some of which are mechanized to facilitate feeding, cleaning and egg collection (Obasanjo Farm). Each cage can hold one to five hens. The density can reach about 2 hens per square foot (23 hens per square metre). The main types are cages, which allow maximum mechanization. The buildings are generally one story, fully enclosed; they have insulated structures with sophisticated ventilation system. Turkeys and other fowl are housed like poultry but generally on the ground. Rabbit production involves housing by groups in cages on one, two or three stories

2.26c BUILDING FOR MACHINERY AND SUPPLIES

This type of building is designed solely to afford protection from the weather, mainly rain. Machinery storage should have as much surface as possible between the interior posts, without being too deep, so that each machine can be taken out easily. The best solution is clean-span shed, wood or metal framed, 25 – 35 feet (eight to 10 metres wide), open on one side and 15 feet (4.5 metres) high under the gutter. At the end of the shed, one bay is reserved for repair and maintenance and another for tools. This part is equipped with sliding or overhead doors. The same shed, or another can be used for storing the fertilizers, seeds and pestitudes

2.2.7 CROP STORAGE

Wheat barley, shelled corn (maize) and other cereals can be stored in farm bins if the moisture is below a certain limit (from 10 to 15 percent). In some cases, artificial drying is necessary before storage, though it is possible to store wet grain, especially shelled corn, in airtight silos for animal fodder. The most common method of storage of dry grains is

(i) In piles of five to ten feet (1.5 to three metres) on a waterproof floor in a building with reinforced walls;

(ii) In square or round bins erected within a building, usually of timber, plywood, corrugated steel, or wire mesh lined with water proof paper; and

(iii) In watertight bins, often of corrugated metal, with their own roofs, for outside erection. Ear corn is dried by natural ventilation through a crib of limited width, located in a building or outside.

Loose or baled lay is stored and sometimes dried by ventilation with fresh or heated air, either under sheds or in special installation called hay towers. Silage is made to conserve moist fodders such as corn sorghum and grass. There are two types of silos, the horizontal silo is a parallepiped, either cut into the ground (trench silo) or built above ground (bunker silo). The floor is natural earth or concrete. The walls can be concrete, timber or plywood or sheet steel. The capacity varies but can be large.

The TOWER silo is an above ground cylinder, with 20 – 30 feet (six to nine metre) diameter and a to – 65 feet (15 – 20 metre) height.

Ordinary silos, which are only watertight, are concrete, masonry spaces or blocks or steel. Special airtight silos with steel walls and a fused-glass surface are used for storage of high dry – matter silage, called "haylage" fruit and vegetable storage for family consumption is usually in caves or cellars. For crops to be marketed, conditioning and storage generally are handled by commercial enterprises, but some large, specialized farms have their own storage. The building are insulated and temperature control is assured either by ventilation with outside air (i.e. for potatoes and onions) or by refrigeration (apples).

2.2.8 FARM MANAGEMENT

Farm management normally consists of making and implementing the decisions involved in organizing and operating a farm for maximum production and profit. Farm management draws on agricultural economies for information on prices, markets, agricultural economies for information on prices, markets, agricultural policy and economic institutions such as leasing and credit. It also draws on plant and animal sciences for information on soils, seed and fertilizer, on control of weeds, insects and disease, and on rations and breeding; on agricultural engineering for information on farm buildings, machinery, irrigation, crop drying, drainage and

erosion control systems; and on psychology and sociology for information on human behaviour. In making his decision, a farm manager thus integrates information from the biological, physical and social sciences.

In southeast Asia, the manager of the typical small farm with ample labour, limited capital and only four to eight acres (1.6 – 3.2 hectares) of land, often fragmented and dispersed, faces an acute capital – land management problem use of early maturity crop varieties; efficient scheduling of the sequence of land preparation, planting and harvesting; use of seed beds and transplanting operations for intensive land use through multiple cropping; efficient use of irrigation and commercial fertilizer and selection f chemicals to control insects, diseases and weeds – all of these are possible measures for increasing production and income from each unit of land.

In western Europe, the typical family farmer has less land than is economical with modern machinery, equipment and levels of education and training, and so must select from the products of an emerging stream of technology the elements that promise improved crop and livestock yields at low cost; adjust his choice of products as relative prices and costs change; and acquire more land as farm labour is attracted by non-farm employment opportunities and farm numbers decline.

2.3.0 POULTRY PRODUCTION (MANAGEMENT & HOUSING)

In the broad sense, the system of management defines the extent to which birds are exposed to sunshine or ultra violet rays and pasture and it also describes the housing pattern. Recall, the extensive system permits the fullest exposure to pasture and sunlight, the intensive system practically precludes or minimizes this exposure which, in between the two system is the semi-intensive (Oluyemi and Robert 1988 page 50).

2.3.1 POULTRY MANAGEMENT

2.3.1a THE EXTENSIVE MANAGEMENT SYSTEM

Under this system, the domestic fowl is exposed to pasture and sunshine. The birds are grazed on pastureland and, they are provided with shelter for sleeping at night and for protection from inclement weather (1 bed page). The major advantages being that

birds acquire part of their diet by scavenging for herbage, seeds and insects and that, they usually remain very healthy. It is only practical if there are no daylight predators in the district. A simple building in which the birds can be enclosed at night is however required (Williamson and Payne 1978 page 623). However also, this system cannot be practiced on a commercial scale unless sufficient land is available. In many countries like Nigeria, local chickens are maintained under a rudimentary form of extensive system where suitable shelter and cultivated pastures lacking supplemented feeding is minimal (Oluyemi and Roberts 1988).

2.3.2 THE INTENSIVE MANAGEMENT SYSTEM

This system prevent access to pasture unless, it is brought to the birds. It also prevents access to sunshine although the pattern of poultry houses in the tropics may allow some entry of sunshine through the sides of the poultry houses. The first important consideration arising from the confinement of birds is the requirement for highly balanced diets. While feeds may be more expensive initially, it may lost less per unit of product. One aspect of confinement is the attendant high stocking density which implies a closer contact among the birds and hence a greater risk of the spread of disease. It is an important factor in the increased incidence of nice habits, due to the more frequent body contact among the birds, hence the need to debeak the fowls when maintained on deep litter (Ibid. page 54).

The housing systems collectively known as intensive system are the deep litter, the wire or slatted floor, the straw yard and the cage system (Ibid. page 54) from a narrower perspectives, the intensive system is normally a well ventilated deep litter house which in most regions of the tropics does not require conventional walls but has some device by which cold driving rain can be prevented from entry during the rainy season (Williamson and Payne 1978 page 624). In tropical areas till, these open but shaded areas must protect against the sun and yet allow a maximum circulation of air and should be built where breezes can move through it.

THE SEMI-INTENSIVE MANAGEMENT SYSTEM

As in the extensive system, the semi-intensive system has largely become obsolete. It was once popular, largely for breeding on the assumption that, it imparted physical

stamina to the birds, thereby enabling them to withstand the strain of egg production when they become layers. The main features being the fixed building and attached runs or fenced pasture. This system combines the advantages and disadvantages of both the intensive and extensive system (Oluyemi and Roberts 1288 page 64). It is however crucial to note that, it is the most common system used by small producers and breeders also often use it. The poultry have access to outside runs where they live during the day and to houses where they sleep at night (Williamson and Payne 1978 page 624).

2.3.2 HOUSING FOR POULTRY – CHICKENS

It is needful to note that poultry is a general term for birds of several species such as chicken or domestic fowls, ducks geese, guinea, fowl, pea fowls, pigeons etc (Yendesveer etal 1986 page 212). The simplest method of rearing poultry is those as single-stage systems, in which they are taken from day-old to maturity in the same house. Floor space allowances for birds kept in this way vary from $0.12m^2$/bird for the lighter breeds and up to $0.24m^2$ for the heavier breeds, the maximum figure being required for broiler breeding stock. There is also what is called the multi-stage systems, where birds are breaded in one house and then moved on afterwards, when the period of artificial heating is over, to a variety of other forms of accommodation (Samsbury and Samsbury 1988).

It is also needful to note that, poultry is graded or categorized into chicks, growers, layers, parent or breeding stock and broilers. The chicks are the small stocks from day old to the first few weeks while, the growers are older in age from about 6 or 8 to 20 weeks and they are either pallets (female) or cockerels (males). The layers are the birds used for the production of table eggs while the parent or breeding stock are the birds used for the production of the fertilized eggs that will develop into chicks through artificial or natural incubation and hatching means, they are either hens (females) or cocks – roosters (males). The broilers, which are brought up to gain carcass at a fast rate, are raised for the production of table meat. See table

Stage of growth	Age of fowls	Management Produce
Embryo	From 21 day-to-day 1 (21 days – pre-natal)	Incubation

Chicks	From 0 - 6 or 8 weeks (Broilers from 0 – 8 or 10 weeks)	Brooding
Growers Female (Pallets) Males (Cockerels)	From 6 or 8 – 20 weeks	Rearing
(a) Pallets	From 20 or 24 weeks - 32 weeks (first day in Lay)	Management of layer
(b) Hen	From 72 – 20 weeks (Second year in lay)	Management of layer
Breeder – female Mated to produce Fertile eggs male Cock or rooster	Above point of lay	Management of breeders

Stages of development and management operation

Source: Oluyemi and Robert 1979 page 79.

The housing of poultry usually depend on the management system as outline below.

MANAGEMENT HOUSING

A	Extensive system	i. Range system ii Fold unit or folding unit
B	Intensive system	i Deep litter system ii Wire and slatted floor system
C	Semi-Intensive system	i Typical semi-intensive system

Straw yard

Hence the housing of poultry will be considered here under the following.

2.3.2a RANGE SYSTEM

In this system, the shelter is usually of simple construction. Wooden posts seave as the structural framework while the side covering is of wire mesh. The floor also consists of wire but it is however supported by slats placed 1 – 2 cm apart and raised about 1m off the ground.

Floor allowances pen binds is from 0.04 – 0.06 m^2. The roof can be of any of aluminium, galvanized iron sheet, strove or palm leaves and may be full span or lean-to. Laying nests are attached to the sides of the shelters while the drinkers and the feeders are attached to the building but, placed on the ground at varying distances. The shelter can either be fixed or movable and, should be rat, termite and a proof (Oluyemi and Roberts 1976 page 51).

The range system could be divided into two parts viz: (i) Open range (ii) Restricted range. In the open unrestricted with or without artificial shelter. There are no permanent buildings and partitions but the whole area is endorsed in a fence to ensure control and the protection of the birds from predators. In the restricted range however, chickens are partially accommodated in some form of colony houses, trap nests feed and water shelters. The area covered here is usually smaller in size than the open range and the degree of care is considerably higher. It is essential to note that, in the range systems (which is an extensive management system), the stocking density is low (Obioha F.C. page 107, 100).

2.3.2b THE FOLD UNIT SYSTEM

The fold units are gable shaped low constructions, which are of timber structural members. The dimensions vary but the floor area is usually about 1.2 x 1.8m. The two slanting sides are covered with – mesh for about 2/3 of the length while the remaining 1/3 is boarded to form a shelter. Where the unit is used to house layers, that boarded section is equipped with nests on one or both sides of the long run. The floor is also of wire mesh and is in direct contact with the ground with the feeders and drinkers placed inside the unit. It should be noted that birds here are subjected to greater restriction than those on the range (Oluyemi and Roberts 1979).

THE DEEP LITTER OR BUILT-UP LITTER SYSTEM

The deep litter system consists of a fixed building having suitable litter material spread on the floor. The deep litter house is variable in size, but one with a capacity of 2000 – 3000 birds, depending on the ages of the birds is economical, larger sizes may be used with skill management. The floor of the deep litter house is usually divided up into pens along the length with a central gangway running the length of the house. The deep litter houses requires two stores viz: (i) Store for eggs and (ii) Store for feeds, which could be located centrally in the house, but usually best located in a separate building. An estimated floor area food feed stores of $36m^2$ for 1000 layers is recommended (Ibid, pages 54, 55). The litter materials may be straw, wood shavings, cereal husks or any suitable absoncent materials, which is capable of slow decomposition and will eventually form a rich, friable and loose manure mixture. Most broilers, brooders, breeders and some commercial layers are raised on litter (Obioha, year 1978).

By way of further elucidation, the floor of deep litter houses can be constructed of rammed earth or concrete. It is however preferable to use concrete in the wet tropics. Nesting boxes and breeding creeps are required in the house as are water and feeding troughs, which are best suspended above the litter. If runs are provided it can be used as semi-intensive house (Williamson and Payne 1978 page 625).
In some design of deep litter housing, movable perches, drinkers and feeders are used so that, as far as possible, the control of the distribution of droppings and water splashing is maintained.

Also, under the system, birds require about 0.27 – 0.36 of floor space per bird if the litter is to work properly. Automatic feeding is more usual and there are now several system for automatic egg collection, greatly reducing the labour cost. (Samsbury & Samsbury 1988)

2.3.2c THE WIRED AND SLATED FLOOR SYSTEM

The fundamental difference between the deep litter and the wire floor system is the materials, wired to cover the floor. Instead of the litter materials, wired mesh is used to cover the cemented floor at a height of 0.6-0.9m above the cemented floor, so that

droppings are accumulated directly on the contact with the droppings. In this system, the problems of litter management are avoided but this may cost higher initially (Oluyeme and Robert 1970). This system has however been a failure with and excessive number of floor eggs which are lost. Extreme behavioural problems can also be created, probably by the boredom inherent in a system such as this allied to the very close proximity of a large number of finds. Nevertheless, in some areas of the world, it is still a very popular form of the housing, especially in the North East of the U.S.A which is an area climatically not dissimilar to western Europe where it has lost its popularity (Samsbury 1988).

2.3.2d THE STRAWYARD SYSTEM

The difference between this and the drop litter system is that the material used for the wall is straw. The system also permit greater access to sunlight. The risk of fire outbreak should discourage the use of this system (Oluyemi and Robert 1979 page 60). However, in the comparism of the results with those from girds kept in multi bird cages in a full controlled environment house, it has been found that those kept in a straw yard performed as well (Samsbury and Samsbury 1988)

2.3.2e THE CAGE OR BATTERY SYSTEM

This system appears structurally closer to the wired floor than any other of the intensive systems. In the cage system, the birds are housed in individual compartments each accommodating a limited number of birds mostly one or two. The individual cage compartment is the basic component unit of the cage system and it is essentially a laying nest with a slopping floor and feeding troughs. The consumption is done to permit ventilation from all the sides. Usually the side, top and floor are constructed of heavily galvanized iron. The front, back and depth are on the average 0.45m, 0.575m and 0.45m respectively, which the sloping floor extends forward and folds gently to form the cradle from which the eggs are collected. It is necessary to note that variations exists in the front widths of the individuals compartment and correspondingly the numbers of birds the compartment can accommodate. The front width range from 0.225-0.250m for capacities of one bird, 0.30-0.38m of two birds and 0.425-0.45m of three birds. The underlying principle controlling the front length of the nests and the number of cages that can be accommodated being that the front

length should provide enough feeding and drinking space for the the birds. It should be noted also that other dimensions of the cage (height and depth) remain constant, regardless of the capacity of the nests (Oluyemi and Robert 1979 page 6-64).

Although there are many types of cages which can be used, they however fall into three major groups viz:

(1) vertically stacked cages

(2) Californian or stair step often called the deep put system

(3) Flat deck cages.

In the vertically stacked cages the cage are laid one on top of the another, in tiers of three to four and are mostly cleaned mechanically with the end of a scrapper, a plastic belt or occasionally using disposable paper belts where the tiers go beyond four, cat ladders are used to service the top tiers. In the Californian arrangements, the cages are staggered or stepped so that the droppings go into a large pit under the cages and can be built up right through the laying cycle when they are cleaned out by a tractor and gone loader. Flat-decked cages are arranged horizontally on the same level on a raised platform such that the fall into the dropping pit beneath.

Adequate passageways between rows of tiered cages are very important for ease of all procedures. In any system of cages disposition, the passageways serve to some extent as the means of distributing the air, to the birds and wider passage ways contribute to the maintenance of a uniform, draught free environment (Samsbury and Samsbury 1988 page 308).

Furthermore, this is the probably the most efficient system as egg production and feed efficiency are high in birds housed in battery cages.

2.4.0 FISH FARMING AND AGRICULTURE

A very ancient method of catching fish involves driving the prey towards a beach and closing off the area with a wall of mud or stone or with a wicker fence. Netting was later employed for this purpose, and today fisher men are experimenting with air-bubble screens and electrics fences for restraining fish in bays or fjords. By this

method, the catch can be kept alive if not needed immediately. There are definite limits however, to the length of time a captured fish can survive, lack of oxygen, unfavourable temperature, and disease are the main hazards. In fresh water, fish may be stored in mesh bones that floats or hand near the landing place in a lake or river. When large quantities of fish must be kept alive, they may be confined in temporary cages of netting or wire. Small quantities are stored in baskets or keep nets similar to used by sportmen.

Fish may be stored in order to comply with market regulations or to stabilize supply. In some cases fish caught in polluted waters may be transported to clean water to allow them to rid their bodies or readily excretable pollutants. If the fish are stored for some time, they usually lose weight, although some success has been achieved in feeding stored catches. If the fish do not eat and are kept under good conditions, they often gain weight faster than under natural conditions. This of course, amount to a primitive form of fish – farming.

2.4.1 FARMING AND REARING HATCHERIES

Fish farming as originally practiced involved capturing specimens and then raising then under optimal conditions in which they were well fed and protected from predator and competitors for light and space. Camp have been raised in ponds for several thousand years in China and India. Other species were cultivated before 1400BC, as Egyptian drawing attest. It was net until 1733 however, that a German farmer successfully raised fish from eggs that he had artificially obtained and fertilized. Male and female frout were collected when ready for sprawning. Eggs and sperm were pressed from their bodies and mixed together under favourable conditions. After the eggs hatched, the fish fry were taken to tanks or pond for further cultivation. Methods have also been developed for artificial breeding of salt water fish and it now appears possible not only to rear sea animals but to have the complete life cycle under hatchery control. Some authorities have claimed that farming the edges of the sea could solve the protein and hunger problems of the world's growing population, but salt water fish – farming has usually emphasized the higher priced and luxury varieties such as Lobster, Shrimps and Oysters.

2.4.2 CARP

Carp raising, practised worldwide is a good example of advanced techniques, for the whole life cycle at last three different types of ponds are used in Europe. Special shallow and warm ponds are rich vegetation provides a good environment for sprawning, a process which today is often aided by hormone injuctions. After sprawning, the parent fish are separated from the eggs and taken to a second pond. The fry, which hatch after a few days are transported to shallow, plankton-rich nursing ponds, where they remain until the fall of the year or the next spring. In tropical areas, such as India, Carp sprawned from wild fish can be collected by experts in natural waters. To collect eggs or fry from wild fish is disadvantageous, however stocks in a desired direction. In Asia, therefore, the fry of common or golden carps are generally bred under culture conditions in hatcheries. Bigger ponds are needed for rearing the fish in the second year of life. There are large carp ponds in Czechoslovakia, which in Asia common carp are often cultivated in rice field, a practice called Wetland cultivation. This method is increasingly yiepandized by sprays used to control pestsund diseases and by toxic agents resulting from industrial development. For feeding carp in ponds, soybean meal, rice bran and similar agricultural products are used. Concentrated food in the form of pellets has been successfully introduced. During the winter season in the temperate zone, the carp are kept in deeper winter ponds with a dependable flow of water to protect them against freezing. In central Europe, carp used ready for the market after the third summer.

In southern Europe, Hungary and Yugoslavia, carp may be sold after the second summer. In tropical areas, the fish grow even faster. To accelerate growth, warm-water ponds now exist in the temperate zone. The first experiments of this sort showed that carp could be kept in small Aquarius with a permanent circulation of warm water of 23^0C (73^0F). Under these conditions they grow rapidly attaining a marketable size and weight after two years. Similar results were obtained in warm-water ponds fed by heated industrial waters. In the temperate zone an average harvest of 400 – 500 kilograms per hectares is normal intensive cultivation of carp. By scientific management and careful selection, it is now possible to obtain yields as high as 3,500 kgs per hectares for carp in warm-water ponds. Other fish, such as the Chinese grass carp, may be similarly raised in ponds, as are decorative species, such

as golden and silver carp. Eels, once raised in ponds of medieval European monasteries, are sometimes cultivated together with carp.

2.4.3 TROUT

Although trout was the first to be artificially fertilized, trout cultivation in Europe and North America is much younger than Carp cultivation. Trout are cold-water fish and must have a constant supply of sufficient oxygen, making cultivation more difficult. Though trout ponds can be smaller than carp ponds, good year-round water circulation is essential. Trout farmers are therefore often treated in mountainous areas where plentiful pure water is available. The young fish are obtained exclusively by artificial fertilization; thus, hatchery buildings with low-temperature fountain water and good filters are the centres of this type of pond fishery. Here the eggs are kept under control during breeding in special small tanks. As soon as the hatchery fry can swim and eat on their own, they are transplanted to reaming ponds for feeding.

Trout are carnivores; meatpacking by-products are used for feed. Formerly, these and similar products were also used to feed more mature trout. Originally, a special refrigerated feed house for keeping and cooking the food was the second main building typical in trout farms. Dry fodders is now preferred, however, and synthetic pellet-type feeds have been developed that required no refrigeration. Such food may be released into the ponds at predetermined intervals by automatic compressed-air dispensers. Though many authorities claim that trout should have as much natural foodstuff as possible and therefore should be raised in natural ponds only, in many countries rearing is done in concrete-lined ponds or concrete tanks, which are easy to keep clean and permit disinfectant application. The length of time necessary to rear fish and the yield per hectare depend on feeding. Some trout farms not only sell their fish fresh and frozen but also smoked and filleted.

For trout a new system of fish cultivation has been introduced, instead of ponds, enclosures of netting or other materials are placed in natural waters, such as lakes, and also in brackish waters. By this means, areas formerly of low value can be farmed intensively. Farming trout in brackish or seawater was of especial interest since the period preceding World War II, trout farming in seawater has grown tremendously.

Keeping trout and other fish in such cages is much easier, construction costs are far lower, and surprisingly dense population can be raised.

Many other fish are raised artificially by various methods. Among these are salmon, sturgeon, milkfish, mullet and tilapias.

2.4.4 BASIC REQUIREMENT FOR FISH FARM

FISHERIES

INTRODUCTION

Fish farming is the rational cultivation of fish in a confined water area of where the practices of both agriculture and animal husbandry are applicable.

FOR ANY SUCCESSFUL FISH FARM

All these must be considered.

i. Land
ii. Water resources
iii. Good soil
iv. Desirable vegetation
v. Labour

i. LAND

A good site has the following qualities.

a. Land with gentle slope

a fairly sloppy land is ideal about 2.5.1

for light soil and 4.1 for fairly loose soil.

ii Desirable Vegetation

Thin forest must be avoided as much as possible to reduce cost of pond construction.

iii Good Sold

A good sold must be able to hold enough water in both dry and rainy seasons. It must therefore contain a minimum of 20% clay and maximum of 60% clay.

iv Good and Reliable water source.

Water is very important in fish culture. Water

The quantity and quality of the available water is important. There must be water available all year round.

The critical need of a good fish pond are

a. Good quantity and quality water
b. Good quantity and quality fish fingerlings
c. Good quality and quantity fish feed
d. Adequate security.

2.4.5 TYPES OF FISH THAT CAN BE CULTURED IN NIGERIA

The following are the recommend culturable species in Nigeria.

FRESH WATER

COMMON NAMES	SCIENTIFIC NAMES
Tilapia	Oreochromis nilotius
	Tilapia guineansis, melanopleura
Common carp	Cyprinus carpio
Mud cat fish	Clarias gariepinus
Hybrid cat fish	Hybrid clarias
Spotted cat fish	Synodontis Tilamentosus
African bony – tongue	Heterotis niloticus
Trunk fish	Gymnarchus niloticus
Niger perch	Lates niloticus
Moon fish	Citharinus citharus.

BRACKISH WATER

COMMON NAME	SCIENTIFIC NAME
Millet	Mugil cephalus, mimfil
falcipinus	
Tilapia	Tilapia guineansis and
melanotheron	
Tarpon	Megalops atlatinus
Tenpounder	Elops lacerta
Grey cat fish	Chrysichthys nigrodigitatus
Red snapper	Lutjanus SPP

Qualities of a good culturable fish species

1. Fast growth

2. Accepts supplementary feed
3. Resistance to disease
4. Tolerance to poor water quality
5. Must be popular and marketable within the community
6. Easy to breed in captivity.

2.4.5b SOURCES OF FISH FEED NUTRIENTS.

NUTRIENT	SOURCES
Protein	Fish meal, fish silage, groundnut cake
	Soya bean, meal, ox-blood.
Carbohydrates (Energy source)	Corn meal, millet, wheat bran, rice bran, cassava.
Lipids (Flat)	Fish oils, palm oils, coconut oil, palm kernel oil.
Vitamins	Vitamin premin, vitamin C
Phosphorus	
Potassium	
Calcium	Fish meal, fish silage
Sodium chloride	Common salt.

HOW TO GET GOOD QUALITY FISH FINGERLINE

1. All state fisheries division of Ministry of Agriculture and natural resources
2. National institute for fresh water fisheries research New Bussa Niger State.

2.4.6 HOME STEAD FISH POND CONSTRUCTION AND MANAGEMENT

2.4.7a INTRODUCTION

A homestead fish pond is defined a any structure or tank which is made of either concrete, earth metal or plastic, built or sited within the vicinity of household for the purpose of rearing fish or its related kind. The size and shape of a homestead fish pond varies from $10.m^2 - 232.5^2$ (50 x 50).

2.4.7b ADVANTAGES OF HOMESTEAD FISH PONDS

i. Very easy to manage and maintain
ii. Productivity is very high when adequately managed
iii. Direct access to healthy, fresh , clean and line wherever it is needed.
iv. Grow fish to any desired size within a specific period.
v. Could be used as a storage pond for live fish
vi. Production cost is very low/low capital investment .
vii. Two or more species of fish can be grown in the same pond.
viii. Fish can be integrated with livestock in the pond
ix. May serve as a part-time job or lobby .
x. May increase the family income.

2.4.7c HOMESTEAD FISH AND DESIGN AND CONSTRUCTION

Although certain well-defined guideline do exist for fish pond construction, it is mainly the topography of the site which determines the basic design of the pond. Certain basic principles are however necessary when selecting a site and deciding the method of pond construction.

2.4.7d SITE SELECTION

The following are essential factors guiding the establishment of a homestead fish pond

i. Topography /land space
ii. Source of water
iii. Material/fund availability
iv. Hired or family labour

2.4.7e TOPOGRAPHY

It is very economical and convenient to construct ponds in areas that are accessible, so that there may be any difficulty in the transportation of input materials and in the marketing of the produce. The labour and material required for the construction and operation should be locally available. For efficient management, the pond site should be within the site of the farmer. This reduces the risk of peaching. Sitting the pond

near the other agricultural or livestock farming activity makes it possible and easier to integrate all the farming activities.

2.4.8 (c) SOURCE OF WATER

A dependable source of water supply must be available within or near the site. However ponds require sufficient water to fill the ponds and to compensate the water loss through seepage and surface evaporation. Water for fish pond could be obtained from any of the following sources.

i. Rain water (Run-off from the roof of the building)
ii. Well-tube
iii. Borehole
iv. Water tanker
v. Tap water
vi. Spring water/stream river/reservoir/lake etc

If a pond is to be sited within a household, it should be located as near possible to the building, to enable the run-off water from the building to be directed into it. However, if the pond is to be sited far away from a building, then water should be supplied by water tankers, boreholes, tube well etc.

2.4.9 PROCEDURE FOR CONSTRUCTION HOMESTEAD FISH POND

2.4.9a LAND CLEARING

This involves the clearing of bushes, grasses and other vegetation in the selected site as well as felling of tree and the up – rooting of stumps, grubbing and burning of materials.

CHAPTER THREE

3.0.0 RESEARCH AREA.
APPLICATION OF SOLAR ENERGY IN FARMING ESTATE

INTRODUCTION

History has shown that the worship of the sun by the people of the past illustrates their understanding of the importance of sunshine to life.

Thus, in recent times, advancement in technology and the accompanying disappointments has persuaded us to reconsider our relationship between nature and technology. There is a growing conviction that progress will come mainly from technology, which is harmony with nature.

The growing interest in "natural energies" explains this shift in altitude. Architecturally, buildings, utilizing the sun sunshine in winter and shading from the sun represent this point of view. This approach to architecture requires an understanding of the natural world, central to this understanding, is the relationship of the sun and the earth.

Hence, this chapter is outlining the thesis problem seeks to define the meaning, concept, planning procedure of active solar energy planning in a farm estate. Little passive solar may just be applicable as regards the climate (tropical) of the proposed project.

3.1.0 PROBLEM STATEMENT.

Energy is basically defined as the ability to do work. This ability is usually found in form of potential energy (energy by virtue of its position). From this introduction, it can be seen that this ability to do work gets across all terrain of living and thus the type of energy applications vary from place to place. There is quite a vast array of states which potential energy is found, wood fuel (locally called firewood), farm waste (biomass water, wind, fossil fuels and food as well, to mention but a few. Now,

in tapping these resources some suffer severe depletion, others result in environmentally adverse conditions and yet others in the manipulation process result in or produce unacceptable by product and side effects.
At this stage, it will be necessary to note that from the above-mentioned forms of potential energy, it will be seen that over 90% of them have to do with power generation. This makes power generation a prime focus in energy issues. However, a solar test for regular solar power generation for the industrial farming estate will serve as the main stay of this study.

Within the content of this study, Nigeria is used as the focal area. Hence, there exist an under commercial and non-commercial (traditional) sources. Now, about 75% of the national population is rural implying that the heavier side of energy consumption is on the non-commercial types (such as biomass used fuels, farm wastes). Regardless of this, quite some amount of commercial energy is handled and distributed by the national power generating and distribution body via its sources like Kainji, Jebba and Shiroro dams, Egbin, Ijora thermal status to mention a few primarily to the urban dwellers and the rural. Combined power output at full operation of these power generating stations and outlets stands at roughly 6028mw of which only about 2470MW is needed to serve the 38% of Nigerians that this power distribution covers------ and for even that percentage, many consumers still do not get regular supply of electricity thus depend on a lot on "alternative". Lot of energy is lost through the likes of wrong choice and application of power generation, inadequate distribution infrastructure (technologically and financially) environmental natural dictates and factors. And of course the extremely centralized and monopolistic nature of the power generation issue, which is a defect closely, related to that of managerial incompetence. Inadequacies that introduced a series of "lapsea" in one's daily/regular routine which really should not be. These inadequacies are what led to the very feared not energy crises, not just in itself but also in its attendant applications.

To include it all, the mostly depending of energy through electricity (as the major sources of energy in Nigeria is infact a slap to modern days technologists and a greater problem to development. Nigeria are loosing many billions every day

in our economy through the persistence inadequacies of electricity per everyday in many, industrial, commercial and houses. Many other are the problem of petrol, diesel and kerosene sometime ago in the country.

Considering all this information there should be a change through technological advancement that are bellowing everywhere nowadays toward the millennium where application of solar energy could be put to test in the farming estate. As part of the reawakening of the third world country in which Nigeria is among the front line in Africa.

Hence, solar energy, a renewable energy is associated with more benign environmental impact and long-term energy security. Also the state of development of a country is related to her per capital energy consumption of a country the more development the nation is.

3.1.1 INSIGHT

By the law of conservation of energy "everything must go somewhere. Energy is thus basically transforming the potentially found to the kinetically application and thereby evolving deriving and actualizing 'work' Energy types are myriad (practically speaking) but however full under a defined series of potential energy forms that are all direct or indirect derivatives of the singularly major source of energy for this planet. The sun better understood as SOLAR ENERGY. Solar radiation impacting on the ear6th leads to wide reach of phenomenon from which energy is very much obtainable in virtually all cases. Through discoveries, invention and construction, we are able to collect and redirect solar energy to our human purposes. The sun heats the earth's atmosphere and land/water surfaces, water evaporates, air circulates, and rivers flower lighting sparks, the tides rise and fall. Plant chlorophyll absorbs photons and retains or transmits the energy to other chemicals (in form of decayed plants and animals) into peat, coal, petroleum, shale oil motion or heat into yet other lands of energy electricity, light, sound, magnetism and food.

3.1.2 TAPPING SOLAR ENERGY

The sun is a colossal fusion-furnace that pours out impossible quantities of electromagnetic radiation by-products of its yearly self-fusion of 140 trillion tons of its own mass. Each second 4-million tons of H+ is converted to helium and by product radiation amounting to a continuous $3.8x10^{23}$ kW is emitted; this is an almost incomprehensible amount of power and fortunately the earth plots an orbit with a rather safe radius from this power plant; of the amount of electromagnetic radiation that reaches the earth roughly 50% is reflected back into space or absorbed by the atmosphere. With a couple of further losses approximately 45% accesses the earth's inner sphere. This quantity that penetrates into the earth's atmosphere is what is generally termed as solar energy.

Energy from the sun is absolutely and totally non-dependable (100% renewable) and inexhaustible thus it becomes an option that is constantly looked at for harnessing in power generation; and even in the tapping of this sources, there is absolutely no by product thus making it a very environmentally benevolent energy source.

Solar energy is used directly by employing either photo thermal devices which convent the solar energy to heat that can then be used in a variety of ways: cooking, space heating, air conditioning, cooling lighting e.t.c.

Photovoltaic cells, which generate electric currents when struck by sunlight in both cases, the collector converters are made of silicon (an element that produces electricity when exposed to light). There do exist set backs with solar energy, few though the initial cost of the unit is one although modernization of the manufacturing process is set to check that technology is only able to convert 15% of the sun's radiant heat to useable work so that a typical large electric generating station capable of producing 1000 mw would require an array of heat collectors – converters of an area of at least 11m/2 (28 km^2 approach) thus space gulp is another causes for thought although this is about the same area needed for a modern nuclear plant (mainly for safety reason) and less than the land that would have to be strip mined to provide fuel to a coal- fired plant of the same capacity for its expected lifetime.

3.2.0 THE MAIN RESEARCH AREA.

SOLAR ENERGY AWARENESS AND DATA INFORMATION.

Due to the Electro-mechanical nature of the project, it will be a great value to give some general view of the technicalities involved as to comprehend the design.

Generally, in designing of solar panels, certain condition and standards need to be adhered to for a better result. Among the criteria are;

3.2.1 THE SUN

The sun being the main instrument of attaining solar powered electricity which is the only practicable application of this source of energy in the tropics is a huge nuclear fusion reactor in which light actions are fused into reviewer atoms and in the process, energy is released. The reaction occurs only in the interior of the sun while the radiation reaching earth however is emitted from the sun's surface.

The amount and composition of solar radiation reaching the outer edges of the earth atmosphere are quite unvarying and are called the solar constant. This varies widely with the sun angles and the composition of the atmosphere.

3.2.2 DATA COLLECTION

This involved the collection of climatic data for the site (Kuje allocated plot for farming, Abuja).

These include outdoor air temperature, humidity, wind speed and directions, hours of sunshine, cloudiness and precipitation.

3.2.3 BIO CLIMATIC ANALYSIS

This is the determination of a thermal stress and comfort condition using any of the thermal indices. The aim is to determine the nature of thermal stress, which are functions of humidity, rainfall e.t.c. as above.

3.2.4 SOLAR GEOMETRY

The bio climatic analysis would have shown us when in the year there is thermal stress and how it should be relieved, either cooling or heating, as seen in the local and various case studies. In each case, the position and movement of sun of the print must be known. This will allow the sun shading devices of the proposed farm estate design to block the sun and prevent over heating on one hand or provision of means of harnessing solar energy for space heating on the other hand. Solar geometry was determined using graphic method (sun path dags), instrumental method or computer programs.

3.2.5 THERMAL ANALYSIS.

This is the analysis of the heat balance of the building. The analysis is first done based on climatic and site data the produce sketch design guides. The performances of the necessary changes and at the end the trial analysis done to confirm the performance of the building. There are several methods for animal heating load calculations. The traditional method uses the degree-day and the total building leaf has per day. Another method is the solar load radial (S & R) and the computer programs.

3.3.0 THE CHOICE OF SOLAR ENERGY TO APPLY

The choice of passive or active solar or conventional system of heating or cooling based on many factors such as client's demand, cost effectiveness, fashion, tradition, availability, maintenance, being independent and durable etc. If a solar system was chosen, then several questions involving these have to be answered.

1. Device, efficiency, air or water system position and size of collectors type and size of storage, auxiliary heat supply and manual or automatic control.

3.3.1 THE INTEGRATION

The integration of choosing the system into the farm estate will cause a change in the existing thermal balance. New calculations need to be made that it can bring out back to the thermal analysis stage.

3.4.0 PHOTOVOLTAIC SYSTEM OPTIONS.

Photovoltaic (PV) systems take many forms. Source involve storage of current not immediately needed, others do not. Some are equipped with the devices to regulate the flow of current. Others have no such devices. Some use inverters to convert DC output into AC power. Others are used only with equipment capable of operating on direct current, some are linked to the utility grid and interact with it. Others stand-alone. The options are quite varied.

The advantage and disadvantage must be derived to know the best suitable one that will be applicable.

3.4.1a DC STAND- ALONE SYSTEMS.

This is the most basic means for application of electricity to a load. It is a remote electrical system designed and dedicated for a single purpose, where the output of the array is delivered directly to the load with no storage and control or regulation. This type of system will typically power a load that requires power only when light (sun) is available. Most P-Powered consumer product such as calculators and water-pumps use this approach.

F16: A – show schematic of different complimentary of array connections.

Array – 0 load

↓

Array – D-load battery

↓

Array – D-load battery.

Fig 3

3.4.2 AC/DC SYSTEMS

This is a system that offers the AC option as well as a supply of D-electricity. This system like the one first discussed (as consist of P-arrays, a voltage regulator and storage batteries). The view element is a D to AC inverter. Note that the system between 500-1500 peak watts of array output.

Shows schematic for AC/DC (SOLAR ARRAY) system.

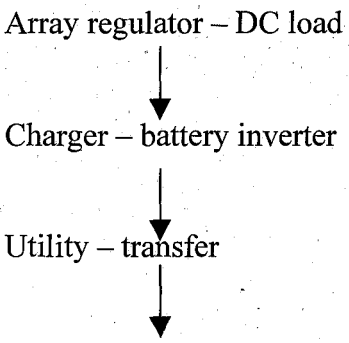
1. Inverter – AC load
2. Array regulator – DC load batteries.

The inverter is integrated between the array regulator batteries and the AC load. The DC load (where applicable) is still served by a direct supply current from the array batteries.

3.4.3 UTILITIES – INTERACTIVE (U) SYSTEMS

The traditional utility – interactive (U) PV system is one in which electricity is brought in from the grid to supplement the
Systems output when needed and sold back to the utility when the PV array's output exceeds the on-site load demand.

Below depicts a transitional system, one that does not completely stand alone power from the grid is substituted for gen.-set as an auxiliary source of electricity.



3.4.4 SCHEMATIC OF U (PV) SYSTEM.

In this hybrid system, we still have a DC load, served as before by direct array output and electricity stored in the batteries. And as shown in the SA systems, AC loads are served through and inverter that processes DC output and the level of battery charger at low, power from the grid comes in to make up for short fall. The utility sufficient power flow to DC side of the system through the battery charges. A sample transfer

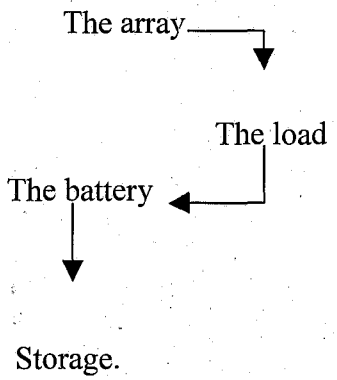
switch disconnects the inverter allowing the utility power to handle the AC load directly.

3.5.0 SELECTING OR CHOOSING A PV SYSTEM.

From the definitions of the two basis PV systems, we have one would be able to ascertain the capacity of the project on the aims, intention of the farm estate, the requirement in focus, the option most appropriate and for a particular applications.

3.5.1 STAND-ALONE PV SYSTEM

Is one that is entirely self contained even though it may be supplemented by an emergency BACK UP system. As it is represented in a closed triangle below.



3.5.2 UTILITY – INTERACTIVE P SYSTEM

By contrast is one in which the need for on site storage is precluded by the system connection with the local utility grid (NEPA). The utility not only takes the place of battery storage in such a system, it also serves as a constantly available source of back-up power. Systems in which the kW meter runs backward (either literally or figuratively) to show sales of excess electricity to the utility are utility interactive.

3.6.0 EFFECTS OF ARRAY ORIENTATION.

There are basic two ways to position P modules. It can also be mounted through a FIXED equal to the horizontal. It is very glaring that tracking makes greater array output. The addition of power gained is not the complexity and expense inherent in a tracking system.

In a small of three to six system, get any optimum output, a P system receive or tap the best energy when it is properly tilted and directed rightly. It should be oriented toward TONE SOLAR SOUTH OF THE NORTH for maximum output.

As the location is far toward the north, the more important true south orientation.

3.6.1a **ALTITUDE ANGLE:** the angle formed between a horizontal surface and a line connecting that point with the center of the sun.

3.6.1b **A 3 1 MUTH ANGLE:** the angle of horizontal (east or west) deviation if the sun's position to true south

3.6.1c Photovoltaic modules are never mounted horizontally (except perhaps at or near the equator), only to be tilted at an angle from the horizontal in line with the site latitude.

Comparing the horizontal and the tilted, the amount of insulation striking on the tilted surface will be greater than the horizontal.

The formula calculating the amount of total tilted insulation (I) at a particular site using horizontal data

$$I = \frac{\text{Total horizontal insulation}}{\text{Cosine of (latitude x 0.85)}}$$

Angle of tilt	angle of tilt
Dry season	Wet season.

3.7.0 **SIZING AN ARRAY *HOW TO**

STAGE ONE

Determine the average daily load by multiplying the load current in amps.

(A) Average hours of daily use = h

(B) Knowing the amount of energy in Amps and voltage being released per day.

= Current = Amps (A)

Volts = (V).

Now to determine the average daily output of a module = A x h

= Amp - hours.

3.7.1 SIZING

Sizing a system means determining how much energy is required and how many solar modules are needed to generate it.

A solar system must provide enough energy to replace that being consumed daily kW by the loads (lights, appliances and equipments) plus some to compensate for energy used by the system itself.

Two things to know before system sizing:

i. HOW MUCH ELECTRICITY WILL YOU BEING USING

ii. HOW MUCH ELECTRICITY A SOLAR MODULE WILL PRODUCE

3.7.2 CALCULATION

3.7.2a HOW MUCH ELECTRICITY WILL YOU BE USING?

Calculation:

This can be calculated for every load and then add the result together.

Electrical use is figured in terms of watt – hours. This is the appliance's power rating (Watts) multiplied by the average amount of time (hours) it operates daily.

In addition to the electricity used by appliances, the system itself also consumes some power (about 30% loss) e.g. all energy utilized/stored in the battery cannot be gotten all.

An inventor uses some energy to convert electricity from DC to AC; and voltage is lost as electricity travels through wires. A factor to allow for these needs is included on the sizing worksheet.

3.7.3a DAILY DC REQUIREMENTS

DC Load (Watts)	Appliance	W x h	=	Wh
Multiply by average daily use	Fluorescent light	13 3	=	39
(Hours).	Television	45 3	=	135
	Fan	20 4	=	80
= Add to find average daily DC energy uses				254
+ Allowance battery and system losses 30%				76
= **Average Daily DC Energy Requirement**				330 **WH**

3.7.3b DAILY AC REQUIREMENTS

AC Load (Watts)	Appliances	W x h	=	Wh
	Power tool	500 0.25	=	125
	Computer	40 3.50	=	140
	Stereo	35 2.00	=	70
= Average daily AC energy use				
+ Allowance for battery/inventor and system losses (40%)				134
Average Daily AC Energy Requirement: -				469

3.7.3c

DAILY POWER REQUIREMENT **BATTERY SIZING**

Total average daily AC and DC Energy Requirement: 799

x 5

799 Daily Power Requirement

2 Reserve factor multiply (1) by

The No of days that batteries must operates loads without solar change.

BACK-UP GENERATOR ADJUSTMENT

Total Energy Requirement $\frac{799}{220} = 3995$

To power the room using SM 55 module

Has a module power rating of 55 W

With area factor of 4 = 55 x 4 = 220

Hence $\frac{799}{220}$ = 4 Panels is needed.

DAILY WATT - HOURS PER MODULE

Selecting a module Wattage Rating and multiply

It by the installation site's area factor, the result is the Daily Watt-hours per modules.

3.7.3d TO ESTIMATE MODULE REQUIREMENT

Total Solar Energy Requirement Divided by

Daily Watt-hours per module.

3.7.3e BATTERY SIZING

Multiplying the daily power requirement by the number of days that batteries must operate loads without solar

Change = (5 day x 799) = 3995 + Safety factor

Reserve factor.

I.e. Safety factor = 30% of 3995 kWh/DA

= 5194 (Required battery capacity)

= 5194 KWh. (To convert to Amp.Hours, divided by voltage)

No. Of Battery: Using single cells with 2 V and 200 amp. Hours capacity

$= \frac{5194 \times 2}{200} = 51.94$

= 52 batteries.

3.7.5 ANOTHER EXAMPLE

A basic 5 system to illustrate the fundamental principles of the ampere - hour method of photovoltaic array sizing. A P system is required to power one 20-watt fluorescent lamp with 0 basket.

The fixture's power requirements are 1.8 amps at 12 volts (nominal) D. An average of 4 hours of light per day are required for seven day per week during late summer and early fall (August, September and October). Availability of power for this small load is not considered critical.

3.7.5a Step 1

Determine the average daily load by Load current in (Amp)

A x Average hours of daily use (h) = 1.8 x 4 = 7.2 Amps.h

3.7.5b Step 2

Determine the full sun or peak sun hour value to be used in the design since output will be required from this system only during late summer and early fall.

Selecting an array altitude mounting angle that is equal to site latitude $+ 20^0$ constant value.

The number of equivalent hours of full sun on a surface filted at an angle equal to the latitude during the months of August, September and October.

August	5 hours
September	4.7 hours
October	3.6 hours

The array can be size according to the average full sun figure of 4.4 hours.

3.7.5c Step 3 Determine the required array size

The array changes the 12 volts battery on sunny days when output exceeds the load on cloudy days and certainly at night the loan will exceed the array output and drain the battery. The array must then be sized to ensure that over the long run the balance is positive and the battery is more likely to be changed than discharged.

The array must be sized to deliver an average daily output equal to the average daily system load (including all internal losses) plus 10% to ensure that the battery will be recharged and the load will be served after a long period of no – sun – days.

Failure to realize this will affect the battery from being charged from its recharged conditions; hence after the daily load requirements are met there will be no surplus left for the battery.

This slight oversizing of the array is good design practice. However, since this is simple system and the load is considered non critical, one can argue that the cabin owner could just get along with a little less light for a while to allow the battery to regain its charge after a worst – case. A set of 1 V curves showing the effect of insulation intensity on the Mobil Solar RN 30 – 12 module period of no – sun days. After all the need for this slight inconvenience will arise infrequently.

Let's assume that in this case the owner understands these parameter and desires to save money, so we will add extra percentage to the array sizing. The array will simply be sized to meet the average daily load, which must include all the internal system losses in the wire runs and electronic controls.

The average daily output of a photovotaic array, calculated in terms of amp – hours delivered at the array's nominal voltage is the product of the number of (average) full sun hours times the actual peak power current (1m) at NOCT of one of the modules in the array times the number of modules in parallel. Or

In a brief formula way

$$\text{Array output} = 1\text{m} \times \text{full sun hours} \times \text{Modules in parallel.}$$

As we desire to size a photovoltaic array in this examples let's assume that the design to be used for sizing are.

Ra 30 – 12 modules manufactured by Mobil Solar Energy Corporation.

i.e. Ra 30 = 30 watt

= 12 volts of 30 watt.

The Ra 30 – 12 module is rated at 30 peak watts and is designed to charge a 12-volt battery. For our system's site which has an average daily ambient temperature of about 10^0C (50 f) the module's peak power current is 2 amps under full sun conditions. The average daily equivalent hours of full sun at this site are 4.4 hours.

= 2 x 4.4 = 8.8 amp hours per day.

3.7.5d Step 4

Select the number and types of modules in Step 1. The average daily load was determined to be 7.2 amp – hours. By delivering 8.8 amp. Hours a day a single Ra 30 – 12 module will satisfy this load with some power to spare. This surplus "Surplus" power will be enough to cover the internal losses in our system from the voltage regulator and wire runs.

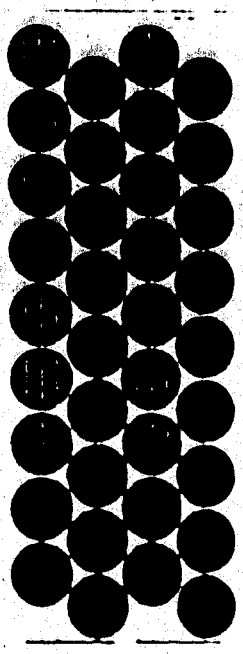
As it is noted before that batteries are considered 100 percent efficient in terms of amp – hours in versus amp – hours out. Higher voltage accompanying amp – hours in than the voltage at which they are taken out changing take place at 13 to 15 volts.

Discharging at 11 to 13 volts.

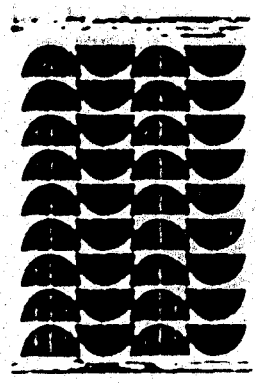
Thus the efficiency loss in the battery is compensated for by the PV module's higher operating voltage. Conclusively, a long no sun days does not delay the battery.

Therefore, it is concluded that an array size of 12 volt 30 – peak-watt module can take the fluorescent.

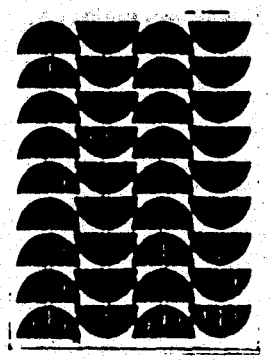
FIG 4



SR100/SR90



SR50-Z

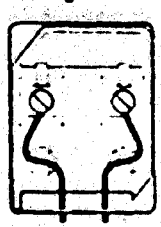


SR50

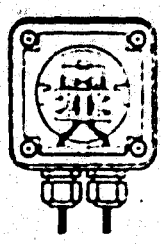
Module type		SR100	SR90	SR50-Z	SR50
Electrical parameters					
Rated power P_{max}	[W]	100	90	50	50
Configuration		6 V / 12 V*	6 V / 12 V*	12 V	6 V / 12 V*
Rated current I_{opt}	[A]	11.8 / 5.9	10.8 / 5.4	2.95	5.9 / 2.95
Rated voltage U_{opt}	[V]	8.5 / 17.0	8.5 / 17.0	17.0	8.5 / 17.0
Short circuit current I_{sc}	[A]	12.4 / 6.5	12.2 / 6.1	3.2	6.4 / 3.2
Open circuit voltage U_{oc}	[V]	10.8 / 21.6	10.8 / 21.6	21.6	10.8 / 21.6
Physical parameters					
Length A	[mm]	1498	1498	822	783
Width B	[mm]	594	594	597	594
Depth C	[mm]	40	40	41	34
Depth including terminal box	[mm]	56	56	–	56
Weight	[kg]	10.9	10.9	5.5	5.9
Interconnect Type					
Type of terminal box		CR	CR	S	CR
Mounting holes					
Hole distance D	[mm]	1463	1463	807	754
Hole distance E	[mm]	643	643	–	–
Hole distance F	[mm]	558	558	500	550
Performance warranty	[years]	25	25	10	25

Power specifications at standard test conditions: 1000 W/m² solar irradiance, 25°C cell temperature and solar spectral irradiance per ASTM E892. Data in standard sheet is for module fitted with our qualified Siemens solar diodes.
* voltage selectable via switch

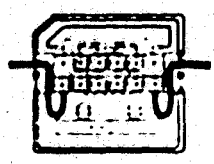
ProCharger™ S box



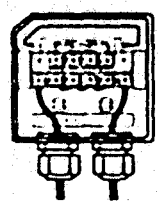
Sp box



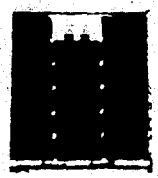
ProCharger™ CR box



ProCharger™ CR box

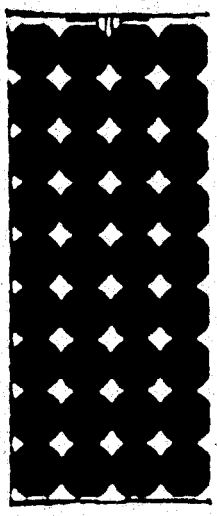


SO panel

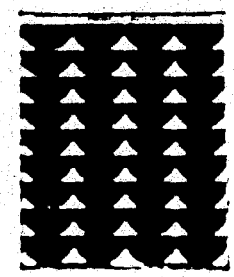


SM10

SM6



SP75/SP70



SP36

SP18

Module type		SM10	SM6	SP75	SP70	SP36	SP18
Electrical parameters							
Rated power P_{max}	[Wp]	10	6	75	70	36	18
Configuration		12 V	12 V	6 / 12 V*	6 / 12 V*	6 V / 12 V*	6 V / 12 V*
Rated current I_{MPP}	[A]	0.61	0.39	8.8 / 4.4	8.5 / 4.25	4.2 / 2.1	2.1 / 1.1
Rated voltage U_{MPP}	[V]	16.3	15.0	8.5 / 17.0	8.25 / 16.5	8.5 / 17.0	8.5 / 17.0
Short circuit current I_{SC}	[A]	0.71	0.42	9.6 / 4.8	9.4 / 4.7	4.8 / 2.4	2.4 / 1.2
Open circuit voltage U_{OC}	[V]	19.9	19.5	10.9 / 21.7	10.7 / 21.4	10.9 / 21.7	10.9 / 21.7
Physical parameters							
Length ⑤	[mm]	360	330	1200		633	633
Width ⑥	[mm]	330	175	527		527	275
Depth ⑦	[mm]	35	35	34		34	34
Depth including terminal box	[mm]	–	–	56		56	56
Weight	[kg]	1.8	1.0	7.6		4.3	2.7
Interconnect Type		⊨:	⊨:	▭		▭	▭
Type of terminal box		cable	cable	CR		CR	CR
Mounting holes							
Hole distance ①	[mm]	333	303	1177		607	607
Hole distance ②	[mm]	–	–	643		152	152
Hole distance ③	[mm]	287	132	483		483	232
Performance warranty	[years]	10	10	25		10	10

Power specifications are at standard test conditions of 1000 W/m² solar irradiance, 25°C cell temperature and solar spectral irradiance per ASTM E892
Detailed data sheets for all module types are available at your qualified Siemens Solar dealer
* Voltage selectable. Default setting 12 V

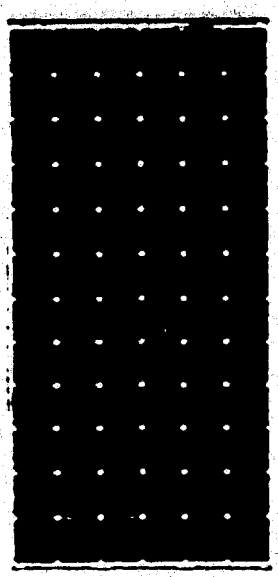
Legend

▭ 1 terminal box
▭ ▭ 2 terminal boxes
⊨: cable

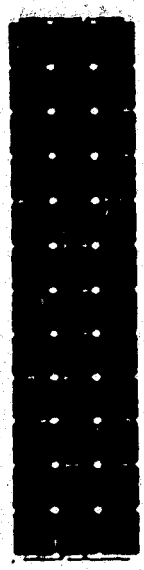
* Distance between mounting clamps

8

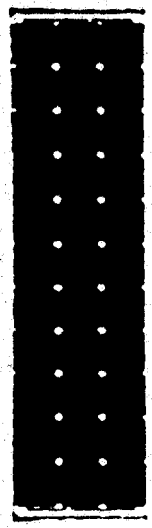
Fig 4



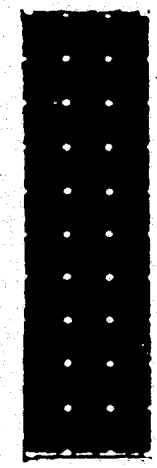
SM110/SM100



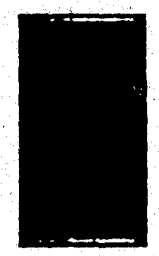
SM55/SM50



SM50-H



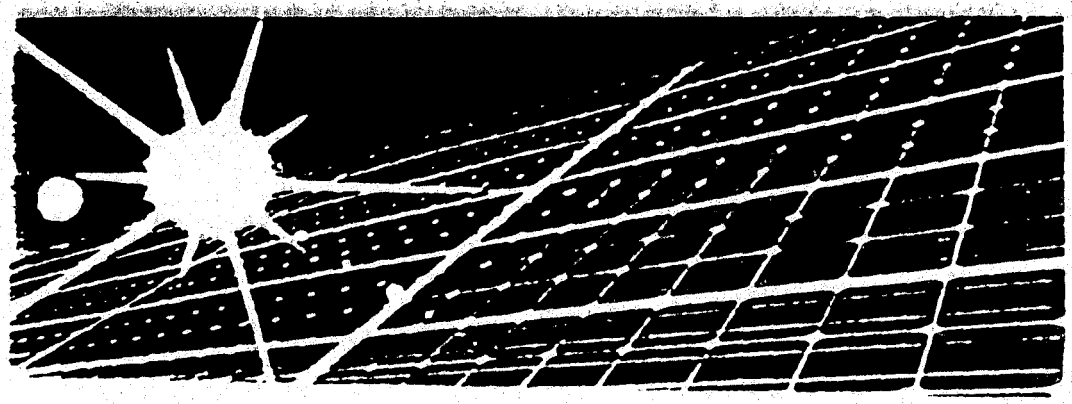
SM46

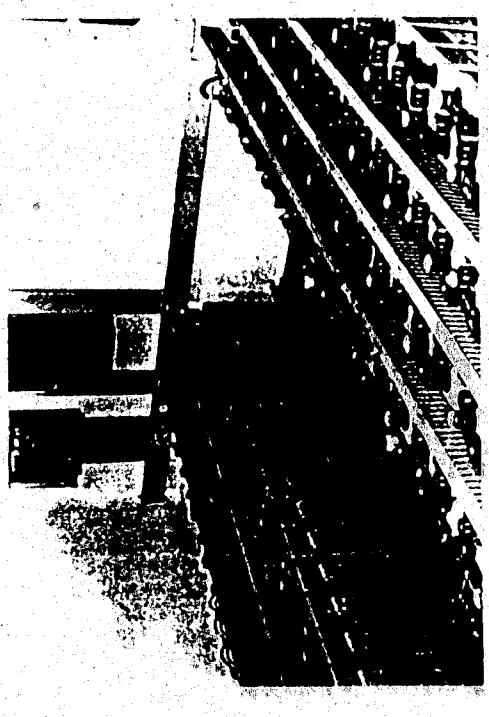


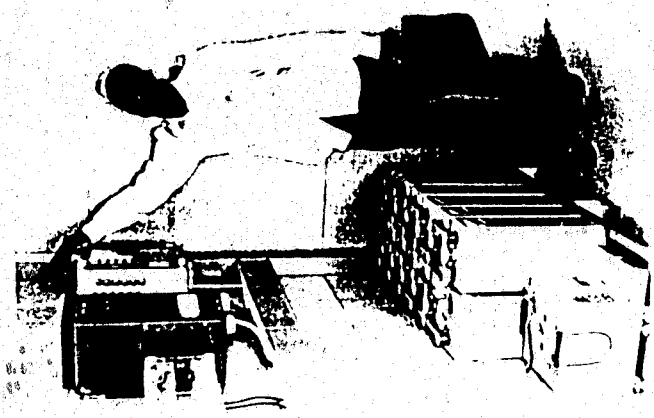
SM20

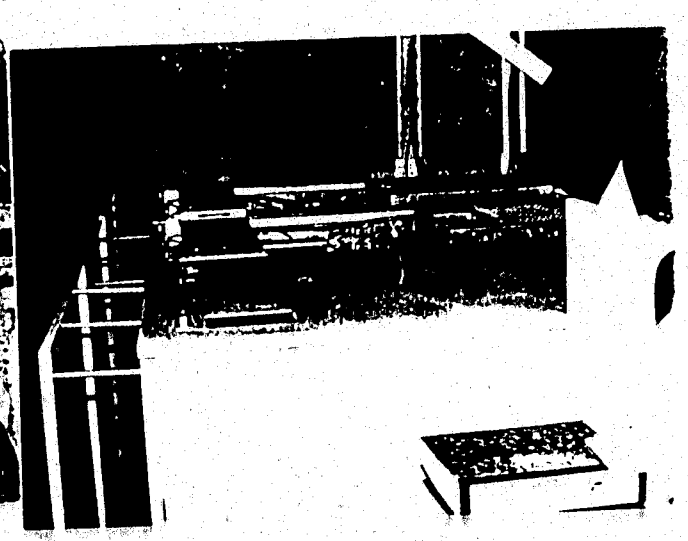
Module type		SM110	SM100	SM110-L	SM100-L	SM55/SM50	SM50-H	SM46	SM20
Electrical parameters									
Rated power P_{max}	[W]	110	100	110	100	55 / 50	50	46	20
Configuration		12/24 V	12/24 V	12/24 V	12/24 V	12 V	12 V	12 V	12 V
Rated current I_{pp}	[A]	6.3/3.15	5.9/2.95	6.3/3.15	5.9/2.95	3.15 / 3.05	3.15	3.15	1.38
Rated voltage U_{pp}	[V]	17.5/35.0	17.0/34.0	17.5/35.0	17.0/34.0	17.4 / 16.6	15.9	14.6	14.5
Short circuit current I_{sc}	[A]	6.9/3.45	6.5/3.25	6.9/3.45	6.5/3.25	3.45 / 3.4	3.35	3.35	1.6
Open circuit voltage U_{oc}	[V]	21.7/43.5	21.0/42.0	21.7/43.5	21.0/42.0	21.7 / 21.4	19.8	18.0	18.0
Physical parameters									
Length ⊕	[mm]	1321		1307		1293	1219	1083	567
Width ⊖	[mm]	660		652		329	329	329	328
Depth ●	[mm]	40		55		34	34	34	35
Depth including terminal box	[mm]	54		52		–	–	–	–
Weight	[kg]	11.5		9.5		5.5	5.2	4.6	2.5
Interconnect Type		⊟ ⊞ / ⊟⊞		⊟ ⊞ / ⊟⊞		⊟ ⊞	⊟ ⊞	⊟ ⊞	⊨◁
Type of terminal box		So		So		S	S	S	cable
Mounting holes									
Hole distance ●	[mm]	1283		-		1264	1191	1054	540
Hole distance ●	[mm]	643		735		643	643	643	–
Hole distance ●	[mm]	615		-		286	286	286	286
Performance warranty	[years]	25		25		25	25	25	10

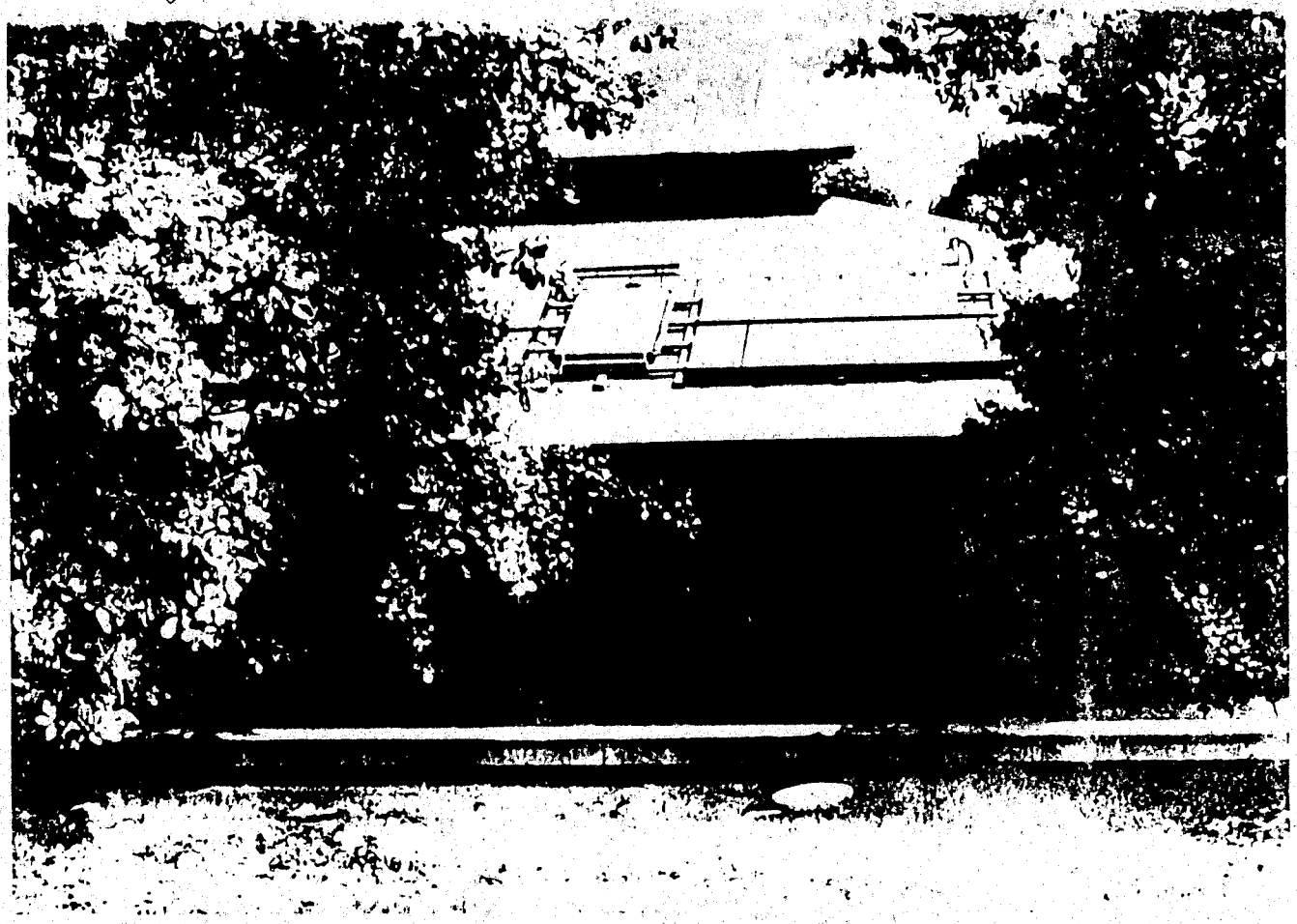
Power specifications are at standard test conditions of 1000 W/m² solar irradiance, 25°C cell temperature and solar spectral irradiance per ASTM E692
Detailed data sheets for all module types available at your qualified Siemens Solar dealer



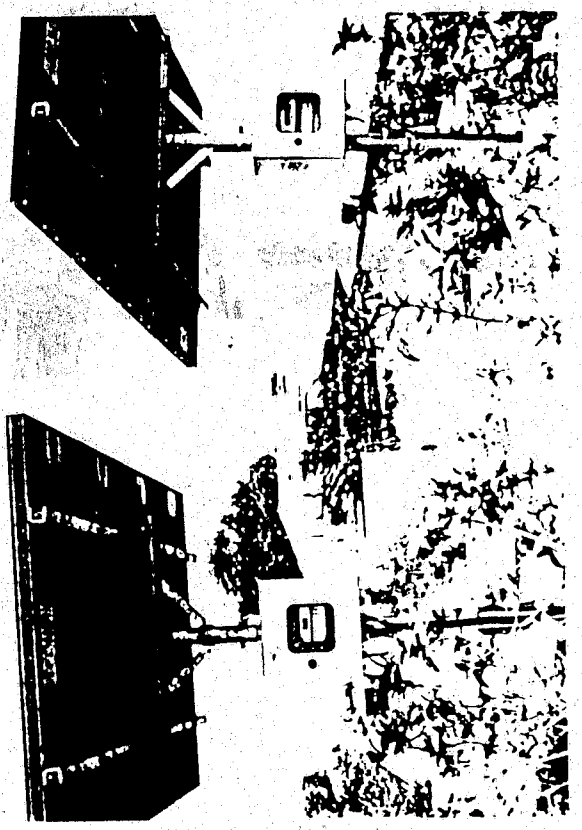


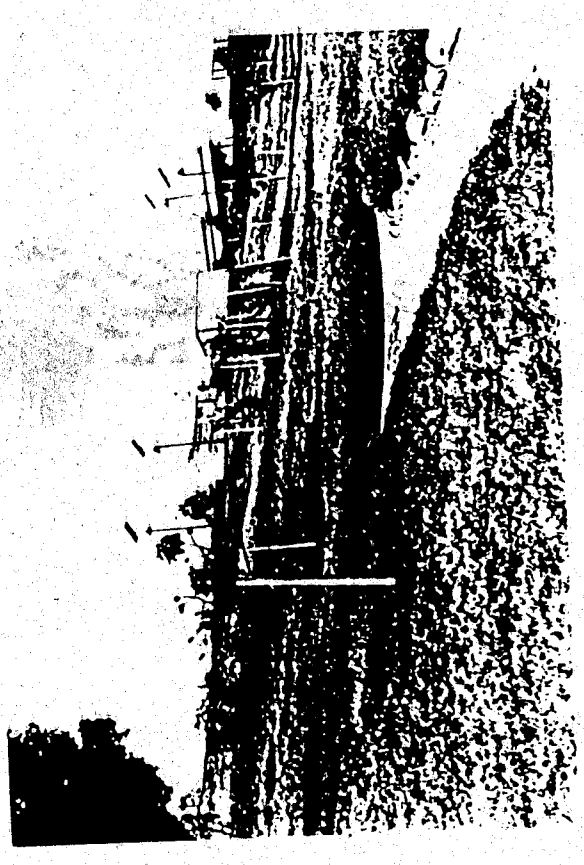






VERTICAL MOUNTING





3.8.0 ELEMENT OF SOLAR ENERGY POWER SYSTEM

Solar systems being with the solar module. Modules gather solar energy in the form of sunlight and convert it into direct current (DC) electricity. The more sunlight they receive the more electricity they produce. Solar modules are the heats of the system key are the power generators.

Components such as charge regulators, batteries and inverters regulate store, condition and deliver the electricity. Other elements connect the different components of the system.

Solar systems have to meet high standards of reliability and economic efficiency. This can only be guaranteed by the use of field proven quality components that are well matched.

STEP OF ITS OPERATION

3.8.1 SUNLIGHT

Sunlight energy in the form of light. This sunlight energy is termed as the fuel of a solar (photovotaic) system that triggered the modules to bring electric current.

3.8.2 SOLAR MODULE

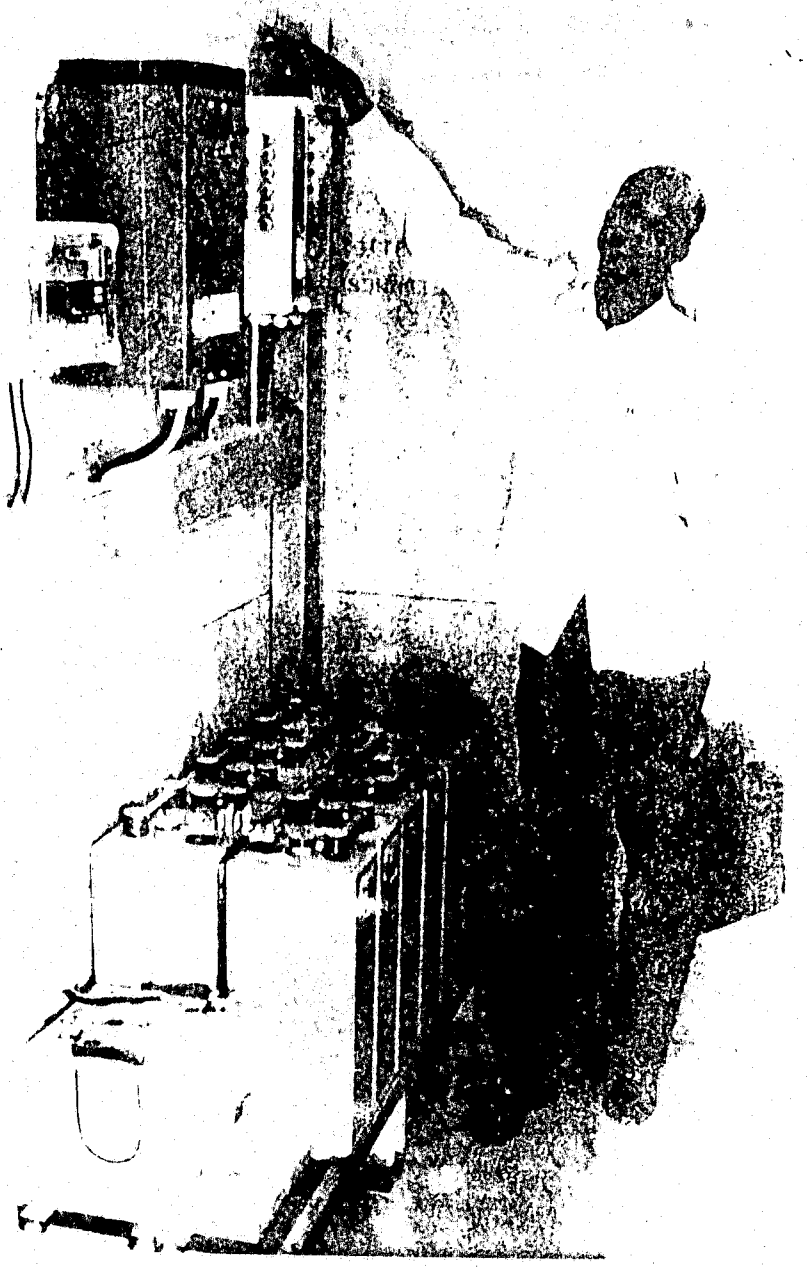
Solar modules generate direct current (DC) electricity directly from sunlight. Using one or more modules depending on the power needs and the amount of sunlight available. Since Abuja (Nigeria) is one of the fortunate zone where maximum solar energy could be tapped tilled at angle 30^0 of South of the North.

3.8.3 CHARGE REGULATOR

Charge regulators are the link between the module battery and load. They protect the battery from overcharge or measure discharge.

3.8.4 BATTERY

Batteries store the energy generated by the solar modules.



3.8.5 INVERTER

Inverters convert DC (direct current) electricity into AC (alternative current) to run many common appliances and equipment.

3.8.6 MOUNTING STRUCTURE

Mounting structures are the most architectural implication of solar modules, which hold the solar modules securely in place either through direct mounting or integral mounting when cost and maintenance, are considered.

Among other means of mounting are pole and ground mounting versions while the former are roof mounting. More information on this in the mounting method.

3.8.7 LOAD

The appliances, lights and equipment being powered are called electrical loads. Energy – efficient loads contribute to overall system efficiency and economy.

3.8.8 WIRING INTERCONNECTS

Proper wiring and connections must be specified for every segment of the system to assure best performance.

3.8.9 BACK-UP GENERATOR

Compatible generators (i.e. diesel) may be used as back up for excessive power demands or during unanticipated long sun less periods.

3.8.10 SPACE

Solar modules should be installed in an area that is generally free from shade and receives as much direct sun exposure as possible.

3.8.11 MAINTENANCE

Solar systems are one of the easiest and most reliable ways to generate electricity. Regular maintenance to check wiring connections, batteries and overall system conditions will help assure long term trouble-free operation.

3.9.0 IMPLICATION OF ACTIVE SOLAR ENERGY (PHOTOVOLTAIC MODULES) IN ARCHITECTURE

The photovotaic modules implications on its valves in architecture cannot be over emphasized because of its technological operation and being still a new invention, especially in Architecture. In this thesis, I could deal with the mounting system and how it affect architecture positively or negatively.

3.9.1 MOUNTING OF PV MODULES

This system is basically applicable to building. There are two basic systems.

i. THE DIRECT MOUNTING SYSTEM
ii. THE INTERNAL MOUNTING SYSTEM

3.9.1a THE DIRECT MOUNTING SYSTEM

It is the direct mounting that begins to present saving in the cost of conventional roofing materials. Economy and simplicity are also easy and possible with the direct mounting system through the elimination of support framework and mounting rails. These systems are not mounted on a superfluous layer sheating but they are secured directly to the roof sheeting either, aluminium or asbestos roofing materials.

These mounting system concept had the attention of photovotaic (PV) researchers in the early 1900s. However, they discovered some notable disadvantages to these methods. This discovery has led to the general disapproval of its uses on some houses that are being handled by expert and researchers and knowledgeable in the field of architecture as a professional and other related fields.

The widely unacceptance of these systems were due to placement and construction of the PV module capping the roofing sheet i.e. the PV modules are applied directly to the structural roof sheating, there is no open space between the module and the roof for it to breadth in which colling could air circulates.

This absence of ventilation can result in direct sunlight operating temperatures 20^0C hotter than that common to other mounting methods. Causing a significant decrease

in electrical conversion efficiency. In addition, module to module inter-connectors requires special flat cables and connectors.

Even more important access to electrical connection of the individual modules after installation in a direct-mount array is very difficult, making routine diagnostic and maintenance a major risk.

Currently no PV manufacturer produces modules that are designed for direct mounting unless the manufacturer has not discovered it.

3.9.1b THE INTEGRAL MOUNTING SYSTEM

This is the major alternative to emerge as preferred installation method for new residential and light commercial construction where the roof is designed at the proper orientation. It represents a logical progression from the direct mounting system; eliminating all its bad features, while improving on module cooling characteristics of rack mount.

This approach not only eliminates interior roofing materials, it also gets rid of the wooden wheating and roofing felt by attaching the PV modules directly to building rafters making both fixed together and structural surface of roof as well as barrier against weather.

The tempered glass, generally 3/16 inch thickness, that is used as the structural element and top "cover plate" for nearly all PV modules is more strong enough to serve as a building's roofing materials, if array mounting is properly designed. If you are inclined to be skeptical, consider how many stores shopping centers and commercial office buildings now feature shaped glass entrance roofs or interior glazed atriums. These spaces most often use the save type of glass found in PV modules, and the spans employed are also about the same. In addition, the PV module is actually stronger than the simple glass sheet because the laminations are layer of plastics film which provide reinforcement against excessive deflection.

Integral mounting on administrative part of the building arrays held an appeal beyond being represented by cost saving in roofing materials or the easy of installation and service. This appeal is partly aesthetical and partly philosophical and related to the fundamental departure from traditional concepts of energy supply and building design of which the solar electric house is a part. While the other mounting techniques are unquestionably serviceable and even desirable in the case of long term using.

Furthermore, if the integral mounting system could serve the model of finished roof that are constructionally fit and aesthetically okay why not we have or consider the PV modules in many ways as the promise of a new architecture and the physical lightness, simplicity and transistences of an integral array can only reinforce this spirit, creating an energy producing structure where the building's own skin produces all the energy it requires perhaps a surplus for exports to less energy conscious neighbors.

3.9.2 MOUNTING BALANCE-OF-SYSTEM (B.O.S) COMPONENTS

The types of consideration used to the planning details and logical integration required is the installation of the PV arrays are necessary in mounting B.O.S components.

The specific consideration for choosing arrays and for mounting are as varied as the functions of these components. Therefore an inventor must be accessible for possible servicing yet out of the way of any obstruction and to be near a safe storage place. Batteries must be well ventilated yet kept warm with access provided for maintenance.

In short, the most trouble-free system is the system that has been well planned ahead of time and put together properly from the start.

Diode, string combines and lighting protection. Following the topology of the PV installation as the electricity floors from array to loads, the first system component

encountered are bypass diodes. Lighting protection devices, block diodes and the string combiners that make parallel connections of the array's module series string.

3.9.3 STORAGE (BATTERY)

As one of the important things to note in this solar farm estate, make use of value-regulated lead-acid batteries are delivered filled and charged. Storage without charging is allowed for a limited period depending on the storage temperature.

Cells and monobloc batteries stored up to 6 months without charging at a storage temperature not exceeding 25^0C shall be charged at 2.33 – 2.40 V/cell or with a constant current of 5A per 100 Ah nominal capacity.

If the storage temperature is over 25^0C, recharge after three months. The required charging time depends on the open circuit voltage before starting charging, see table 1 below.

Batteries stored 6 – 12 months without charging at a storage temperature not exceeding 25^0C shall be given an extended charge with a constant current of 2.5A per 100 Ah for 12 hours followed by a second constant current charge step of 1.5 – 1.5A per 100 Ah for 24 hours. A charging voltage of 2.6 V/cell minimum shall be achieved during the second charging step.

3.9.3a

Tables: RECHARGING TIME FOR VALVE-REGULATED LEAD-ACID BATTERIES IN DEPENDENCE ON THE OPEN CIRCUIT VOLTAGE

NORMAL VOLTAGE				SURPLUS RECHARGE TIME	
2v	4v	6v	12v	IU characteristic U>2,33v/c	I-characteristic I=5A/100Ah
OPEN CURRENT VOLTAGE					
<2.09v	<4.18v	<6.27v	<12.54v	12h	8h
<2.06v	<4.10v	<6.12v	<12.20v	24h	12h
<2.04v	<4.08v	<6.10v	<12.00v	INFORM VHB	

3.9.3b ACCOMMODATION AND INSTALLATION

Batteries can be installed in battery rooms or fitted into battery cabinets – in workshops or office rooms. The quantities of charging gasses (hydrogen and oxygen) released into the atmosphere are very small. The ventilation of the accommodation area shall be adequately designed to prevent the formation of hazardous explosive gas/air mixture and to cool the battery. The requirements specified in relevant national or international standard must be observed.

3.9.3c INSTALLATION

Value-regulated lead-acid batteries are normally installed upright on stands or in cabinets. However, they can be installed in horizontal position care must be taken to ensure that the plates are vertical.

For both vertical and horizontal installation, a distance of 5mm should be provided between the individual cells/monoblocs to ensure that the heat is properly dissipated. The preferred distance is 10mm.

3.9.3d MAINTENANCE

Value-regulated lead-acid batteries cannot be topped up with water. The maintenance is limited to visual inspection of the battery, voltage measurement, and cleaning of the cell containers.

NOTE: Never open or remove the safety valves.

Regular inspection and cleaning of the battery is required to prevent the formation of creeping currents.

For cleaning the cell containers, use cloth moisture with clear water only, without any additives.

3.9.3e STAND ALONE SINEWAVE INVERTER

POWER: 20 KVA, the appliance can be briefly overloaded. The Inverter has an Automatic switch as soon as a consumer is switched in, the inverter switches automatically.

3.9.3f FUNCTION TECHNOLOGY

This inverter is designed to convert DC – battery voltage (Direct Voltage) to 225V AC (Simisoidal alternating voltage). The inverter provides a stabilized, crystal accurate alternating voltage. With a sinewave inverter almost any type of electric consumer may be connected as for example energy saving lights, fluorescent tubes, computers, radio and HIFI – equipment and other household appliances, freezers, pumps, etc.

3.9.4 DESIGN SPECIFIC

This is referred to the application in the solar farm estate which was devoted vividly to the technical note on the project so as to give a background knowledge of the criteria followed in arriving at the design of solar farm estate.

The solar farm estate as it is proposed in this project took mostly all the project operation in area of lighting and pumping. This project shall be solely depended on electricity from the sun. the poultry section fisher section and administrative are mostly considered for this type of project.

Hence, most of the P V modules installation will be based on integral mounting system which is very save and heat control i.e. the use of P V modules as a means of roofing (as it is discussed in 3.20b).

3.9.1 COST AND VALUE OF USING OF PHOTOVOLTAIC MODULES OVER OTHER MEANS OF LIGHTING.

In the first instance, no matter how cost a thing might be, if it usefulness and quality of characters is guaranteed, it cost become an after thought.

Therefore, as the chapter one of this project is concerned, it is very independent, very save, durable and everlasting without any interruption of electric power supply.

CHAPTER FOUR
CASE STUDIES

4.0 INTRODUCTION

Structures of buildings are used to determine the particular concept being proposed. They even give much information about and enlightenment to how the new proposed project is going to be. However, since buildings must address many important issues, hence many different strategies of design must be incorporated in solving some buildings' problems.

Therefore, the success or non-successes of many buildings of farm estate, residential, etc. whether solar is used or not in part of the building can be demonstrated below. Literature into the field of solar planning is buildings is based on studies made mostly abroad and Africa. Hence this restrict the analysis of the studies within a certain parameters.

i. Appreciation of the site planning procedure during designing.
ii. The term, method and technology of the use of solar energy.
iii. The performances of built-up space as regards effective space utilization.
iv. Flexibility of such farm in respect to space relationship and functionality.
v. Appraisal of the qualities of general solar energy planning as in respect to other determinants in design considerations.

4.1.0 CASE STUDY ONE (1)

OBASANJO FARM LIMITED

LOCATION: OFF OWODE ROAD, OTA, OGUN STATE

CLIENT: GENERAL OLUSEGUN AREMU OBASANJO COMMANDER IN CHIEF OF THE FEDERAL REPUBLIC OF NIGERIA.

ARCHITECT:- NON-INDIGENOUS

STUDY REFERENCE: PLANNING, WATER PUMPING & DESIGNING

4.1.1 DESCRIPTION

The farm was designed and built since 1980 by General Olusegun Obasanjo, after he had served as the then Head of State under the military regime.

The land covers about 55 hectares of land which are mainly for farming estate where most of the cities or town facilities are present like accommodation, restaurant, hotels, etc. Hence it is a pseudo-microscopic view of a society or city.

The planning and the design were fairly planned to meet up with that time design and there are no updated of planning neither renovation of the farming estate.

4.1.2 BUILDING CONSTRUCTION

The entire farm building was constructed on a reinforced concrete structure as the foundation slab is concerned. Some other area used block wall but the main farms were used with net and flexible gauze wire to allow proper ventilation and to reduce or act against linkages of the roof and rusting.

4.1.3 FACILITIES

Most of the unit of operation in the farm is based on advanced planning system where the use of tractor or vehicle to transport load from one place to another is encouraged.

i. The gate house
ii. Hotel
iii. Buying & selling
iv. Administrative
v. Canteen
vi. Canteen
vii. Feed Milk
viii. Storage
ix. Processing Unit
x. Hatchery.

THE MAIN FARM

i. Poultry unit
ii. Piggery
iii. Turkey
iv. Fisheries (under construction)

ACCOMMODATION

i. Senior staff quarters
ii. Director's House

4.1.4 CAPACITY OF THE FARM (POULTRY UNIT)

Rearing houses (day old) – 7 rearing houses

Cages (Gas brooding house) – 1 – 5 houses (Pens)

Each house contained about 20,000 fowl = 100,000 birds.

DIP LITTERS

8 – 10 weeks (Broilers for slaughter (processing unit))

LAYERS - 20 houses

Each house contain 8,000 layers = 160,000 layers in cage.

BROWLER - 27 houses.

Each house contain 10,000 broilers = 270,000 broilers.

TOTAL OF BIRDS = 530,000 birds.

4.2.0 CASE STUDY TWO (2)

OUTSIDE FARMING OPERATION BUT A RESIDENTIAL BUILDINGS

THE SOUTHERN MASSACHUSETTS HOUSE USA (U.I. SYSTEM)

LOCATION:- SOUTHERN MASSACHUSETTS

CLIENT:- SEMIREFINED PROFESSIONAL MAN AND HIS WIFE.

ARCHITECT: SOLAR DESIGN ASSOCIATES.

CAPACITY:- COVERS AREA OF 600 M^2.

4.2.1 STUDY REFERENCE

DESCRIPTION

The residential building was designed and built in the early 1979 by Solar Designs Associates for a semirefined professional man and his wife. The building covers an area of 600m^2, it was designed to be comfortable and highly aesthetically with concern for energy conservation and self reliance that did not only enhance choice of solar energy, but also a trim-electrical load demand.

The south Massachusetts house is a compact structure, built largely of masonry concrete

Concrete and steel to assure high internal thermal mass. The house is earth-sheltered on much of the north, east and west sides, with exposed wills insulated through the use of the Dyrit-system 14 cm of foam faced with a low-maintenance cement-based stucco like material. The south-facing portion of the house incorporates full floor-to-ceiling glass for direct passive solar gain, which is augmented by an attached solar given house.

Domestic hot water heating is provided by 90m^2. Flat-plate thermal solar collector any who also serves for supplementary space heating. With heating out of the picture and cooling a function of good ventilation as a passive design. Electrical load in the house are principally refrigerator, freezer, cloth dryer and electric oven along with lighting and occasionally use of power tools in the workshop and electronic entertainment equipment. The monthly food demand has on occasion, dropped to 300 Kw-/H through 350 – 400 KW/H is closed to normal.

The choice of utility-interactive photovotaic system was the client's desire heopposed to the use of on-site battery storage.

4.2.2 SIZING/FITTING

The sizing was influenced by both the load demands of the residence and roof area available.

- Annual daily peak sun hours south England = 3.8 Kw/h
- Modules chosen = 40w – Ra 40B (mobile solar made per m^2 module out = 15.6 VDC & 40W of $1kw/m^2$ and 25^0C
- 112 modules specified = 4.48 peak kilowatts
- Adjusted expected average cell temperature = 450C.

ACTUAL OUTPUT

$(45^0C - 25^0)$ x 0.4% = 8% reduction for NOCT

40W p x 0.92 = 36.8Wp/module at NOCT OF 45^0C

4.122W p x 3.8 peak sun hour/avg. dry

= **13.66** KW h/avg. day.

CASE STUDY THREE (3) - BALCOMB HOUSE

THE SANTA F.E. HOUSE, New Mexico

LOCATION: Santa – F. E. New Mexico

CLIENT: William Lumplain & Susan Nichols.

CAPACITY OR LAND: 700m2

STUDY REFERENCE: SOLAR ENERGY PLANNING by Philips Tabb, 1984.

DESCRIPTION

The house was designed in 1981, they got the commission while they were supervising the construction of the South Massachusetts house. The requirement was also a U I photovotaic system. The clients are rational Alternatives (solar builders/developers based in Santa F. E).

The $700m^2$, single-glory house features 3-bedrooms, 2 baths, a library, an open plan living and dining area, a kitchen, a solar sunspace, an air-lock garage, an expensive landscape south patio and a walled private garden terrace on the north side of the house that includes a solar outdoor hot tub.

The house was designed in the characteristic pueblo style architecture typical of the southwest. Exposed ceilings with vigas and pine decking, bricks floors and Kara fireplaces which is the charm of Santa – Fe. The house to earth-beamed on the north side and features walls of mansory and adobe to provide internal thermal mass with south facing glass for direct passive solar gain.

MERITS

i. A highlighting reduced bills, cheap and the end of each month is average $14 per month.

ii. Being that the load appliances are low, the modules can be used fast longer.

iii. An independence utility of energy is achieved.

iv. It compliments the use of fuel or Hydropower supply.

v. Used of some building materials that are thermal passive oriented.

4.2.3 DE-MERIT

The U.I. photovotaic system does not allow for full dependence of solar power.

Full capacities of the solar modules (cells) are not utilized.

Client interests are restricted (limited).

4.2.3 APPRAISAL

This is an ideal example of solar energy building by the client because, it is glaring that energy economy was not the top-most priority of the client but of power complementing the conventional method that exists.

CASE STUDY FIVE

GREGORY BATTESON BUILDING

LOCATION	-	Sacramento California U.S.A.
CLIENT	-	Office of the State Architect for California
STUDY REFERENCE:		Heating, Cooling and Lighting (Design Method For Architects) by Norbert Lechner, 1991.

FACILITIES

Named after the anthropologist Gregory Batteson. This office building was set out to illustrate energy conscious in design but it ended up demonstration the more 'humane' values in architecture.

In the Batteson building architectural design features are well integrated in the warm and articulated facades which are consequences of various shading elements. The building consist of central atrium which create a conceptually clear circulation cove and acts as a plaza. Solar application is in the form of cooling needs in the building due to the mild climate of sacraments as a result of first priority is to reduce the cooling load from the sun to enter. Also the atrium roof glazing is carefully designed to prevent unwanted sunlight from entering. Domestic water supply is generated by 2000 HZ of solar collector located on the roof just south of the clerestories.

CONSTRUCTION

The entire building was constructed on a reinforced concrete frame structure, leaving the column and beams and floor slabs exposed to function as means of aiding shading although creating acoustical problems but carpeting on the floor and vertical acoustical battles hanging from the wall absorb excess office noise.

APPRAISAL

The many indentation setbacks and terraces break up the façade thus aiding in treating the problem of shading through the use of trellis system for the south windows, automatic shade glide and partial shading of the atrium.

Also the effective use of exposed building concrete frame as thermal and the presence of 700 tons of rock bed under the atrium floor acts as absorber to accomplish over 90% of the building cooling needs during summer.

ADVANTAGE

Architectural designs are well integrated.

DISADVANTAGE

A caustic problem is pronounced in the building.

CHAPTER FIVE.

5.1.0 PHYSICAL AND SOCIAL-CULTURAL BACKGROUND.

Abuja, FCT covers an area of 8000sq kms. This makes it more than twice the area of Lagos State, the former federal capital territory. According to the agenda panel, this vast area was considered necessary in order to allow room not just for the capital city but also for a city region that will provide most of needs of the city including water, forestry, industrial, agricultural, open spaces, defense, air transport and other needs. As at now, the federal Capital City (FCC) is planned to cover an area of about 250sqkm^2 while rest

Of the territory or the city region covers about 2,750 sq. kms.

The territory is located between longitude 6^0 47.5" – 7^0 20" east and latitude 8^0 30" – 9^0 15" North; ethnically, it is composed of Gwari (Gwari (64.9%), Karo (83%), Gandana (7.9%), Gada (65%), Hausa (4.9%), Fulani (4.6%) and others totaling (2.9%). The philosophy of the establishment of the new capital city lies as promised by the late General Murtala Mohammed, an area that is not within the control of any ethnic group in the country, a virgin land, for all Nigeria, a symbol of oneness and unity.

5.2.0 CLIMATIC CONDITION

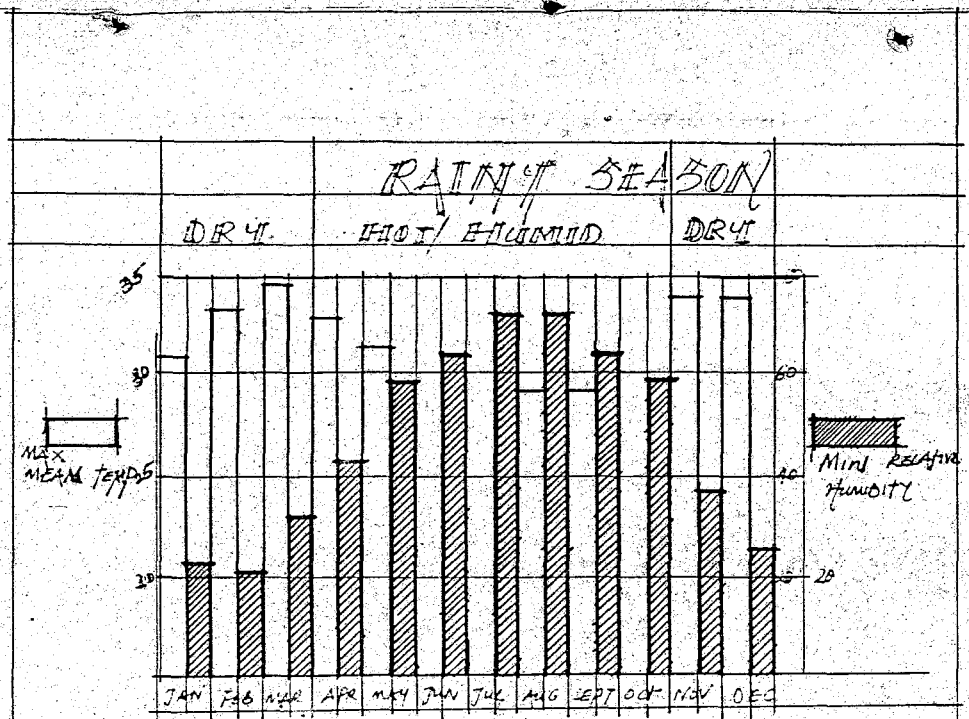
A comfortable living environment will depend on maximizing the aspects of the environment, which reduce heat and the effect of humidity and protect from rain and dust. Planning with climate should take place at all scales. While detailed climatic information is not yet available, extrapolations from existing airport meteorological stations have been used to develop the basic description of climatic parameters. These factors and their planning implications are discussed below.

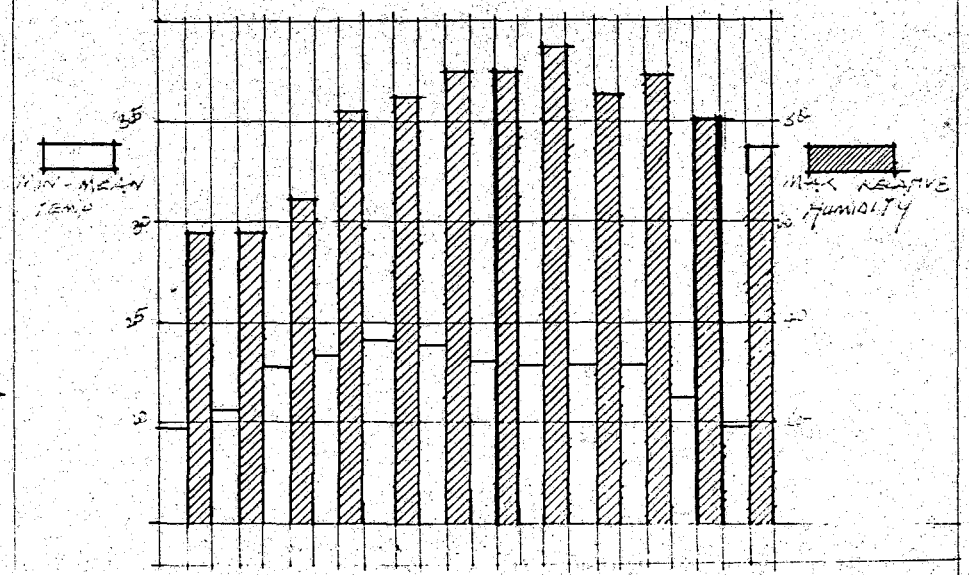
5.3.0 TEMPERATURE.

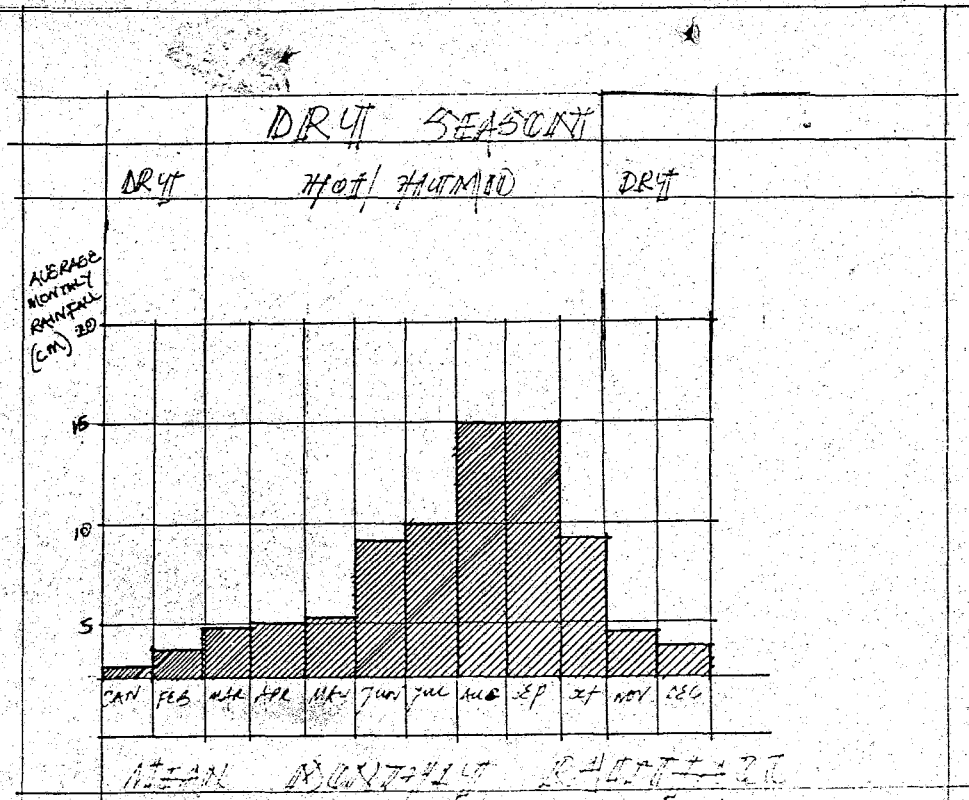
In human terms, net radiation is felt as air temperature, the response to which is greatly influenced by the humidity condition in the air.

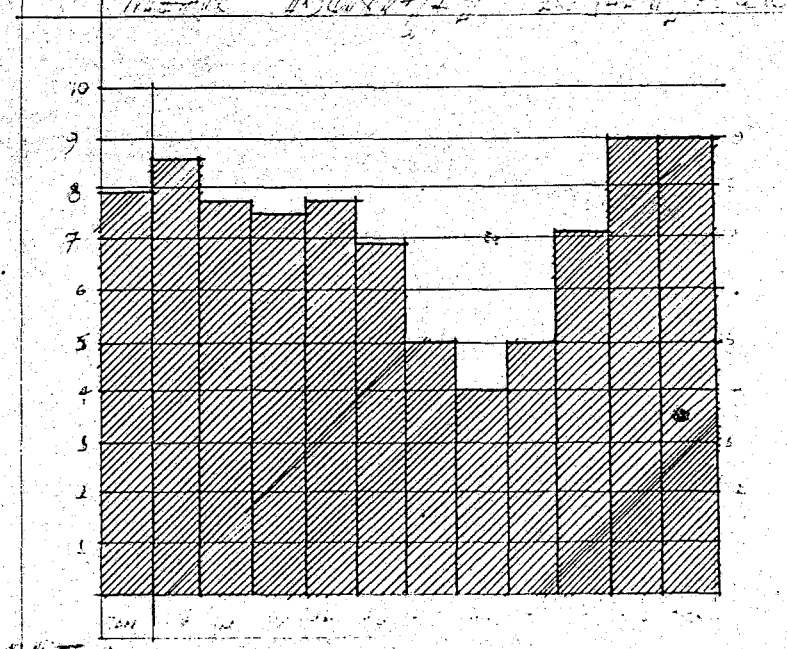
This area at Kuje in Abuja experiences two seasons in a year as is obtainable in other part of the country. It records its highest temperatures during the dry season months, which is generally cloudless.

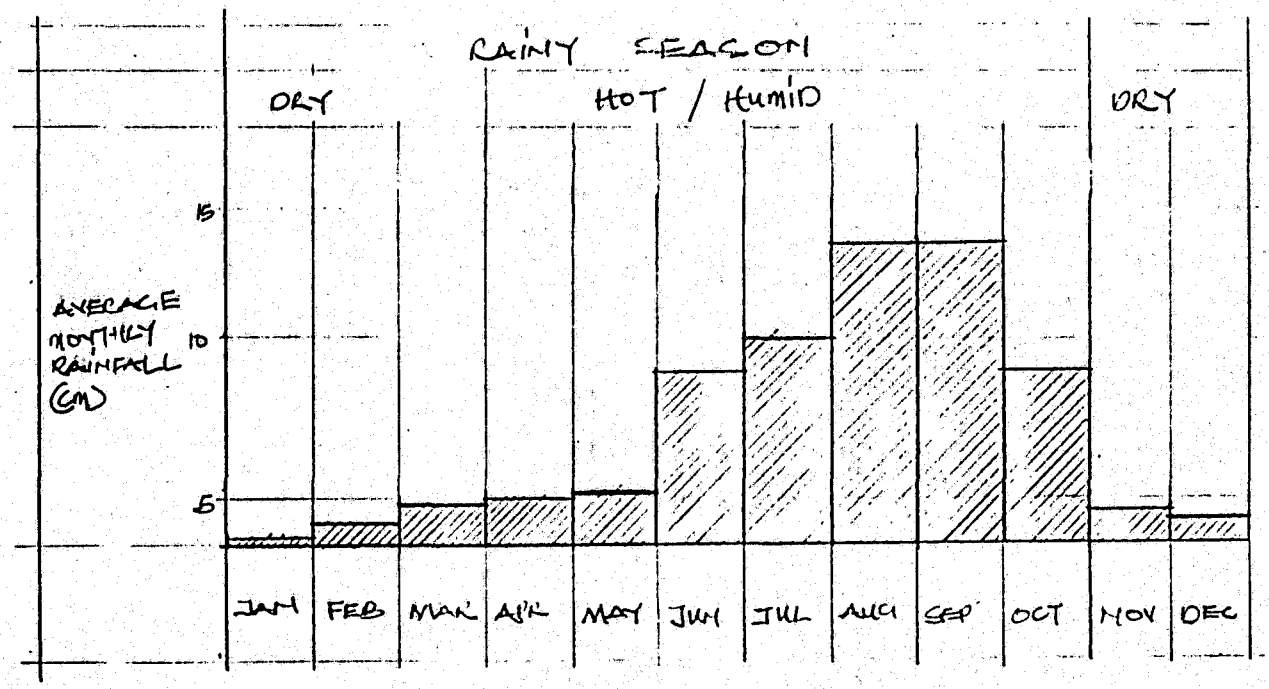
Temperature in these months could rise as high as 37^0c. This season is characterized by high diurnal ranges which drops to as low as 17^0c may be recorded between the highest and lowest temperature in a day. During the rainy season temperature drop due to dense cloud cover the diurnal range also drop to around 7^0c especially between July and August.


RAINY SEASON
DRY
HOT/ HUMID
DRY
35
30
25
20
60
40
20
MAX MEAN TEMP
MIN RELATIVE HUMIDITY
JAN FEB MAR APR MAY JUN JUL AUG SEPT OCT NOV DEC

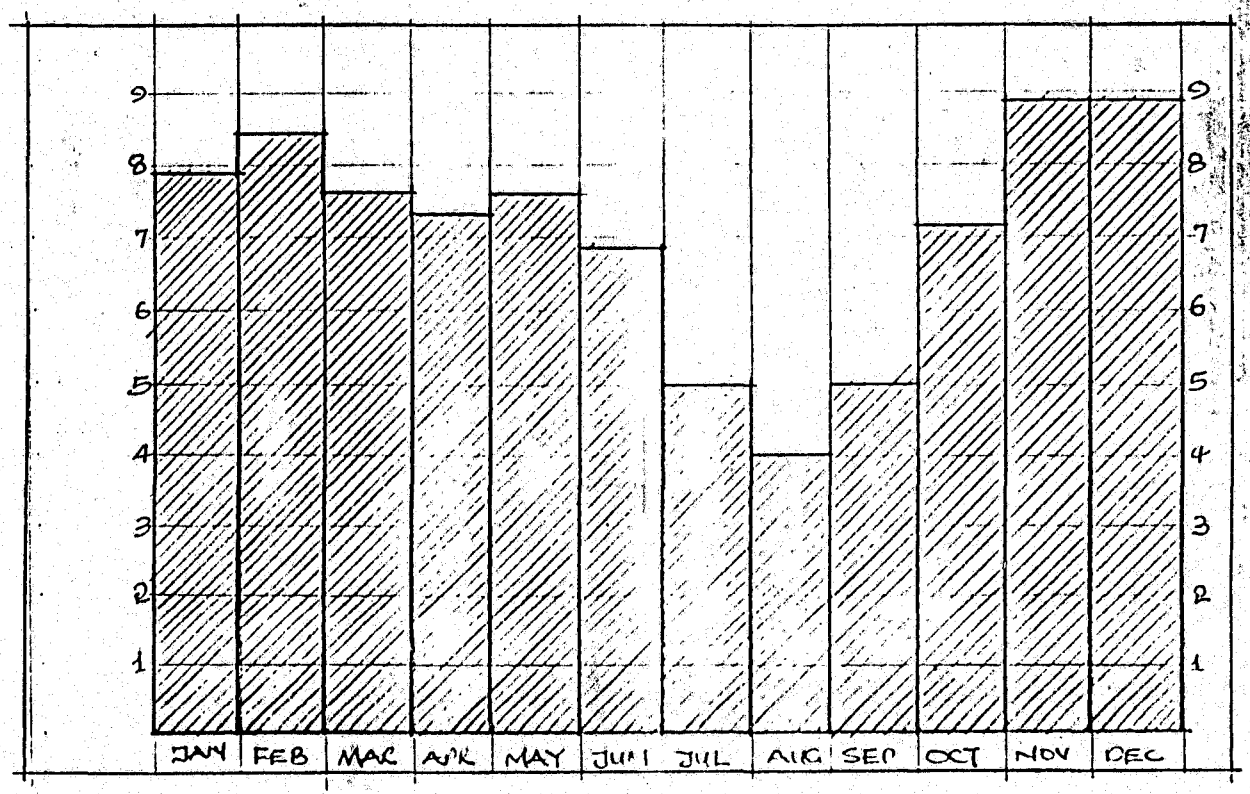

35
30
25
20
MIN - MEAN TEMP
MAX RELATIVE HUMIDITY


DRY SEASON
DRY
HOT/ HUMID
DRY
AVERAGE MONTHLY RAINFALL (CM)
20
15
10
5
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

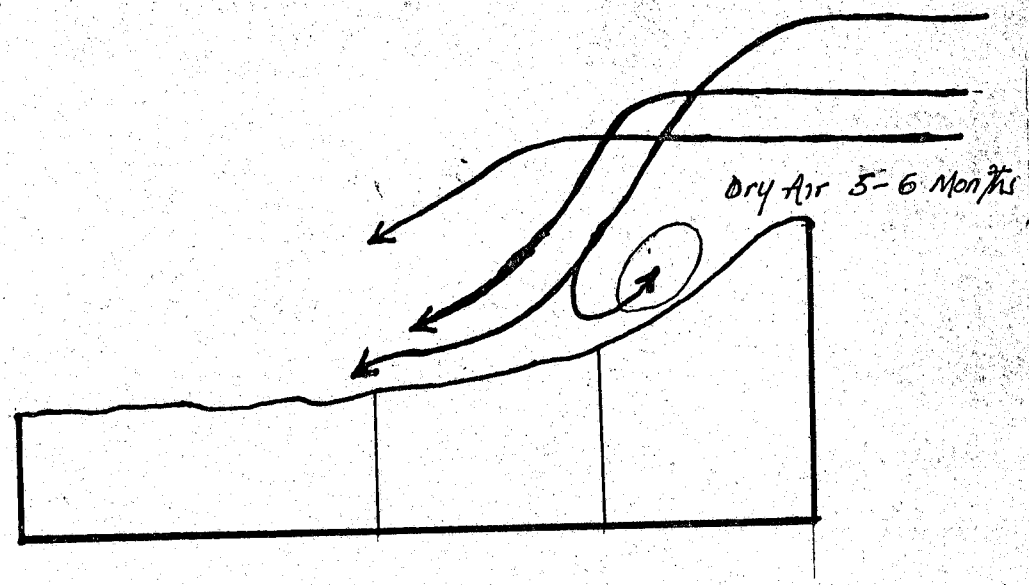

MEAN MONTHLY SUNSHINE
10
9
8
7
6
5
4
3
2
1



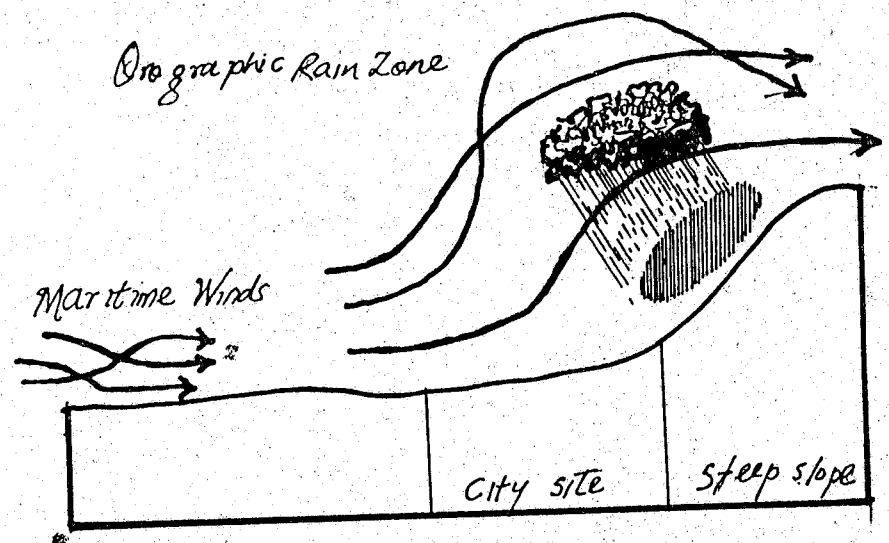
MEAN MONTHLY RAINFALL Fig 7a



MEAN MONTHLY SUNSHINE DURATION Fig 7b



DRY SEASON 5-6 Months



WET SEASON 6-7 Months

SEASONAL WIND PATTERN

5.4.0 HUMIDITY

Human sensibility to temperature is greatly affected by relative humidity. In the figure below, the monthly variation in temperature and humidity for Abuja and its environment are taken at 0700hours for Abuja and 1600 hours.

During the dry season, relative humidity fall in the afternoon to as low as 20(%) percent in the Kuje site zone. This low humidity, coupled with the high afternoon temperatures, account for the desiccating effects of the dry seasons. In the rainy season, the relative humidity is much higher, especially in the morning hours when it can reach as high as 95%. Even though the temperature is slightly lower, the effect is to create a heat trap. When this situation occurs, the general feeling is to be uncomfortably hot.

5.5.0 SUNSHINE

Record of sunshine reveal an average of 275 hours per month especially in thedry season. Usually, the maximum daily sunshine hours are recorded in the month of December while the minimum is observed in the month of August. Lowest sunshine periods are generally recorded in the rainy season due to the increase in cloud cover. The period between November and April has more sunshine hours.

5.6.0 RAINFALL

Rainfall normally begins from the month of March and ends in October. Thus, the duration of the rainy season is between 180 days to 190 days. Figure below show the mean monthly rainfall in Kuje, Abuja. The mean monthly distribution shows a tendency for concentration in three or four months.

In Kuje, Abuja has frequent occurrence of squall lines, which begin with dense, dark, cumulo-nimbus clouds with thunder and lightning followed by strong winds and intense rainfall. The intense rain may last for up to one-half hour and is then followed by drizzle of several hours' duration. This condition is then replaced by a few days of bright, clear skies. It is thought to originate from the Jos Plateau region and to travel from east to west across the site. It is most common in the late afternoon at the beginning and ends of the rainy season, and often causes serious property damage.

ALLUVIAL SOIL: it is a poor material for use as building foundation and have limited use as road construction materials. However, the sandy portion would make good concrete aggregate.

5.7.4 LATERITES

They are used as building foundation for road construction and also used as building or walling materials.

PEDIMENTS

The soil consists of poorly graded sand and silly sand. It contains no clay fraction. It is limited to the pediments, it is used for concrete aggregates.

5.7.5 ALLUVIAL SOIL

These can only be used on road construction.

5.8.0 TOPOGRAPHY OR SLOPE ANALYSIS.

The aim of slope analysis is to investigate and recognize parts of the site that are most suitable for building different types of structures. The topography of KUJE, Abuja is characterized by gently undulating terrain interlaced by riverine depressions. The plateau like setting is occasionally intercepted by hills and rock outcrops.

Generally, the land rises from 200metres above sea level in the river valleys to above 600metres in the mountainous area.

5.9.0 WIND DUST

Abuja is dominated by two major air masses. These are the tropical maritime air mass and the tropical continental air mass. The tropical maritime is formed over the Atlantic Ocean to the south of the country and is warm and moist. It moves in a southwest to the north- east direction.

The tropical continental air mass is developed over the Sahara desert and is warm and dry. It blows in the opposite direction of the northeast to the southwest. These are oscillation between these two weather conditions in the country.

5.10.0 VEGETATION

The riparian vegetation along watercourse densely wooded area and reserved forest plantation are features on the site that need to be carefully considered. They provide ample advantage to the preservation of micro-climate and provision of natural habitats for certain species of wild life and games.

5.11.0 SUN AND CLOUD COVER

During the dry month (November – April), the monthly variation in the amount of sunshine follows the general trend of an increase from over 275 hours on the city. As the rainy season approaches, the cloudiness increases. The city site is exposed to 2500 sunshine hours annually (mabogurge). The decline in sunshine hours becomes more intense as the rainy season progresses and it got to its lowest values in August. At this period, there is an inversion in the city where there is less sunshine hours compared to southern part of the territory.

5.12.0 SOCIO-CULTURAL LIFE.

Exploration from latest available statistics determines the demographic characteristics of KUJE in Abuja and its subsequent influence on the project at hand. These characteristics are age/sex distribution. The number of households, students and the anticipated income distribution by the year 2000 population.

The economically active part of the population is estimated as 20% of the total population or about 70% of the population in the age group from 15 years to 54 years. Thus, it can be expected that within the formal and informal sector of the economy the new town will engage about.

The ratio between the formal and informal services sector is assumed as 46% and 54% respectively. The informal service work force is either non-range (trainees and apprentices etc) receiving various forms of non-monetary compensation or age bringing in sufficiently small amount of income calculation purposes. Moreover, most in this group belong to children age bracket. This sector is a combustible sector. Therefore, all affordable proteins food is at their control.

5.13.0 THE EXISTING LAND USE AND FUTURE GROWTH.

Kuje (Abuja) covers about 1600 hectares that could be divided into the following land use categories:

1. Residential
2. Industrial
3. Public utilities and controlled open spaces.

The residential area is divided into three districts, which are further organized into neighborhoods and groupings. Due to these reasons, a hierarchy of centers is proposed in the master plan to serve respective residential clusters. The town center, which is the main central business and commercial area, is I shaped and connects the existing Gwagwalada with the highest point within the planning area.

The industrial area covers about 300 hectares of land. Industries are classified into two categories, i.e. small and medium and mini large industrial area. The classification was used to analyze their locational options with the industrial area.

The planning segregates the goods traffic from the workers traffic with the industrial areas.

These two major areas, residential and industrial lies within an agricultural zone. Most of the land is heavily cultivated and shifting cultivation method is generally practiced. The main food and cash crops in this region are yams, sorghum, maize, cowpeas, millet and groundnuts. Grasses are also grown for hut and lent making.

5.14.0 TRANSPORTATION AND TRAFFIC FLOW.

The use of linear space/linear system make possible a series of entrances and exits to allow buses and small cars (mostly) to loop off the spine and to provide direct services to a district and then return to the spine. Arterial coll. or local streets makes it possible for maximum flexibility in transit service between the sectors, the neighboring towns, via the transit. This easy and accessible within the town and the

neighboring towns and to the neighboring towns like road to Gwagwalada from Kuje and also to airport and linking up to the main city of Abuja but the proposed project in a better siting for accessibility, it maintains a balance in siting a farm estate of such because of health.

5.15.0 ECONOMY AND COMMERCE

There are a lot of business, household and personal services that supply goods and services to town – Kuje.

This range from:

(a) Large scale modern retail shopping outlet kiosks, restaurant etc.

(b) Private commercial offices in the commercial core, sectors, centers and district centers

(c) Mechanized / local agricultural farms, estates, specialized business service e.g. banking, insurance e.t.c.

(d) Modern and traditional markets.

All these services will enhance the siting of proposed application of solar energy in farm estate in Kuje (Abuja)

CHAPTER SIX

6.0 SITE ANALYSIS

6.1.0 CRITERIA FOR SITE SELECTION

Criteria for the site selection are what to be considered before a site could be selected. Before any site can be selected, the project must be considered and the purpose it will serve in that environment, whether it's going to be a nuisance or source of pollution to the city of its location or enhance the beauty of the city.

In a project like this, the use of solar energy in farm estate, there should be rules and guides to follow before such project could be established. This is because of the function the project will serve. And as a farm estate with respect to poultry and fisheries, where the environmental pollution cannot be removed from its operation in area of poultry rearing and management, the site must be considered that it will not hinder the hygiene life and environmental balance of the city.

That is while a better site that will be accessible to motorist and other important factors could be selected along Gwagwalada to Kuje. It can also be accessible through airport to Kuje town.

To follow environmental law on site selection for any farm operation, it must be away from residential zone in which this site is complaint. It is just about 11\2 to 2km away from Kuje town via Gwagwalada i.e. along medium prison in Kuje, Abuja.

FACTORS CONSIDERED FOR THE USE OF THE SITE.

(i) Relative accessibility
(ii) Availability of services
(iii) Size of and expansion potential
(iv) Safety
(v) Security.

6.1.1 RELATIVE ACCESSIBILIY

Is the site of the proposed farm estate (poultry/fishery) relatively feasible and accessible to anybody that want to visit the site for patronizing, transport e.t.c? Upon the fact that environmental law is considered in term of farm housing (poultry/fishery), yet the farm is very accessible and even along the main road of Gwagwalada. Even most of the productions are to transported to the main metropolis and city center where the product could be disbursed easily without any middleman interaction. The road is very motorable, from place to Gwagwalada is about 38km and from the site to Abuja metropolis is about 48km with good road construction.

6.1.2 SECURITY

In farm estate like where solar energy is going to be applied, proper security is going to be achieved both on human and mostly on the production of fishing and poultry farming on the site.

This can be achieved through the planning procedures of the site where security operation is at high level.

6.1.3 LOCATION

The site is located along the road from Gwagwalada to Kuje of about 30km. It is also 11\2 to 3km to the main town of Kuje due to environmental control regulation. If to access the location from the main city of Abuja, it is about 30-45km to the site. The route is through the airport road to Kuje town and to the site.

The site is also an allocated land for the purpose of farming. It is bound in the west ad north by river Wushe and river Wupa. These also enhance the accomplishment of the farm estate for better yield and production because the farm basic need is water.

6.1.1 AVAILABILITY OF SERVICES

The availability of public utilities is always considered when selecting a site for industrial purposes. These services enable the efficient and steady running of the industry.

6.1.2 SIZE OF LAND/EXPANSION POTENTIAL.

Among the factor considered before selection of this site, is the size of the land that could be able to accommodate all functions the farm estate could contain. Also the expansion of the site potential is also being taken care of for a better future and to meet up to some certain standard. Therefore, population and future forecast is considered for expansion.

6.1.6 SAFETY

Safety in this respect covers both human and artificial operation that might load to environmental disturbances/problems through traffic noise, atmospheric less laden dust and gases and human traffic.

These might lad to nuisance on the site. They are all controlled through planting of trees and barricade with the use of fencing to act as break to any of these obstruction and to give room for good production. Especially in the poultry section.

6.2.0 SITE CHARACTERISTICS (INVENTORY)

Among the characteristics of the site are base on three aspects:

i. Underneath the site
ii. On the site
iii. Above the site.

6.2.1 UNDERNEATH THE SITE

Considering the type of inventory underneath the site, they are operations or passage of some gadgets that are among the services underneath the site.

Among these gadgets or services are underground piping, telephone cables, electric cables, and N.N.P.C pipeline e.t.c. Among these underground laying there is no noticed of any of them because the site is a virgin land, only the overhead or above site that we can find an electrical grid line.

Also the information I also got was that they are just starting execution of the project.

6.2.2 ON THE SITE

Looking generally at the site as a whole, we could be able to find out that it is up to 60-80 hectares of land. Without any onsite structure; either buildings or symbol of use on the site. All is just gently slope. Only that the site is being used for local farming where heaps and cultivation were made in some other place as it is not done on some other side. Among some features on the site are rivers and some seasonal streams, gently slope with varying contours that are gently (affordable establishing farm estate on).

Trees, grasses and channels for drainage are part of the onsite character being observed before any structure is put on it.

6.2.3 ABOVE THE SITE

Electricity grid line poles cables are part of the inventory above the site. Unlike other cables like that are not present on the site such as telephone lines, and others.

Most of these above the site inventory are part of the project to be embarked on by the federal government as I was informed.

6.3.0 ACCESS AND CIRCULATION

The main access to the site is through the main road of gawgawlada to kuje. This road will make the approach to be abit noisy but when going at distance of the site, it become unnoticed.

While circulation on the site is considered like side walks, paths. And other pedestrian movement patterns including users purpose, schedule of use and volume of use.

6.4.0 UTILITIES

The location of site is in a place where most of the conveyance from (type of pipe etc) of gas, sewer, telephone and water utilities is not noticed. And also there is no any utility underground. But in case of power it is above the site.

6.5.0 SCENERY (MAN MADE AND NATURALN FEATURES).

Among the man made on the bite are power poles while the off site features are fenestration patterns, paving of road.

The natural features of the sites includes contours drainage patterns, soil type and bearing capacity, trees rocks ridges, peaks, valleys, rivers and pools etc

6.6.0 CLIMATIC FACTORS.

Among the climatic factors, we have on the site are

1. Topographical features
2. Vegetation

6.6.1 TOPOGRAPHICAL FEATURES / SOIL

The soil type is typical of sandy day soil with high percentage of sand, which could be easier to work with.

The soil at the site has traces of granites rock in some places the topography of the site is a gently sloppy land and other part being flat in toward the north side. The slope side is greatly undulating terrain where the solar energy mounting could be installed for better tilting angle and receiving the rays of the sun

6.6.2 VEGETATION

A thorough observation of the side shows that there has been existence portion of land gently toward the extreme end of the site where the poultry and fishery production site could be established this area are grown of green grasses where it could be easy to cultivate and evacuate easily.

Among the observation made about some other information on the site are some trees like palm trees, conifers, climbers, shrubs and some family of elephant grasses which

are scattered all over the chosen site. Therefore some of the trees are going to be retained on the side for fenestration and windbreak.

6.7.0 ENVIRONMENTAL PROBLEMS ON SITE.

Among the environmental problem on the site are:

(i) Pollution

(ii) Wind

(iii) Human factors.

6.7.1 POLLUTION

To consider the environmental factors through pollution on the site, the rivers need to be considered mostly during the dry season where too much heat might lead to dryness of the river and some living creature or plant will die and cause an odour or pollution to the environment. The creation of embarkment against any odour is made on the site.

6.7.2 WIND/DUST

The direction of the wind in this thesis is very important which are accompanied by heavy down pour of rainfall, heavy sun penetration from the S.W trade wind during June to October/November. While the N.E trade wind which are accompanied by dust and whirl wind through the site. These factors can affect the success and achievement of the project in the mode of applying solar energy.

Therefore, the orientation of the site and planning are very important to reduce odour and maintain balance and control of wind vibration. Being that the site is gently sloppy toward the North, the siting of the administrating is toward the North at one end of the site that maximum tapping of solar energy could be achieved toward the south of the north while the poultry and fishery department is toward the extreme end where the vibration of the wind direction will affect the other facilities in the site.

6.7.3 HUMAN FACTOR

Among the human factors to be considered as part of the environmental problems are movements or patronizing without purpose and overlooking. This could be checked by using fence and electric security system to monitor the security of the environment.

CHAPTER SEVEN.

7.0.0 CONCEPT AND DESIGN.

7.1. THE DESIGN PHILOSOPHY AND CONCEPT.

The design concept and philosophy of this project is rationalized by considering the site in the proper shape based on the following principles:

- Response to the site profile
- Response to the site shape
- Planning with focus or about an area
- Easy accessibility and flow of traffic within the farm
- Location of units in relation to one another
- The solar energy (PVC modules) as a means of information

7.1.1 DESIGN CONCEPT

The design concept of use of photovoltaic cells in farm estate (poultry and fishery) was derived from the design based on the following procedures.

In achieving the concept, several case studies was done to know the condition, situation and problems facing some farm estate with respect to design concept on facilities provided.

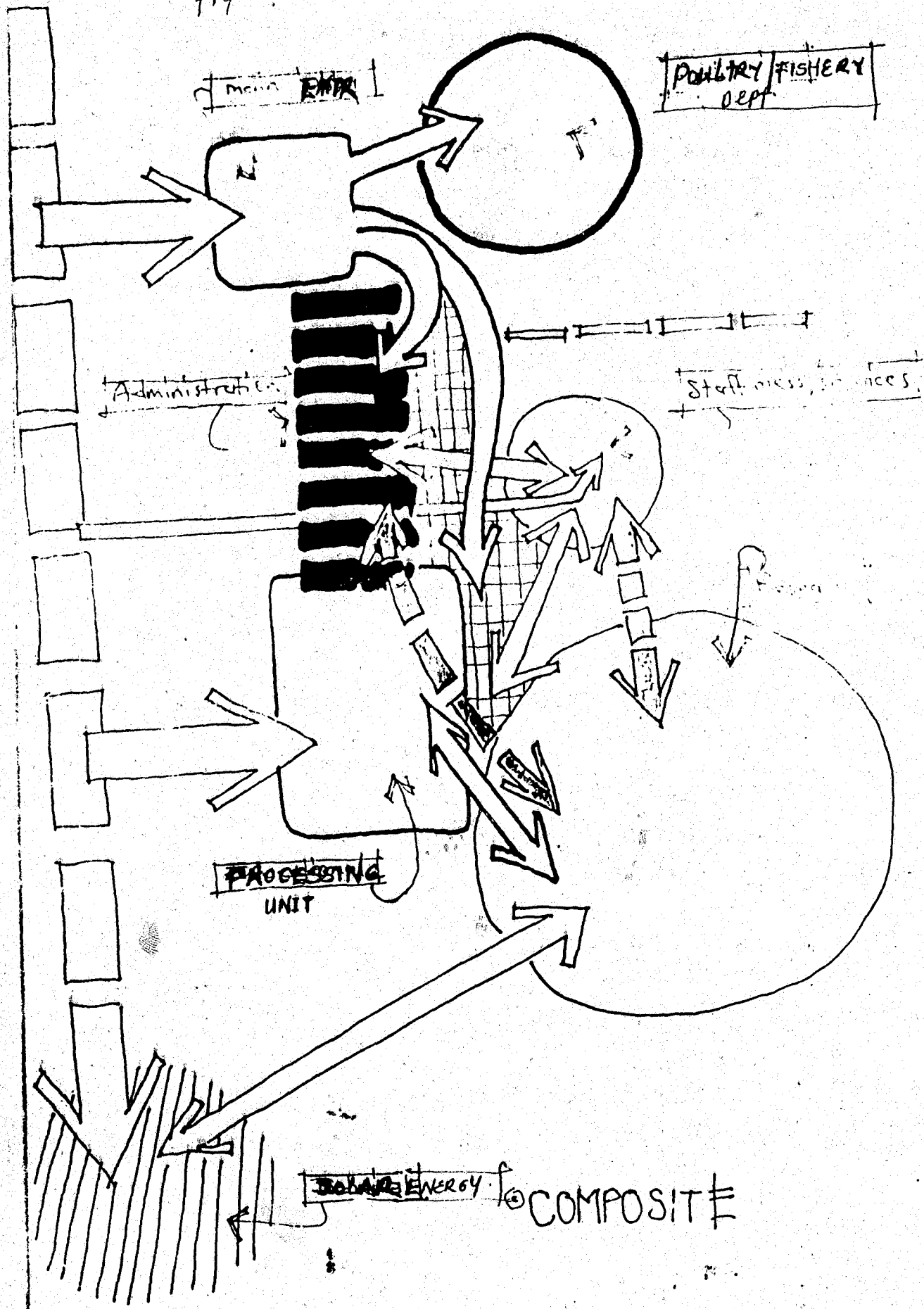


fig
POULTRY
FISHERY
dept
Administration
PROCESSING
UNIT
SOLAR ENERGY
COMPOSITE

Having carried out the case studies the facilities to be provided was listed down with the various units. The relationship of each unit has with the other by the use of colored dots. The colored dots show the level of relationship of each unit. Red color dot indicates a hot relationship; yellow colored dots indicate a warm relationship and a blue colour dots indicates a cold relationship.

After the units have been established with colored dots, a functional flow diagram was constructed from triangle of functions. This procedure is done for all the facilities that were provided in farm estate.

After the triangle of function, are integrated triangle of function was established which comprises all the units in the farm estate using the same method from the triangle of functions.

The next stage was the general floor diagram, which shows the relationship of all the units. Allocation of space to each facilities provided then follow the units were then subjected to subjective boxing based on the total space allocation. The boxes were then reduced to convenient scale. The boxes were later subjected to variances alternatives. When doing these environmental factors such as ventilation, lighting airflow and solar operation with cost were considered. Taking this into consideration, an alternative approached was also adopted or selected for the design form and in some little area of the plan because of planning by taking the site climatic condition into consideration.

For the functionality of the design, the re-arrangement of the alternative chosen was repealed over and over again until the final functional form of the design was achieved, thus represent the plan form concept called CANONIC DESIGN TO ARCHITECTURE.

7.1.2 ELEVATION CONCEPT

The most attractive part of the elevation is the approach which comprises of the administrative building which depict a fish entrance to serve as a means

PROPOSED SOLUTION OR DESIGN RISK

The proposed solutions are as follows.

- There will be functional relationship of each unit to one another.
- The pen will be rat proof by using the right proportion of aggregates for the floor slab and raising the slab high above the ground.
- The pen sub is orientated in such a way that the longer side of the pen will not face the two seasonal winds.
- In the entrance area of each unit a pit of about 150m deep by 800mm long by 200mm width will be provided with disinfectants.
- The environment will be well landscaped.
- For smooth running and growth of the birds infrastructural facilities will be provided.

SITE ANALYSIS

The site is located in the KUJE to Gwagwalada Road.

Topography Features

The site itself is a flat land and flatly sloping toward south. The shape is long with gentle undulating terrain.

7.2.0 DESIGN OUTLINING

7.2.1 ADMINISTRATION

This shall be the central coordinating point (nerve center) of the farm. It is a place where control, formulation and implementation of policies will be emphasized. This will enable the organization to reap her purposes.

And since an effective management and implementation cannot be taken with levity for, the achievement of optimum productivity, effort shall be geared toward the provision of adequate and convenient office accommodation for the administrators of the farm and their assistants.

The administrative building shall therefore contain the following.

1. Reception/sales office

2. General office
3. Account clerk's office
4. Accountant office
5. Farm manager's office
6. Farm manager's secretary office
7. Board room
8. Store
9. Conveniences.

7.2.2 POULTRY UNITS - Intensive system type

They shall also house the egg production section. Effort shall be geared better cross, maintaining a netted warm house for brooder well controlled rearing system, etc.

The atmospheric conditions and the ancient temperatures necessary for the rearing of the birds shall be taken into consideration.

(a) Parent stock section
(b) Brooding
(c) Browler section
(d) Broiler section
(e) Layers section
(f) Equipment store
(g) Feed store
(h) Unit head offices
(i) Processing unit
(j) Loading bay
(k) Isolation area
(l) Vaccinating entrance

7.2.3 FISHERIES UNIT

Pond construction and layout

Fishery laboratory and growing.

7.2.4 PROCESSING UNIT

It is a unit where the animals are processed for human consumption. This unit consist:

- Procurement room
- Production
- Storage
- Supervisor.

7.2.5 FEED MILL UNIT

A farming estate of this magnitude will definitely need a large supply of feeds for the poultry and fisheries as the demand rise.

The mill shall produce all types and grades of feeds needed for the fisheries and poultry on the farm. The unit shall consist:

i. Grains storage silos
ii. Grains grinding sections
iii. Concentrate storage
iv. Mixing
v. Unit head
vi. Production staff rest room
vii. Loading bay
viii. Drying section.

7.2.6 STAFF FACILITIES

Working in the poultry and fisheries farm where solar energy is going tobe used need a lot of energy and experience in handling and taking care of the birds, fisheries, eggs, etc.

Therefore, for a successful management, the following facilities are provided for the staffs.,

- Canteen (Recreation area)
- Accommodation
- Changing room
- Toilets
- First aid room.

7.2.7 STORAGE & WARE

This area allows storage of dressed product.

- Poultry storage
- Fisheries
- Loading bay
- Section store.

7.2.8 MAINTENANCE UNIT

This unit shall also be central facilities that will be vested with the responsibility of handling the maintenance operations of the whole farm. Hence the rovision of efficient facilities for its smooth running cannot be over emphasized.

i. Central workshop
ii. Equipment store
iii. Unit head's office
iv. Loading bay.

7.2.9 AUXILIARY FACILITIES

- Loading and off loading
- Solar panel
- Water tank
- Incinerator
- Security gate
- Car parks.

7.3.0 SPACE REQUIREMENTS

7.3.1 SPACE SCHEDULE AND ANALYSIS

Table 3

ITEMS	LENGTH (m)	BREADTH (m)	NO	TOTAL m^2
ADMINISTRATION SECTION				
Entrance Hall	6.0	14.0	1	64
Reception Hall	5.5	7.0	1	38.5
Secretary to Sale Rep.	3.6	3.0		10.8
Sale Representative	3.6	4.0	1	14.4
Secretary to Farm Man.	4.2	4.0	1	16.8
Farm Manager	4.2	5.0	1	21.0
Sec. To Admin. Manager	4.2	4.0	1	16.8
Administrative Manager	4.2	5.0	1	21.0
General Office	3.6	8.5	1	30.6
Record Room	3.0	3.6	1	10.8
Board Room	3.5	6.0	1	21.0
Toilet	1.2	1.5	12	21.6
Chief Executive Officer	5.0	5.0	1	25.0
Sec. To C.E.O.	3.0	3.6	1	10.8
General Manager	5.0	4.0	1	20.0
Production Manager	4.0	5.0	1	20
Sec. To Prod. Manager	4.0	4.0	1	16
Cashier	3.0	4.0	1	12
Reception to Cashier	3.0	4.0	1	12
Account 1	3.6	5.8	1	20.88
Account 2	2.7	5.8	1	15.66
Sec. To Quality Con. Off.	4.0	3.2	1	12.8
Quality Control Officer	4.0	4.0	1	16
Changing Room	3.6	4.0	1	14.4
Storage	5.5	8.0	1	44.0
Egg Point	4.0	4.0	1	16
Sale	4.0	4.0	1	16
Checking	2.0	4.0	1	8.0

RESTAURANT/CANTEEN

ITEMS	LENGTH (m)	BREADTH (m)	NO	TOTAL m^2
Restaurant	8.0	6.0	1	48.0
Services	6.5	5.0	1	32.5
Kitchen	4.0	5.5	1	22.0
Store	3.0	2.0	1	6.0
Lobby	3.5	2.0	1	7.0
Outdoor Cooking	2.0	5.5	1	11.0
Upper Floor				
Conference Hall	9.0	6.5	1	58.5
Computer Room	4.8	4.8	1	23.04
Solar Control Office	6.0	4.0	2	48
Information	4.5	4.0	1	18
Services	4.5	4.0	1	18
Staircase Hall	2.4	13.5	1	32.4

7.3.2 PROCESSING UNITS

ITEMS	LENGTH (m)	BREADTH (m)	NO	TOTAL m^2
Entrance	3.0	5.5	1	16.5
Lobby	6.0	3.0	1	18.0
Truck Bay (Receiving Door)	7.5	3.0	1	22.5
Defeathering	7.5	6.0	1	45.0
Laboratory	4.5	5.0	1	22.5
Store	3.0	5.0	1	15.0
Oven	3.0	5.0	1	15.0
Processing Zone	9.0	16.0	1	144
Changing Rooms	3.0	2.0	2	12.0
Toilets	1.2	1.5	2	3.6
Cold Room	6.0	4.0	1	24.0
Ware House	6.0	6.0	1	36.0

7.3.2 FISHERY UNIT

ITEMS	LENGTH (m)	BREADTH (m)	NO	TOTAL m^2
Fish Pond	15.0	25.0		375
Hatchery				
Laboratory	6.0	8.0	1	48
Collection Central	6.0	6.0	1	36
Equipment Store	6.0	6.0	1	36
Changing Room	3.0	5.0	4	15
Toilet	2.0	1.5	2	3
Cold Room	6.0	8.0	1	48
Storage	5.0	8.0	2	40
Ware Floor	7.0	10.0	1	70
Control Room	3.0	4.0	2	12

7.3.4 POULTRY UNIT

ITEMS	LENGTH (m)	BREADTH (m)	NO	TOTAL m^2
Poultry Cage	5.0	25.0	4	124
Store	3.0	3.0	1	29
Control Room	2.0	3.0	1	6

7.4.0 MATERIALS AND CONSTRUCTIONS

Many factors are taken into consideration in the selection of materials to be used for a building in farm estate like this. It can be broadly classified into economic criteria, mechanical properties, functional requirement and aesthetic values.

Generally, the design should require little maintenance and this entails careful choice of materials to be used in the construction.

The construction must withstand the following factors:

i. Physiological factors of weather, effect of acid and alkalinity.
ii. Building materials that may aid in the breeding of bacteria and other microorganisms need to be avoided.
iii. The material to be used must be kept clean and smooth.
iv. The material to be used must meet the building standard regulation.
v. The materials must be of high resistivity to fire and corrosion.
vi. The materials must be of high durability.
vii. The material should be replaceable.

Mechanically, the behaviours of materials are based on the economic rational and aesthetic values. These become the main factors of the project at hand.

In addition, structural dynamic properties due to shear, tensile, compression, creep, plasticity and twisting are all paramount importance in mechanical consideration of this project.

The materials used for the project include:

i. Steel
ii. Concrete
iii. Fixed brick
iv. Sancrete Blocks
v. Glass
vi. Wire mesh
vii. Cement
viii. Gravel
ix. Water
x. Insulating material i.e. hiring
xi. Long span corrugated aluminium roofing sheet coated with red iron II oxide.
xii. Wood (Plywood and Timber)
xiii. Solar panels.

75.0 STEEL

This material which is a metal is, an alloy of carbon and iron with high tensile and comprehensive strength. It is a stiff material with a modulus of elasticity of 205 KN/mm^2. It is also a ductile material with a yield point of $240 - 45^0$ N/mm and, it has the ability to undergo considerable strain after the limit and before ultimate failure. On a broad basis, the propentres of steel are such that the dead/imposed load ration of its members is small which means that, it is capable of carrying heavy line loads at the expense of a comparatively small dead or self weight. It is used in the building construction industry for reinforcement of concrete, doors and windows frames, roof truss members floors, handrails girdens etc. It is very versatile construction material which shall be very useful in all the buildings on the proposed project in one form or another ranging from $21 - 35$ KN/mm^2 and it is used as a building materials where structural forms with monolithic characters are desired. Such forms which are usually three dimensional are slabs walls, columns and foundations. Concrete which can be prestressed i.e. pre-tensioned or post-tensioned can be cast in-situ or precast. The use of concrete in this proposed project shall cut across almost all the buildings, as it shall be need in all, in one form or another in the construction processes.

7.5.1 TIMBER

This is one of the earliest structural materials and, it has a comparatively lightweight as, species used for normal structural purposes have weights approximately $1/16^{th}$ that of steel. However, as an organic material, knots and faults brought about during growth or seasoning constitutes zones of weakness, it is also a stiff material, with a modulus of elasticity of 4 KN/mm^2. Timber can be used in conjuction with other materials such as steel and aluminium without problems. It shall be used in this proposed projects as, partitioning materials, rails, roof truss members, doors and windows and their frames skirting and girdles in the office and so on.

7.5.2 ASPHALT

Asphalt is a black substance or material, which flows as a viscous liquid when hot and solidifies when cold. It can be used as damp proof membrane i.e. to prevent the floor

of water from one part of a building to another. Mostly, it is used in roof gutters for water resistance, that is, in the prevention of water in the gutter from seeping through unprotected concrete into the spaces beneath the gutter. It is also used for tanking purposes in under the ground level designs, such as underground concrete reservoirs and swimming pools. It should be noted that it could also come in many forms – mastic asphalt, for roof coverings, roofing felts or black sheating felts etc. Bituminous felt, which is used as a water repellant carpet, is also a form of asphalt. Asphalt will be used extensively in this project in the various units in one form or another as it is depended upon as an effective water repellant material.

7.5.3 GLASS

Glass is a hard and brittle material, which is usually transparent but, can also come in tints of varying colours, and can also be translucent, depending on the production specification. The process of heating soda lime and sand to the temperature at which they all melt and fuse manufactures it. In the molten state, it is drawn, cast, rolled, or run on to a bed of molten tin to form flat glass. Glass comes in diverse variety of types, thick nesses and sizes, but the standard market size in Nigeria is 2.4m x 1.2m and 0.9m x 0.6m approximately with thick nesses of 3mm, 4mm, 6mm, etc. The following are the types of glass in common use in the building construction industry.

Float Glass: This type is transparent with flat parallel, bright fire-polished surfaces with no distortion. It can be coated or tinted to reduce the admission of solar radiation.

Patterned Glass: Translucent on account of the fact that it is patterned or textured on one or both of the surfaces.

Wired Glass: This comes either transparent or translucent and has wire mesh embedded in it for strengthening. It is commonly used in fire protection and prevention doors and in roof glazing because the wire mesh holds broken glass together and so minimizes danger from broken glass. It is usually very strong.

Toughened Glass: This also comes either transparent or translucent and is usually very thick, such that, when broken, it fragments into comparatively harmless pieces. It is usually used for shop fronts, doors and safety screens.

Clear Sheet Glass: This is usually transparent, not exactly flat nor uniform in thickness and has the tendency to cause optical distortions.

Double Glazing Units: This is made of two panels of float glass, spaced apart and hermetically sealed around a dehydrated air space, to improve thermal insulation. It is used where heat transfer between spaces is least or not desired.

7.5.4 PLASTIC

Plastics are synthetic resinous substances, molded under pressure while heated; they come in a large range with diverse characteristics and properties. The tensile strength of un-reinforced plastic is about $60N/mm^2$ but, when reinforced with a suitable material such as fibre, a tensile strength of $160N/mm^2$ is achieved, using a randomly oriented fibre with a volume fraction of 1/10. The compressive strength goes in the same order.

On a broad basis, plastics have a high coefficient of expansion – about 8 times that of steel but when reinforced with glass fibre, they have a coefficient about the same as that of steel. It must also be noted that, plastics are light in weight and this is advantageous, where materials of lightweight are required. Thin tiles and sheets of plastics are used as floor finishes for offices, hospitals and public buildings. Examples of plastic materials available as floor finishes are – (i) pvc (poly vinyl chloride), asbestos tiles, (ii) flexible p.v.c. tiles and sheets, (iii) flexible pvc sheets and a backing of felt or cellular pvc and, (iv) thermoplastic tiles. Plastics can be used as materials for windows, walls, partitions and transparent roofing sheets. All the pens and other buildings with the need for improved natural lighting on the proposed farm will have plastic (translucent) roofing in some parts.

7.5.5 LATERITE

This material, which is brownish-red in colour, and is like sand in nature, while having clayish look, shall be used extensively on the farm, in the building works as an earth filling material. When well consolidated, it provides a solid base for the oversite concrete slab. It shall also be used on the farm as roads cover in the areas of the farm where animals will not pass through often. Also, it shall be used as a firm base for gravel in the roads that shall have gravel finishing. The importance of this material cannot be overemphasized, as it shall be used in almost all the buildings on the farm.

7.5.6 GRAVEL

Gravel, which comes from crushed granite, is an important aggregate (coarse) in the preparation of concrete. It comes in ¾", ½" and ¼" size, which gives the required strength in the preparation of concrete. The smaller the size of gravel, the finer the nature of concrete it is used for and sometimes, the stronger. Gravel shall also be used on this proposed farm, as a road covering material, on account of the fact that it resolves the problems of slipperiness and, the tendency to create messy situations of late rite. Gravel initiates friction thereby reducing or eliminating slipperiness, which is undesirable on farm roads.

7.5.7 CONSTRUCTION

Good results from construction works do not depend on good specification of materials and works alone it also depend on good craftsmanship. Therefore, the specification and detailing of materials and construction methods is of utmost importance. Consideration will be given here, to the various aspect of construction work as they affect or concern this project.

7.5.8 SITE CLEARANCE

Trees and shrubs in areas to be covered by buildings shall be cut down, grubbed up and carted away from site. Topsoil in these areas shall be removed to the depth 150mm, in order to rid the areas of all organic matter. The site clearance will be done either through manual labour or with the aid of earth moving equipments-depending on the size of the structures to be erected. After the clearance, the area shall be

treated (sprayed) with appropriate insecticides to eliminate the possibility of providing refuge or abode to disturbing insects such as soldier ants and termites.

7.5.9 FOUNDATIONS

There are many types of foundation in the building construction industry. The ones that shall be used in this proposed project will be two, viz (i) strip and (ii) pad foundation. The strip foundation, which is a continuous strip of concrete, shall be used under all load-bearing walls. The strip width shall be three times the wall thickness while it thickness shall be the same as that of the walls. The pad foundation which on the other hand is more or less an under the ground level footing for a column, shall be used under all the columns in the buildings. The base or spread of the pad foundation shall be determined by the loads on it and the bearing capacity of the subsoil, while its thickness shall be at least equal to the projection of the pad on each side of the column. The strip foundation shall be of mass concrete while the pad foundations shall be reinforced concrete.

7.5.10STRUCTURAL SYSTEMS

The structural systems-slabs, beams, columns and foundations are adequately co-coordinated to allow appreciable stability. The walls and columns have been arranged to follow a particular spaced cross-grid pattern, with expansion joints, at necessary locations to allow for differential settlements without structural damage to buildings and, to prevent cracks in concrete floor slabs. This will ensure efficient structural stability for the buildings on the farm.

7.5.11WINDOWS

Windows are openings, formed in walls or roofs, to admit daylight into interior spaces, through some transparent and/or translucent materials fixed in such opening. Other functions of windows are ventilation and visual access. The various types of windows that shall be used in the buildings on this proposed farm shall include custom made toughened clear glass panels for areas like exhibition and display halls, aluminium sliding windows for offices, rigid thermoplastic windows, which shall be used as a means of admitting daylight into such buildings.

7.5.12DOORS

Doors are solid barriers in a doorway or opening and, can be opened for access or closed to deny access for privacy and security reasons. They shall also be designed for the purposes of this work to function as thermal, acoustic, fire and weather barriers and shall be used in the various buildings on the proposed farm. Doors like single leave, single swing flush doors shall be used in the offices and farm houses interiors, while double leave, single-swing doors will be used for the stores, warehouse and barns. Also, purpose made sheet metal sliding doors and galvanized steel roller shutter doors, shall be made used of where appropriate.

7.5.13WALLS AND WALL FINISHES

Walls are continuous, usually vertical, solid structures of brick, stone, concrete, timber, plastic or metal, thin in proportion to their length and height, which encloses and protects buildings, or serves as internal partition mediums. They are usually either load bearing or non-load bearing.

All non-load bearing walls in the buildings on the farm shall be 150mm thick while, the load bearing walls shall be 225mm thick. Load bearing walls shall also have columns and beams running through them, at certain intervals both vertically and horizontally, for structural stability. They shall be plastered with 12.5mm thick (internally) and 19mm thick (externally), cement/sand mortar and rendered with texcote fire retardant paints. The veterinary clinic, toilets and showers walls shall be lined with white glazed ceramic tiles to height 2.10m to prevent capillary action of water and dirt stains.

7.5.14 ROOFS

Roofs are constructed to serve as weather covers for the interior parts of buildings. They are classified according to materials e.g. steel roof and timber roof or according to construction e.g. flat roof and pitched roof. The following roof types shall be adopted for buildings on the far

(a) **Pitched Lattice Steel Roof Truss**

This roof type made of 3", equal sided, angle iron shall be used for the roof construction of some buildings on the farm. It is designed to allow for the admittance of natural daylight in these functions, through the use of thermoplastic sheets as part of the roofing sheets. This roof type also has the advantage of the ability to cover a large span without internal supports.

(b) **Flat Reinforced Concrete Roof**

This roof type shall be used in the changing rooms/toilet areas of buildings. It shall also be used in areas that have the potential of generating, catching or spreading fire. It has the added advantage of being able to provide both a roof for the toilets and space for service items such as central air-conditioners and overhead water tanks.

7.5.15CEILINGS

The ceiling material for all offices and other spaces/functions with ceilings in the complex shall be 600 x 600mm, 12mm thick, acoustic fibrocement boards, mounted on steel railings fixed at 600 x 600mm centers. Floor to ceiling heights shall be as detailed in the drawings.

CHAPTER EIGHT

8.0.0 ELECTRICAL SERVICES

8.1.0 ELECTRICITY AND LIGHTING

The National Electric Power Authourity (NEPA) main of 415kv which is readily available but not always constant. At time, the power might be faulty and not easy to repair with immediate effect. Hence, an alternative form of energy (solar energy) through the sun shall however be made available in form of a private photovoltaic modules generating houses on the different positioning in the farm that is able to supply the farm electricity and lighting.

The internal distribution of this power shall be via conduit pipes and cables as the case may demand or dictate.

8.2.0 HEATING, COOLING, AND LIGHTING

The building regulations are concerned with heating appliances, which produce smoke, or gases and these are divided into three classes:

(i) High rating appliances – rating exceeding 45 kW

(ii) Class I appliances – solid fuel or oil burning appliances

(iii) Class II appliances – gas appliances, rating not exceeding 45kw

INCINERATORS are similarly classified, but by their cubic capacity.

NOTE: since the installation of high appliances will almost invariably be carried out under supervision of a heating engineer, only at outline functional requirements are prescribed.

APPLIANCES – means a heat – producing appliance, including a cooker, which is design to burn

(a) Solid fuel solid fuel appliances

(b) Oil oil burning appliances

(c) Gaseous fuel gas appliances

Appliances also include an INCINERATOR using any means for ignition of refuse, including electricity.

Fuel is among the means of passage conveying appliance discharged to the external air and includes any part of the passage in an appliance maintain duct which serve the purpose of a fuel.

Appliance ventilation duct: - it is a duct, which supplies an appliance, and also take away combustion products.

CONSTRUCTION HEARTH

This is a hearth forming part of the structure of a building. It is usually a concrete slab.

8.3.0 WATER SUPPLY

In most of the developing countries, more often than not the water management planning process is ignored to the detriment of the citizens. Inadequate treatment of the mixture of river water and raw sewage had caused a lot of epidemics and water borne diseases in the past.

Therefore, water management program in the KUJE town is expected to be planned in such a way as to avoid and prevent water borne diseases.

DEMAND FOR WATER IN THE KUJE FARM.

i. Potable water for the farm estate
ii. Irrigation water for agriculture and landscaping
iii. Emergency fire fighting requirements.

Between the year 1982 and 2000, average daily consumption of water ranges between 197litres and 265 litres per person per day.

Average daily water consumption for various buildings and other facilities

TYPE OF ESTABLISHMENT	GALLONS PER DAY
Bath house (per bather)	60
Multiple family apartments (per resident)	40
Single family (per resident)	50 – 75
Livestock (per animal)	12
Poultry (chicken (per 100)	5 - 10

8.3.1 WATER SUPPLY

Small properties – good construction.

Single source of water with adequate volume and pressure is required. Public water works connection.

Primary supply is going to exceed 500 gal/min at a pressure of 15 Psc at highest main roof level where cross mains connect to riser or feed mains. Additional volume and pressure are often required depending on the hazard of occupancy or construction

SOURCES OF WATER SUPPLY:

Public water – one or more connection to reliable public water system of good pressure and capacity are preferable as a primary source.

8.3.2 ELEVATED GRAVITY TANKS

Acceptable as a primary source when public water is not available. The capacity is the type that will be able to control the whole farm estate, which it will also depend on the height, construction and the need to supply hose connections in addition to, sprinklers. This can be used for wetting the birds during dry season in hot sun. Also the use of tanks for water supply is not left out in one way or the other.

8.4.0 REFUSE DISPOSAL (WASTE)

Refuse disposal in this case is concerned only with the construction and ventilation of refuse storage chambers, chutes and happens in buildings containing more than one dwelling, e.g. a block of flats.

The aim is to prescribe requirements with regard to the waste to both fire resistance and hygiene.

The waste or refuse disposal are some discussed food bedding, slurry dung, urine dropped on the concrete channel slab, rather than unlittered floor etc.

8.4.1 SLURRY DUNG

This is mostly part of the problem that is facing many farm house; inability to control their slurry and other waste items from the concrete cubicle passages and yards to the slurry store. These tractor scrapers are usually rear mounted with renewable rubber blades and should be preferably reversible. Steel blades should be avoided to preserve the life span of the concrete floors. Also, in some barns and pens, slatted passages shall be used so that the stacks tread the dung between the gaps in the slats, it falls into the channel below. No scrapping is therefore needed and the stocks will kept reasonably clear. The channels are designed to allow the slurry to flow to some emptying point and they have a minimum depth of 3% of their lengths plus 400mm. The floors of the channel are designed to the level with the incorporation of some weir to refrain a depth of about 150m of liquid, in order to prevent the liquid from draining away separately from the solids. Waste disposal vehicles shall then be used to empty the slurry store and emptying point periodically.

8.5.0 DRAINAGE AND SEWAGE DISPOSAL

Surface water drainage: Paved areas an laid to gradient or falls toward gullies or channels that collect surface water and discharge through drains to sewers or soakaways. Paved areas on level ground are laid in bays to fall toward a central gully. When the ground slopes, paved areas should be made to fall towards a channel running down the slope to a gully. All down pipes an connected to a back inlet trapped gullies. Rainwater running off roofs are collected off roofs and discharged by rainwater pipes to drains.

In the layout of drainage system, drains are run in straight lines with a few changes of direction, gradient and junctions as practical to minimize blockages which generally occur at changes of direction, changes of gradient; junctions and pipe joints and to economise in the expense of junction fittings and manholes.

Foul-water drain system: This collect discharges from W.C.s, baths, basins and sinks . Soil pipes connect directly to the foul-water drain as a vent to the drain system. Soil and waste pipes are run inside the buildings to prevent blockages by freezing. Where the drain connection to a soil pipe passes through the wall of the building there is at least 50 mm clearance all round the drain to accommodate differential movements between walls and drain that might otherwise fracture the drain.

For the collection and storage of foul water a cesspools is to be constructed. This should be watertight to loss of water from within and entry of ground water from without, the former to avoid ground pollution, the latter to prevent flooding and overflowing of chamber.

8.6.0 ACOUSTICS

Acoustics problems are not much envisaged in this farm estate as adequate air exchange points (windows/screen walls) are provided to allow for easy escape of sound especially in the long barns and pens. Acoustics problems occur only where noise (when produced in an enclosure) is denied exit from the enclosure thereby causing echoes and reverberations. Appropriate measures have been taken to avoid

such situations. Which can cause several problems and commotion in the cattle herd, since they are highly sensitive to heavy noise.

8.7.0 FIRE SERVICE AND SAFETY (OUTBREAK AND PRECAUTIONS)

Since regulations are made in the interest of public health and safety, they do not attempt to achieve non-combustible buildings but rather to ensure the safety of the buildings, its occupants and the public.

Buildings must therefore be constructed so that

(a) they will resist collapse for a sufficient period of time to allow evacuation of occupants

(b) the speed of fire within and between them is kept to a minimum

A 24 hours control house shall be provided on the farm. It shall house an electric panel of the design of the whole farm and that of the building there in. this panel is electrically connected with all the offices, rooms and spaces on the farm complex with highly sensitive flame/smoke detectors. The fire control house shall also house the fire fighting department and their equipment.

If there is an outbreak of fire in any section or space of the complex, the detectors send signals, which appear in the form of light on the electronic panel at the exact location in the building in question. This helps the fire fighters in detecting fire outbreak immediately after it breaks. Before serious damage is done it is quickly extinguished, through the appropriate medium of extinguishing that class of fire. Also for the categories or classes of fire that can be extinguished with water, dry and wet risers are located also at different strategic locations in the buildings. Water hydrants are also provided at different location on the farm for the same purpose.

8.8.0 SOLAR CONTROL

Solar Angles

The position of the sun with respect to any point on the earth's surface is defined by the angle of Azimuth and the angle of Altitude. The latitude of course determines these angles, the date and hour.

AZIMUTH is simply the angle measured horizontally from the North meridian for morning hours it is measured in an eastern direction for afternoon hours, Westerly.

ALTITUDE is the angle, measured vertically, between the sun and the horizontal plane of the horizon.

North meridian is the true North not the Magnetic North.

8.9.0 SECURITY

SITE SECURITY

Defensible space is a term used to describe a series of physical design characteristic that minimize resident control of behaviour, particularly crime within a residential community.

Therefore, the farm estate has to follow some kind of difensible space guidelines which clearly defines all areas as public, semi private and private. In so doing, it determines who has the right to be in each space and worker to be confident in responding to any questionable activity or persons within the farm. This rule of concepts improve the ability of security men to monitor any activities within the farm.

In this farm estate, the terms limiting access is adopted, that is, it is refers to the use of physical farm estate planning to prevent a potential criminal from entering certain space. Although no barrier is impregnable, physical barriers of these types are real and are relatively difficult to overcome.

To maintain some assured security, certain systems is adopted like:

(i) Zone of influence i.e. area surrounded by building on an outdoor extension of dwelling where person in charge could be able to monitor that environment against any criminal.

(ii) Use of real symbolic barrier where before any access is done to any office or gate, there must have been an approval from the security gate or before going to any offices tacklers of knowing the location of the farm.

While symbolic barriers is a define areas or relate them to particular building without physically preventing intrusion.

Some elements of security in the farm estate.

(1) Plant materials
(2) Ground covers
(3) Low shrubs
(4) Mid-sized shrubs
(5) Trees

Construction Elements

(1) Low fences
(2) High fences
(3) Gates
(4) Billiards
(5) Paving materials and fixture
(6) Slopes and Berms
(7) Stair and Ramps.

Manufacture Elements

Site furniture
Play equipment structure
Site tighting

All this aforementioned information always serve the purpose of eliminating unassigned space, minimizing penetrability, maximizing surveillance and minimizing design conflicts.

8.10.0 COMMUNITY

The community tribe is mostly comprises of the Gwaris. Most of there occupations are farming and fishing. Hardly could anybody meet them at home during the day, except they were on market days only or festival period.

Among many groups of people that are in the community but not the indigenes are people that have migrated to that place from the main city of Abuja to dwell, house and establish on the land. Most of these people are working in the main F.C.T. Abuja while some have their sub-office in Kuje town.

These types of give balance and give room for a solar farm estate like this to move faster in development and production.

8.11.0 MAINTENANCE

Maintenance is of major importance in farm estate like, this because proper maintenance ensures high yield in the farming operation without any failure. These are considered on the high quality of materials specification and the type of construction being applied. As these processes are achieved, a proper visitation and observation are organized to be done on machines and all other necessary equipment and gadgets to be used. This is with respect to photovoltaic modules being used. As it has been guaranteed for 20 years before any tangible reparation could be done, yet regular observation during some clearing and greasing are required for optimum performance.

CHAPTER NINE

9.1.0 AESTHETICS

Aesthetics can be defined as that part of philosophy, which deals with the perception of beautiful as distinguished from the moral or useful. It is also the branch of psychology which deals with sensations and emotions evoked by beauty. Now having said this, there is this general believes that aesthetics is a very subjective phenomenon. This habitual saying "beauty is in the eye of the bidder" proves this. Yes these of course still holds but I am of the view that a carefully planned design most times wins the applause of the sundry. So in this regard, Solar Farm Estate is a modern design, which evolved owing to thorough consultations. There is an immediate sense of variation and richness throughout the whole proposals which was made possible by the juxtaposition of avalanche of materials ranging from variable roof forms; terraces; external wall treatments, grandiose combination of numerous landscape elements, etc.

In this proposal (design), I acknowledge the theory of space and light, which have positive psychological, health and energy saving benefits. This is shown by the fact that positive exposure to full spectrum light results in less truancy. Also as part of the proposals, the aesthetics of the interior decoration is reinforced by the use of specially designed furniture system, the generously proportioned tables in various offices, board room, reception etc. all in a bid to encourage positive attitudes, moods and high performance. In addition, the proposed design with its apparent simplicity conceals a deep understanding of various factors necessary for smooth running of the industry.

9.2.0 GENERAL APPRAISALS

In appraising a project of this magnitude, it becomes very imperative to hard press some of the appreciable qualities the proposed design possessed. Nevertheless, it is a proposal committed to recognizing the need for future expansion (expanded innovations), permit flexibility of all kind if the need arise in future.

9.2.1 EASY ACCESSIBILITY

The proposed design is going to be established in Kuje in Abuja. Abuja as we all know remains the seat of the Federal Capital Territory. It has a well-linked and good road network. The ideal site is easily accessible, infact the question of easy accessibility should be put off. This is because Abuja road network remains the best in this country as at today and coupled with fact that problem of traffic-hold-up is hardly noticed.

9.2.2 PLANNING

The basic principles guiding this proposed design i.e. the canonic approach to design and zoning principles. Although the site layout was done to reflect the hierarchy of the traditional industrial pattern which is also the zoning principles. The facilities are spaced in such a way to allow for easy circulation. In addition to canonic design and zoning principles, the design permits flexibility and spaces for future expansion. The planning conspicuously defy curve type of driveways within the site, this is to avoid maneuvering for heavy trucks who usually form curve ways difficult.

9.2.3 LANDSCAPE

The proposed design is landscaped in such a way that as you drive in the site you could have a possible appreciation of a panoramic view of the beautiful but simple serenity. This is made possible by the grandiose combination of numerous landscape elements such as trees, shrubs, grasses, flowers, lighting fixture round the site, water pool, fountain etc. Undoubtedly, such type of site enhanced pleasant environment conducive for business transaction and the main job in this particular industry.

9.2.4 PARKING, LOADING AND OFF-LOADING BAYS

As part of the requirement for this solar farm estate and for it to excel, enough parking spaces were provided for staffs and visitors. Loading and off loading bays was also provided for trucks, lorries and van. Ambulance bay was provided and even located in close proximity to the works clinic. In addition to these requirements, the security must be provided.

9.2.5 FACILITIES

All necessary facilities for "operation excellence" of the proposed Solar Farm Estate were provided. They include administrative block, fishery and poultry unit, processing block, warehouse, waste section and a host of others that are merely included in the site plan.

CONCLUSION

From all reasonable doubt, as it is very paramount for man to live and survive in the life God has created them, food took the major human needs for survival, growth and advancement.

Approaching this view under the establishment of farm estate (fishery and poultry production). The living of man must develop for them to think that they can rationalize and solve the problem of life about clothing and shelter coupled with technology advancement of our age.

Low key of production due to approach of technology with the use of National Electric Power Authourity and the use of generator plant really have some adverse effect to some our rural farm land and urban area. Even deviating from all these source of energy production (where there is no light).

Hence, solar energy application into both the rural and urban aspect of life and bring changes and great technological advancement out toward our agricultural based environment and normal human life. Being the only independent sources of energy.

Therefore, this project or thesis is not the best solution so far but a way out to economic advancement and great transformation of revival to our agricultural environment. If the government or each individual elite and men of understanding could consider the future outcome of it and not the capital based that need to be expended on it, it will solve many problem.

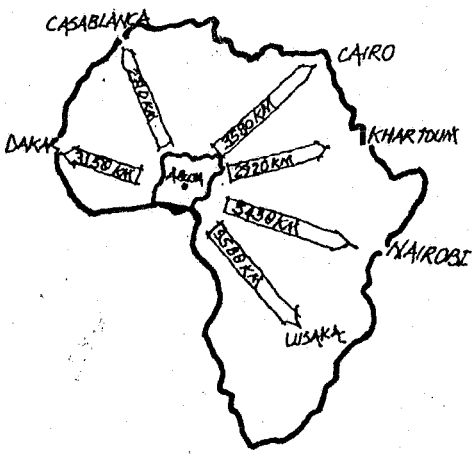
Conclusively, architecture offers solution to various aspect of life.

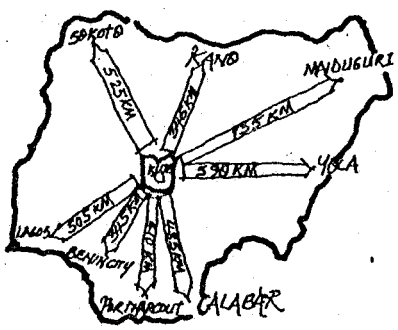
REFERENCES

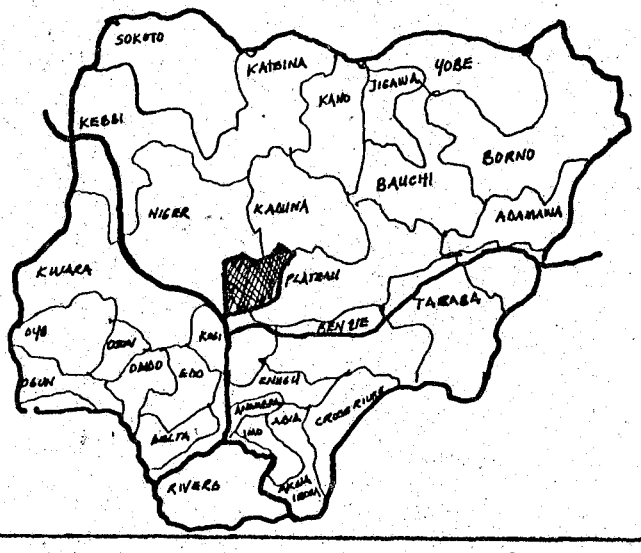
1. Adeleke B.O and Goh C.L (1981); Certificate Physical and Human Geography, University Press, Ibadan, Pp 6-10.
2. Edward T. W (1978); Site Analysis, Pitman, London, Pp 18 – 20, 102-110
3. Federal Republic of Nigeria (1983), Regional Development Plan for the Federal Capital Territory, Dox-Nigeria-A, Lagos Volume 2 of two (Book 3 of four) Pp 1225-1247.
4. Federal Department of fisheries (October 1998) Aquacultures Extension Guide, Federal Department of Fisheries (F.C.T. Abuja) Vol. 1.
5. Fernandes. E.O, Faist A.P (1981), Building Energy Management, Pergamon Press, New York (First Edition), Pp
6. IAR & TOAU, Ibadan and AERLS, A.B.U Zaria, (1989) Livestock and Poultry Management, University Press. Ibadan.
7. Givoni B. (1976), Man, climate & Architecture, Applied Science publishers, New York.
8. Markus T.A and Morris E.N, (1980), Buildings, Climate and Energy, Pitman Limited (First Edition), London.
9. Morenikeji .W. (1999), Essentials of Research methods, Gabesther Educational, Ibadan (First Published), Pp 124-125.
10. Oladele Moses (1996), Solar Estate Sokoto, M Tech (Arch) thesis F.U.T. , Unpublished, Minna.
11. Ruddy, William and Duran, Fernando (July, 1975), Effect of Building Envelope Parameters on Annual Heating/ Cooling Level, ASHRAE Journal. New York.
12. Strom and Warm Aus. D.S (SVE 1999), Country House (Stand alone system 1.3 kwp), Siemen, Germany.

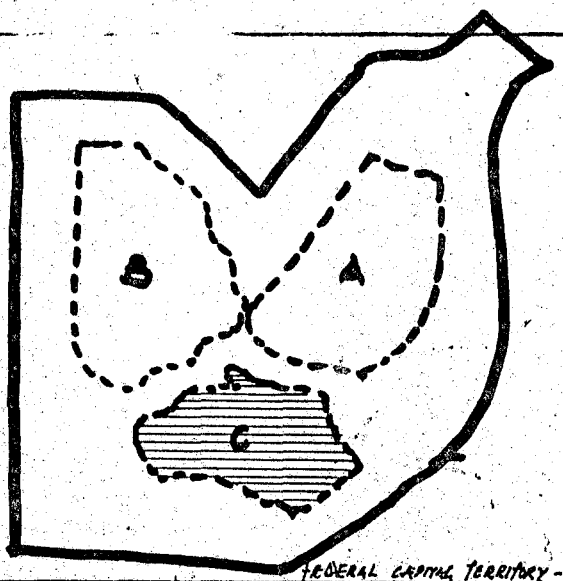
BIBLIOGRAPHY

1. Burberry .P. (1978), Building for Energy Conservation, Wiley, New York.
2. Ewa .K. (1992), Early Life History of Fish-An Energetic Approach, Chapman & Hall, London.
3. Gniadzik .J.S (1984), Structural Systems in Architecture, University Press, A.B.U Zaria.
4. John .S.G (1983), Practical Passive Solar Design, Mc Graw-hill, New York.
5. Odiah. R.I. (1997/98), Bennelt lighting Catalogue, Benneth Industries Ltd, Lagos.
6. Seymour .J. A.I.A (1980), the Architect's Guide to Energy Conservation (realistic Energy Planning for Building), Mc Graw-Hill. New York, 1980
7. The Federal Department of / Livestock and Pest control services (1997), The Federal Capital Territory, Abuja.
8. Tony .J.P and Paul. J.B. (1982), Fisheries Ecology Chapman & Hall, London.
9. William T.M. (1976), Energy Economics and Building Design, The Kingsport Press, U.S.A.
10. W. Palz & W Steemers (1981), Solar Houses in Envelope-How They here Worked, Pergarmos Press, New York.

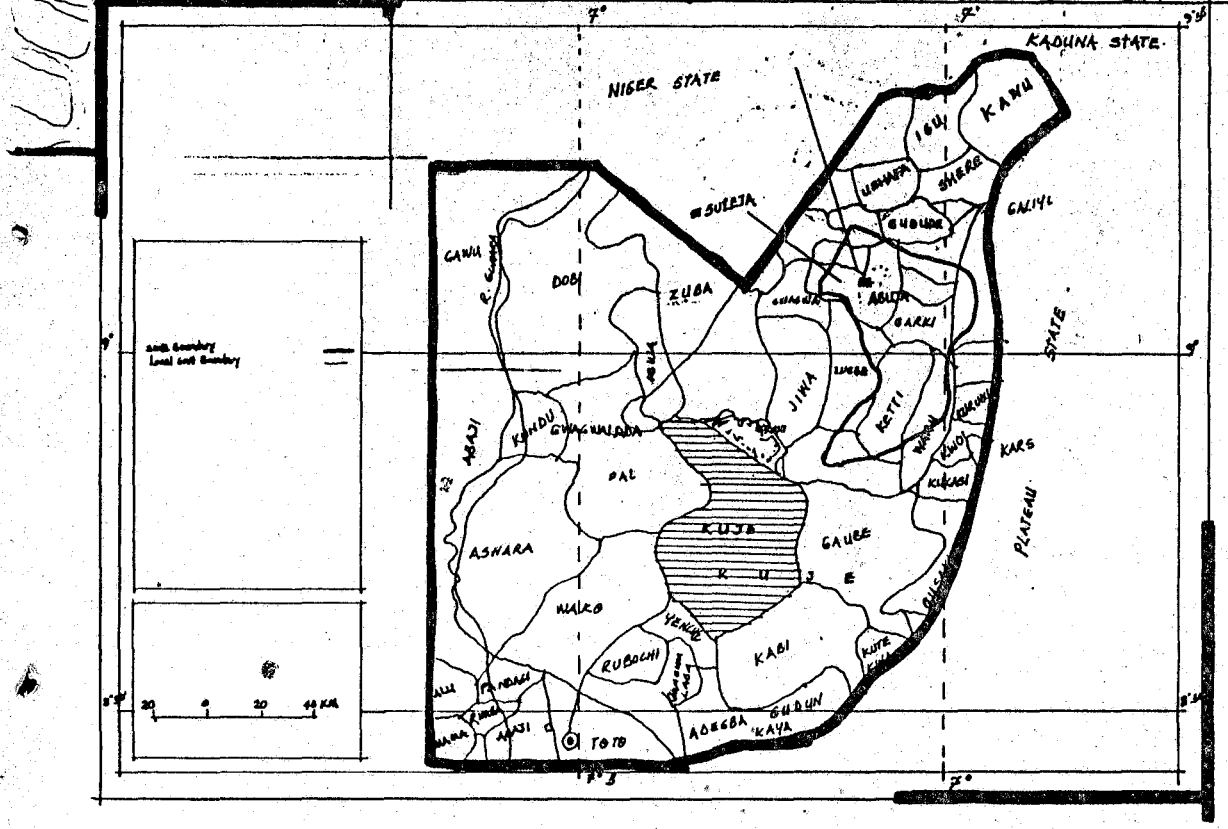

CASABLANCA
CAIRO
DAKAR
KHARTOUM
NAIROBI
LUSAKA
2800KM
3580KM
3150KM
5220KM
5430KM
5580KM


SOKOTO
KANO
MAIDUGURI
YOLA
LAGOS
BENIN CITY
PORTHARCOURT
CALABAR
525KM
285KM
450KM
390KM
505KM





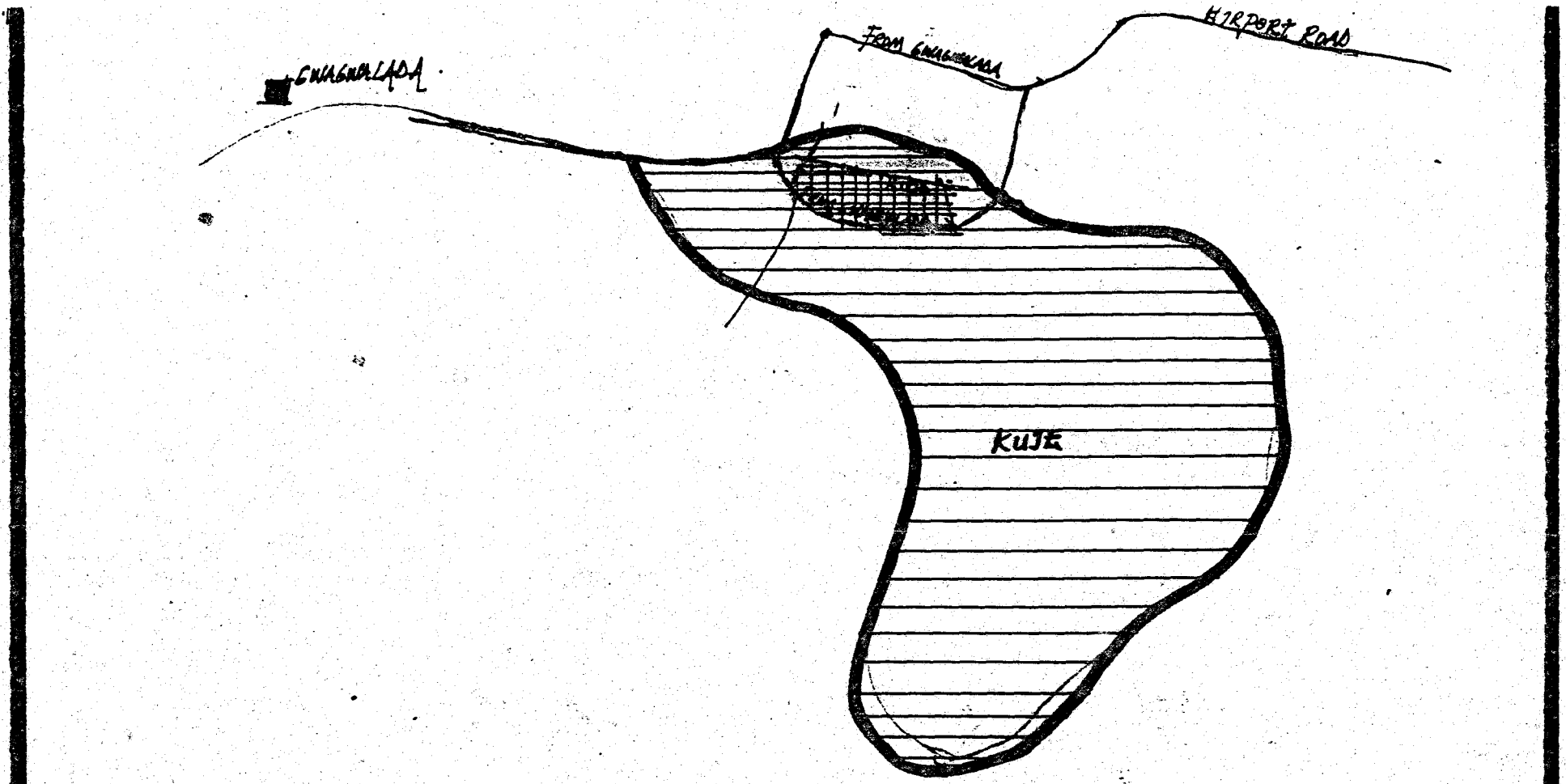
FEDERAL CAPITAL TERRITORY - SOCIAL INF. MAP.



ABUJA

SUPR. DR (MRS) ZUBAIRU

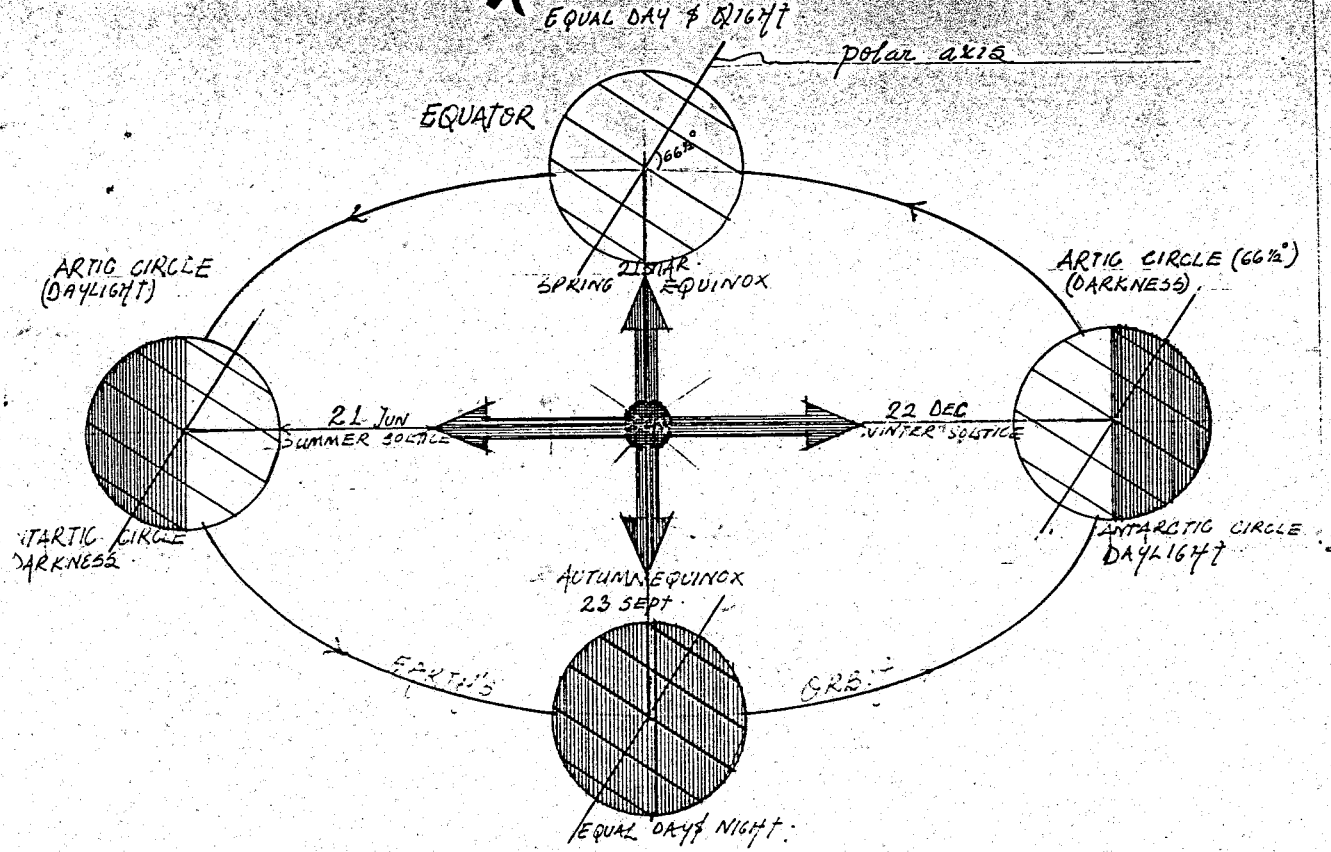
SCALE

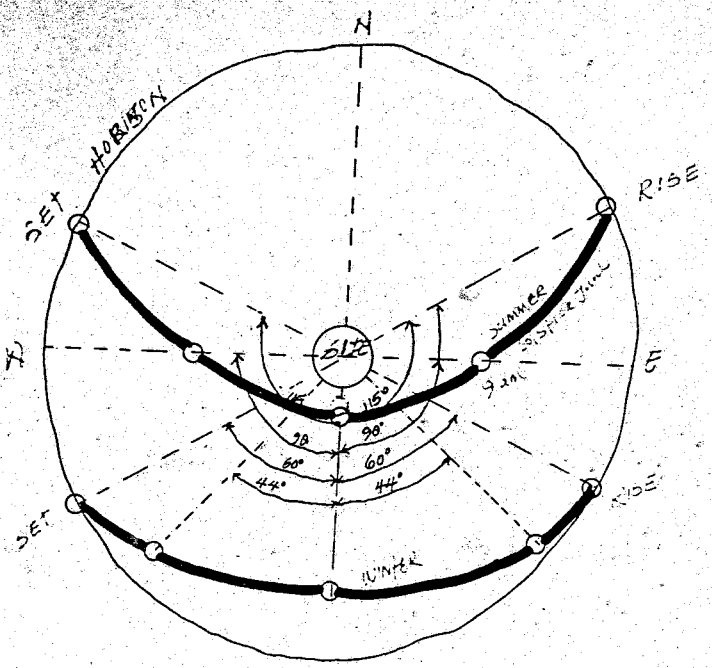


FARM ESTATE KUJE

1: PHOTOVOLTAIC PANEL FOR PUMPI

EFFECTS OF SOLAR ENERGY (SUN) ON EARTH



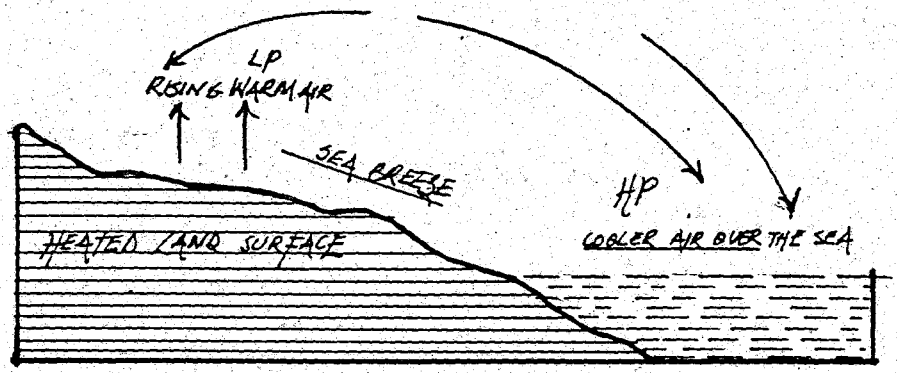


THE REVOLUTION OF THE EARTH AND ITS EFFECTS ON SEASONS AND THE VARIATIONS OF LENGTH OF DAY & NIGHT.

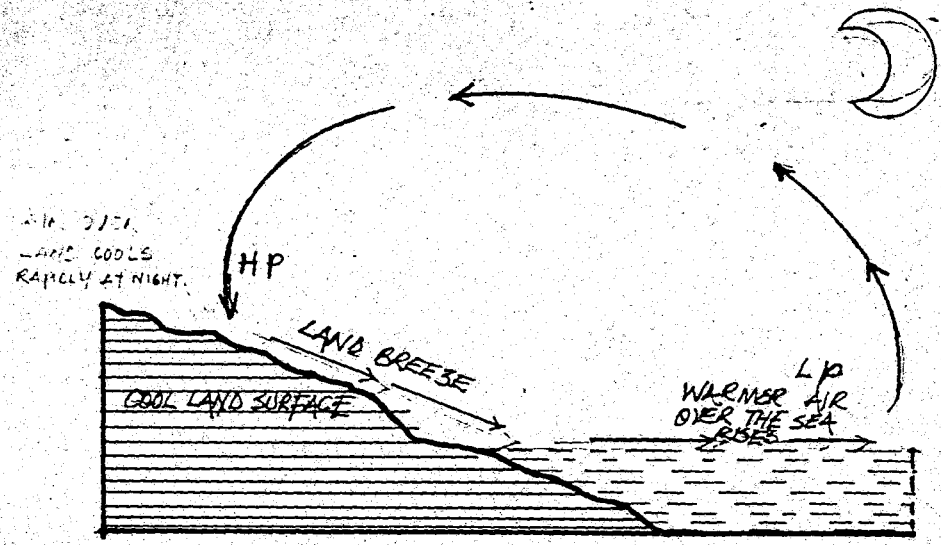
NIGERIA receives 5.02 × 10¹² KWh of energy per day from the sun

MEAN MONTHLY TEMPERATURE AND HUMIDITY

MEAN MONTHLY



SEA BREEZE DAY



LAND BREEZE (NIGHT)

NAME	OLAWOLU F.B.E
REGNO	93/4044
DEPT	AGRICULTURE
LEVEL	600L.

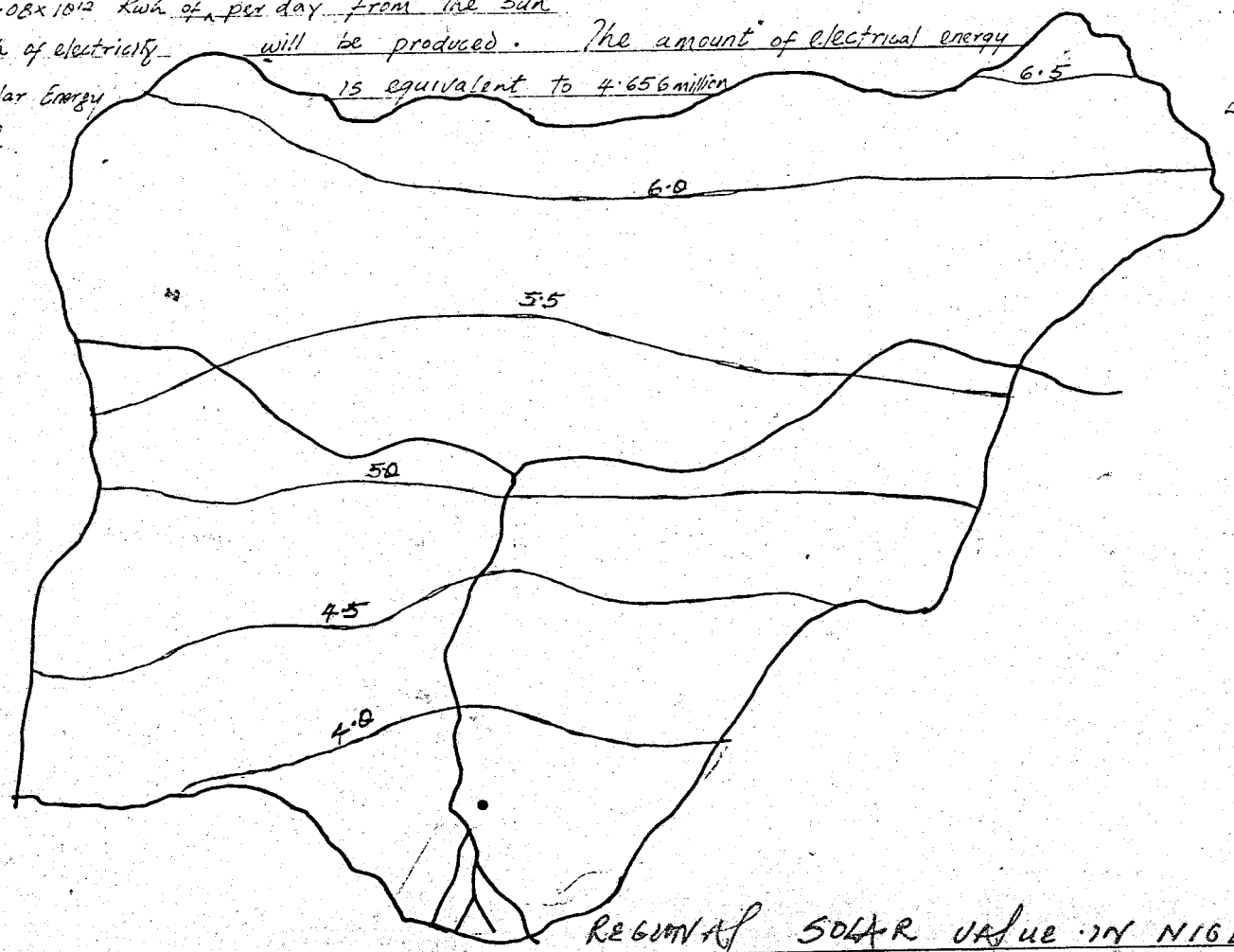
SOLAR FARM. ES1

Nigeria receives 5.08×10^{12} Kwh of energy per day from the sun

2.541×10^{6} MWh of electricity will be produced. The amount of electrical energy

is computed from Solar Energy is equivalent to 4.656 million

barrels of oil per day.

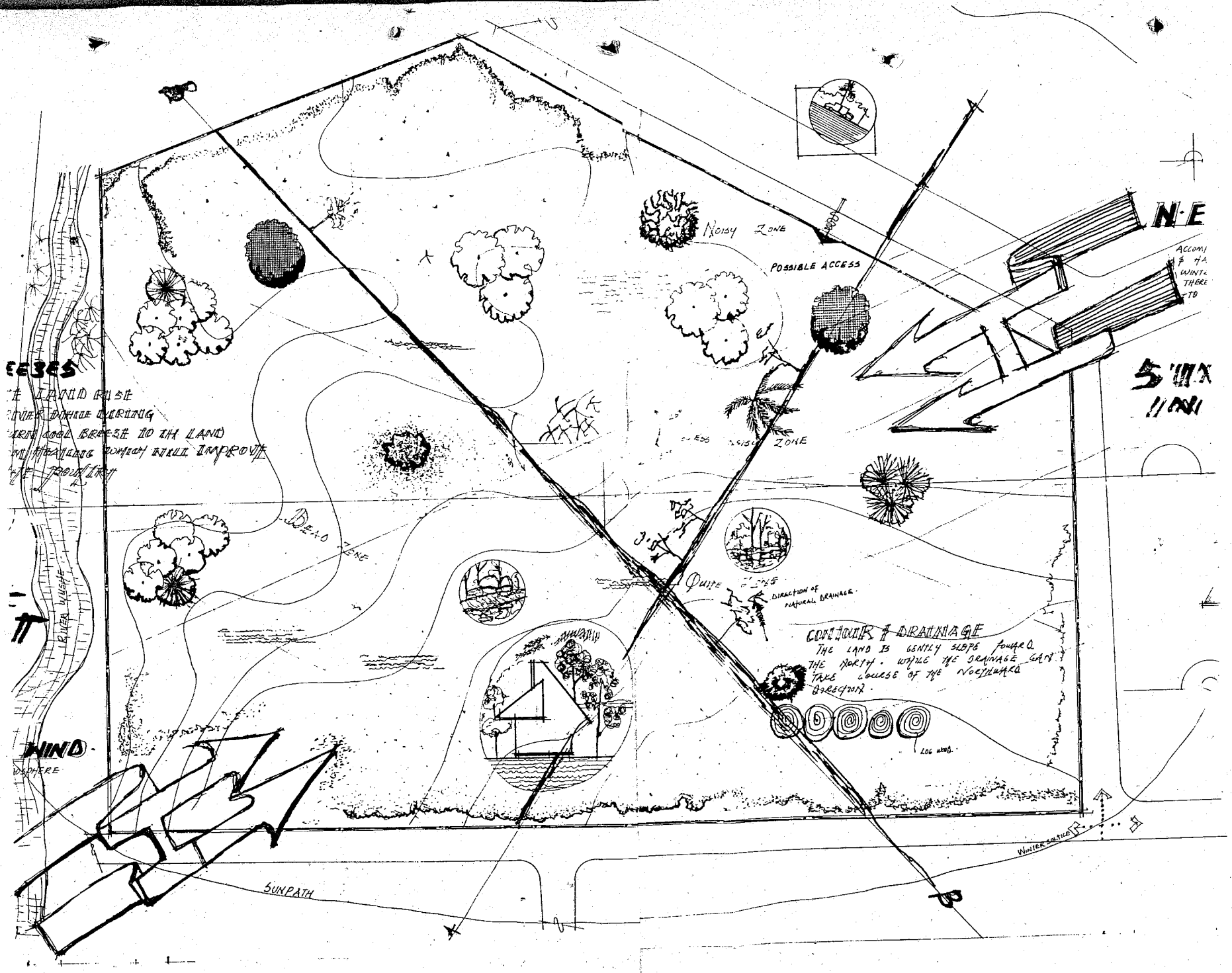


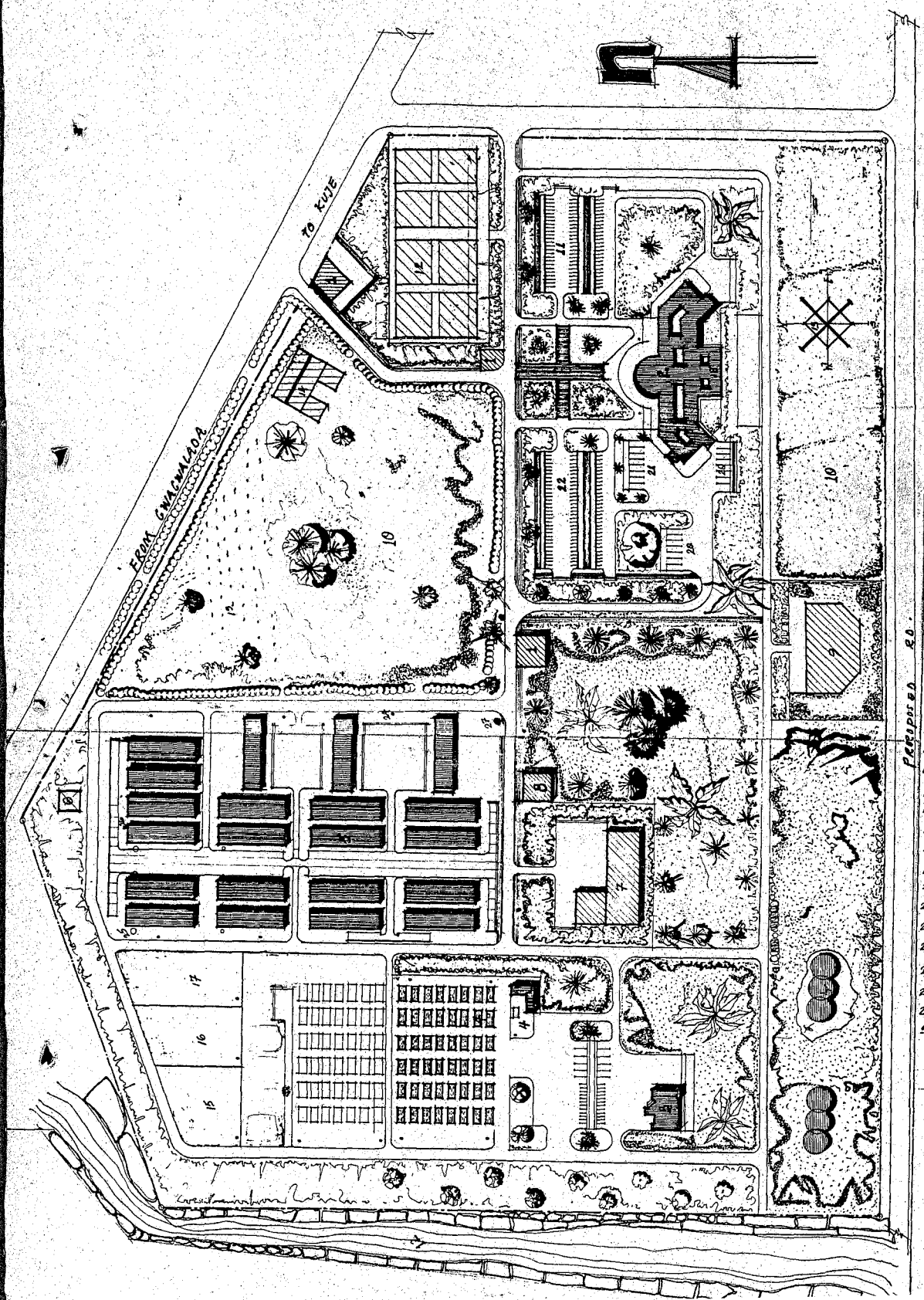
REGIONAL SOLAR VALUE IN NIGERIA.

STATE (KUJE) ABUJA.

M. Tech Thesis

SUPERVISOR	Dr (Mrs) Zubairu
BORE	-
DATE	March 92K.


Noisy Zone
POSSIBLE ACCESS
N-E
ACCOM
& HA
WINT
THERE
TO
SUN
WIN
ZONE
DEAD ZONE
QUIET ZONE
DIRECTION OF NATURAL DRAINAGE.
CONTOUR & DRAINAGE
THE LAND IS GENTLY SLOPE TOWARD THE NORTH. WHILE THE DRAINAGE CAN TAKE COURSE OF THE NORTHWARD DIRECTION.
LOG MOB.
RIVER WASH
WIND
SUNPATH
WINTER SOLSTICE
B

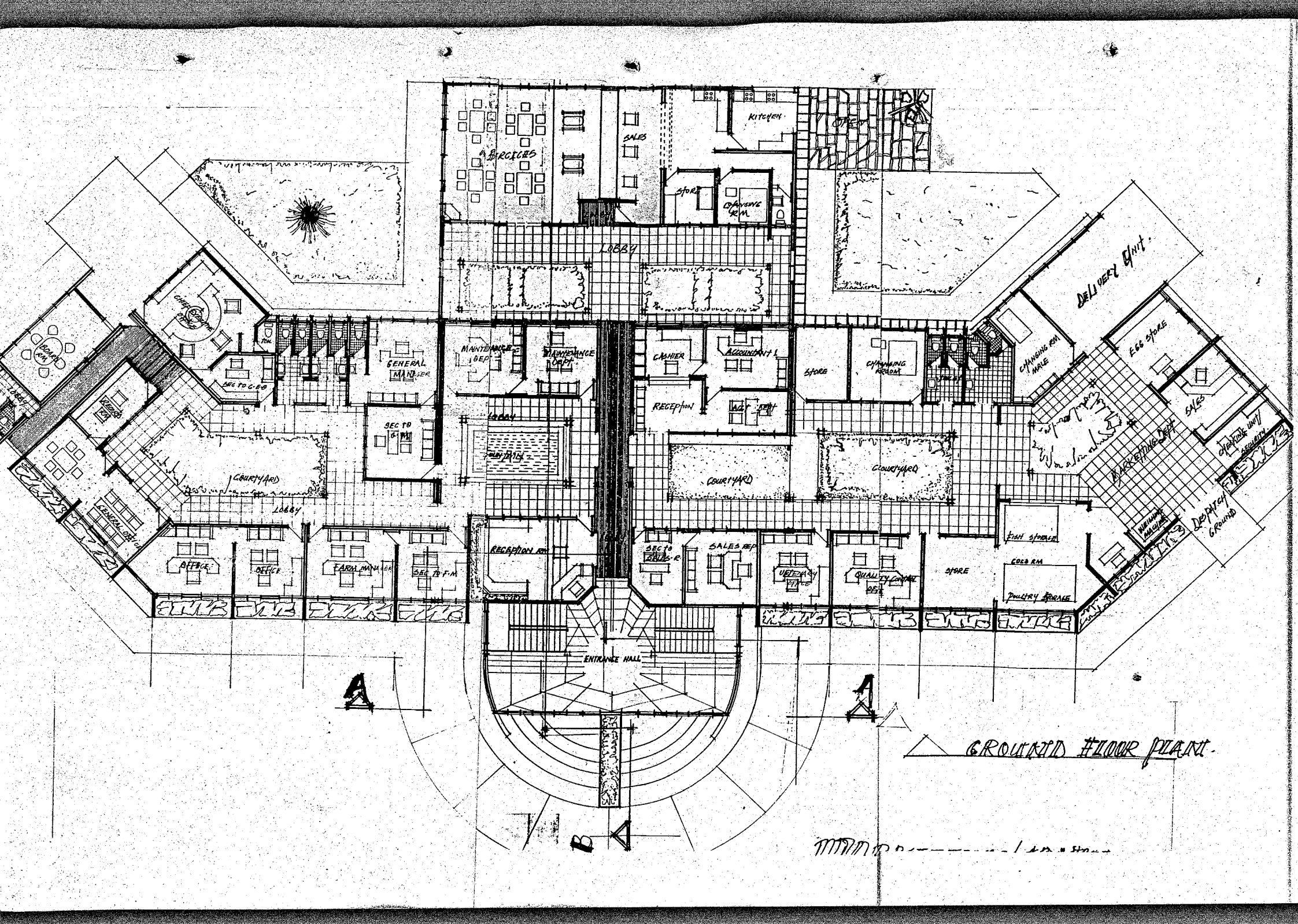


LEGENDS.

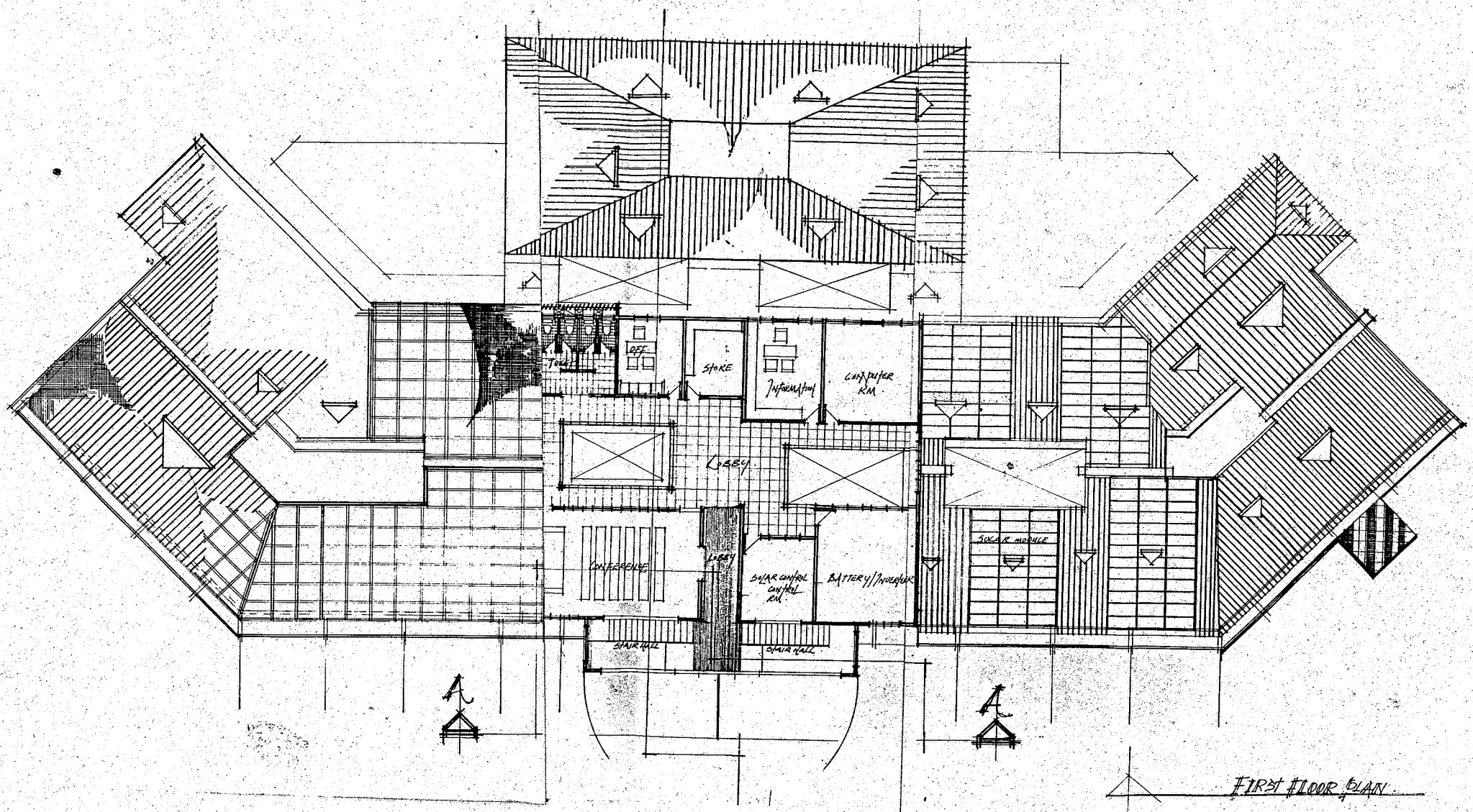
1	GATE HOUSE
2	ADMINISTRATIVE/REST.
3	PROCESSING UNIT.
4	FISHERY FARM
5	POULTRY SECTION.
6	SEWAGE DISPOSAL
7	STORAGE & FEEDMILL.
8	CLINIC & VETERINARY UNIT.
9	DIRECTORS LODGE
10	FUTURE EXPANSION.
11	CAR PARK (WORKERS)
12	STAFF ACCOMODATION
13	SOLAR MONITOR.
14	SHOPPING CENTRE (MINI)
15	GOAT SHED (FUTURE)
16	SHEEP SHED (FUTURE)
17	PIGGERY SHED (FUTURE)
18	RESTURANT.
19	CEREAL FARM (FUTURE).
20	DELIVERY
21	DESPATCH.
22	CAR PARK (CUSTOMERS)
23	REFUSE DISPOSAL
24	FARM SECURITY LIMIT
25	SILOS.
26	WATER TANKS.
27	BORE-HOLES.
28	
29	
30	

FUTURE EXPANSION

DEVELOPED.



GROUND FLOOR PLAN.

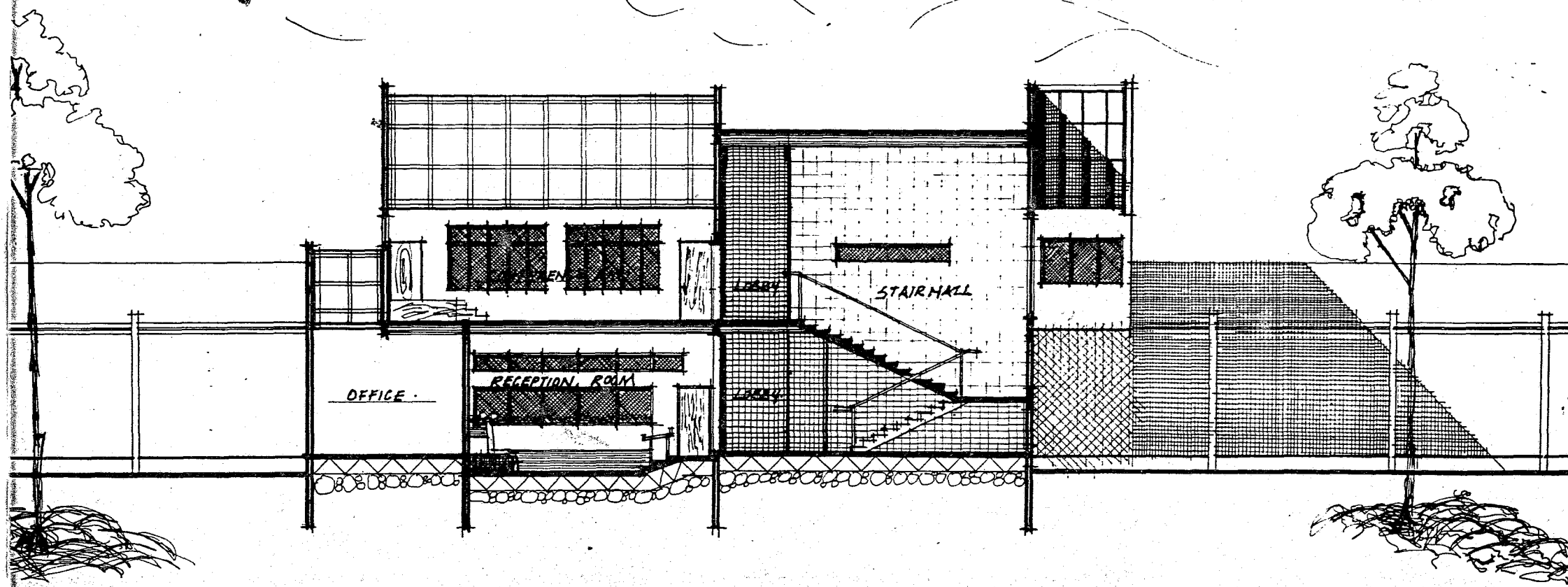


FIRST FLOOR PLAN

Approach Elevation

SOLAR FARM ESTATE (Mk1) ABIA.

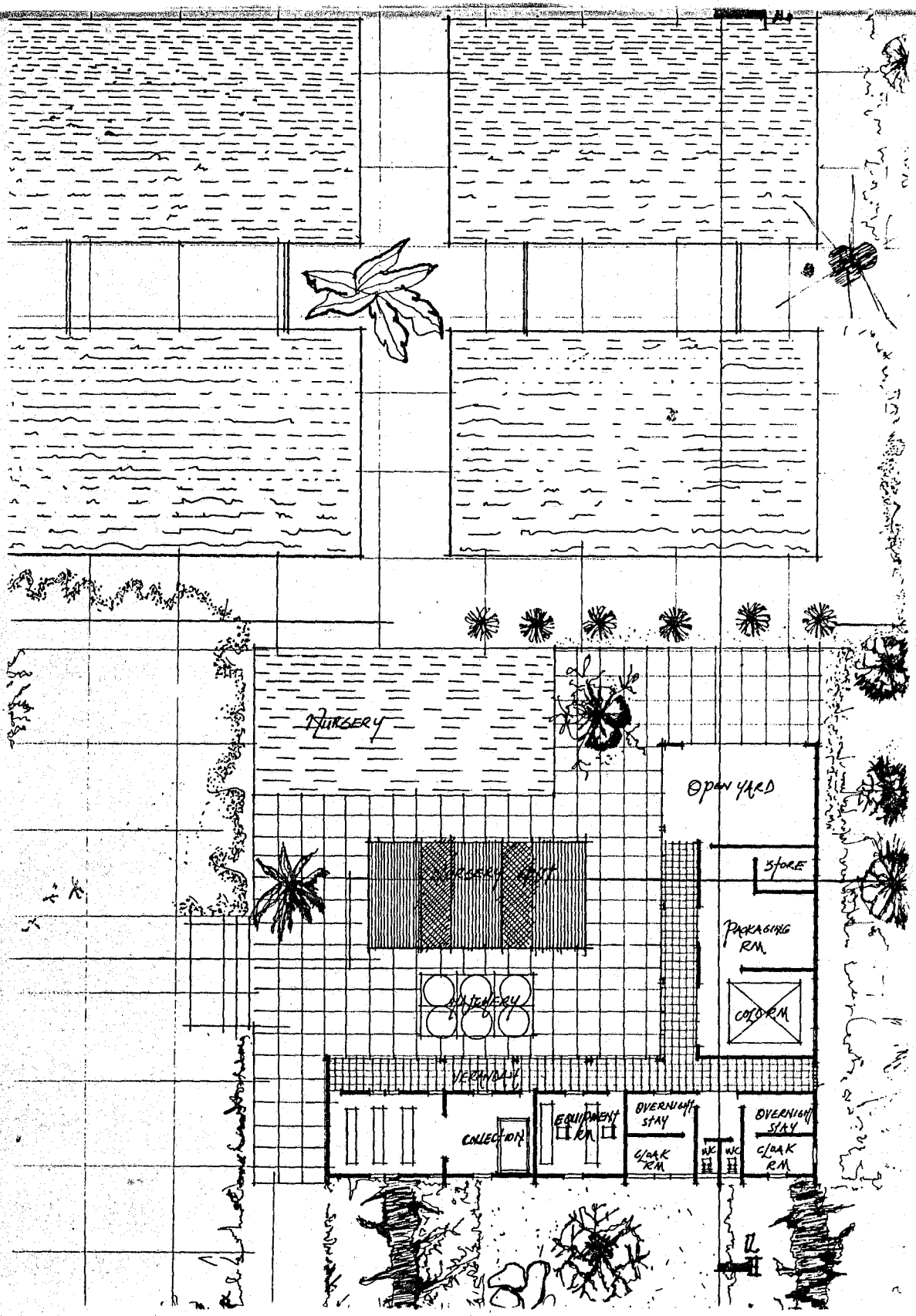
RESEARCH : PHOTOVOLTAIC PANEL FOR PLANTATION



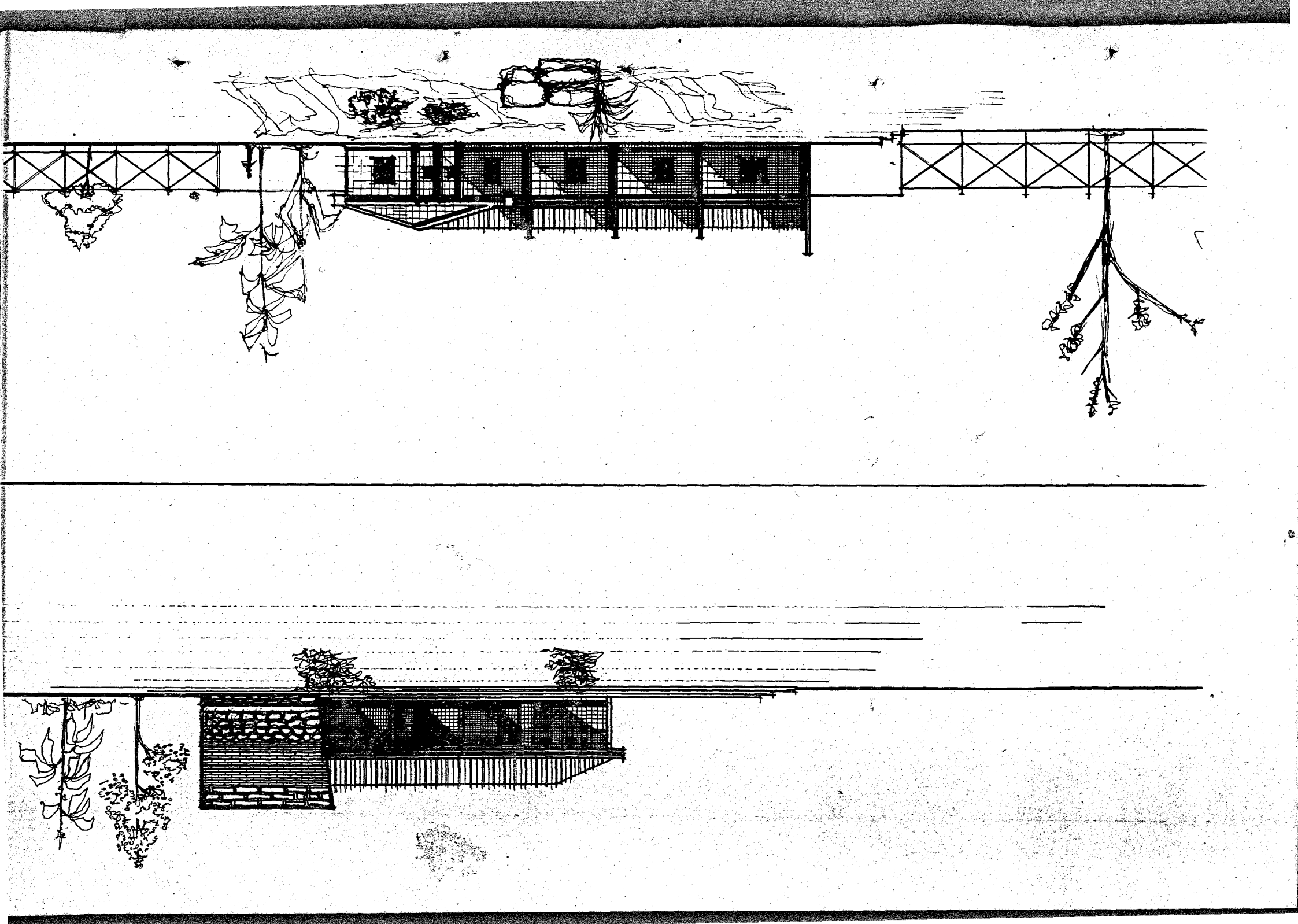
SOLAR FARM ESTATE (KUJE) ABUJA

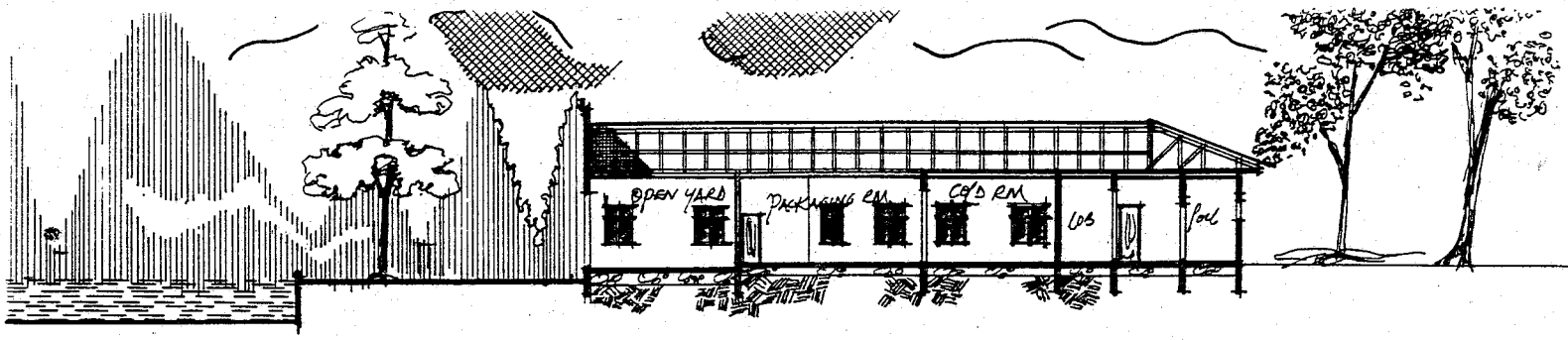
RESEARCH · PHOTOVOLTAIC PANEL FOR PUMPING & LIGHTING

ENTRANCE PORCH
RECEPTION HALL
RECEPTION
CONFERENCE ROOM
FOUNTAIN COURTYARD
SECTION A-A
OFFICE
COURTYARD
RECEPTION

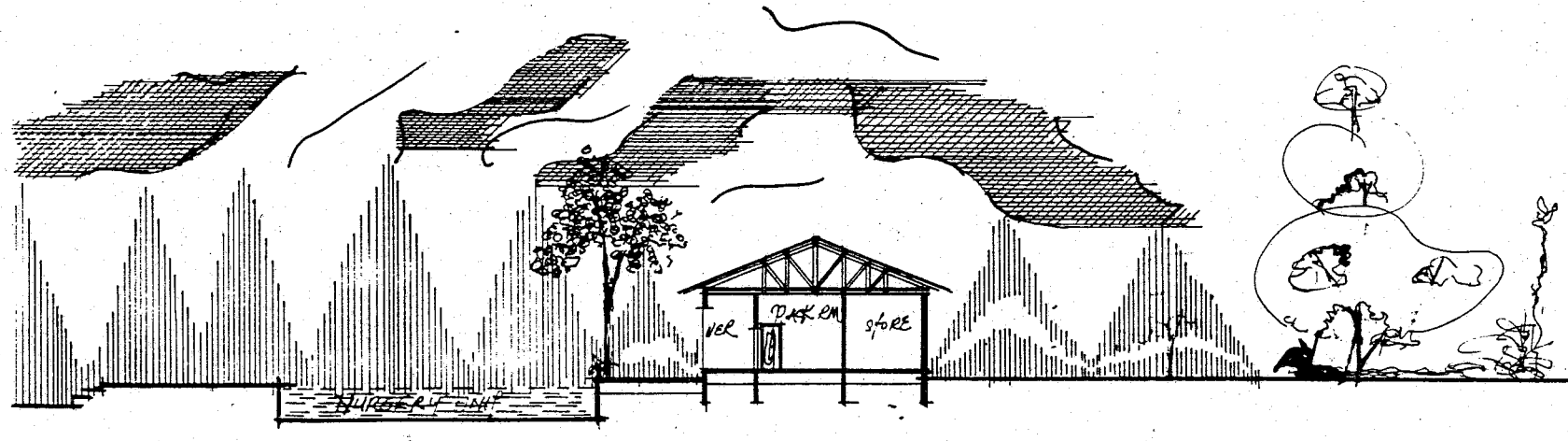


TYPICAL UNIT



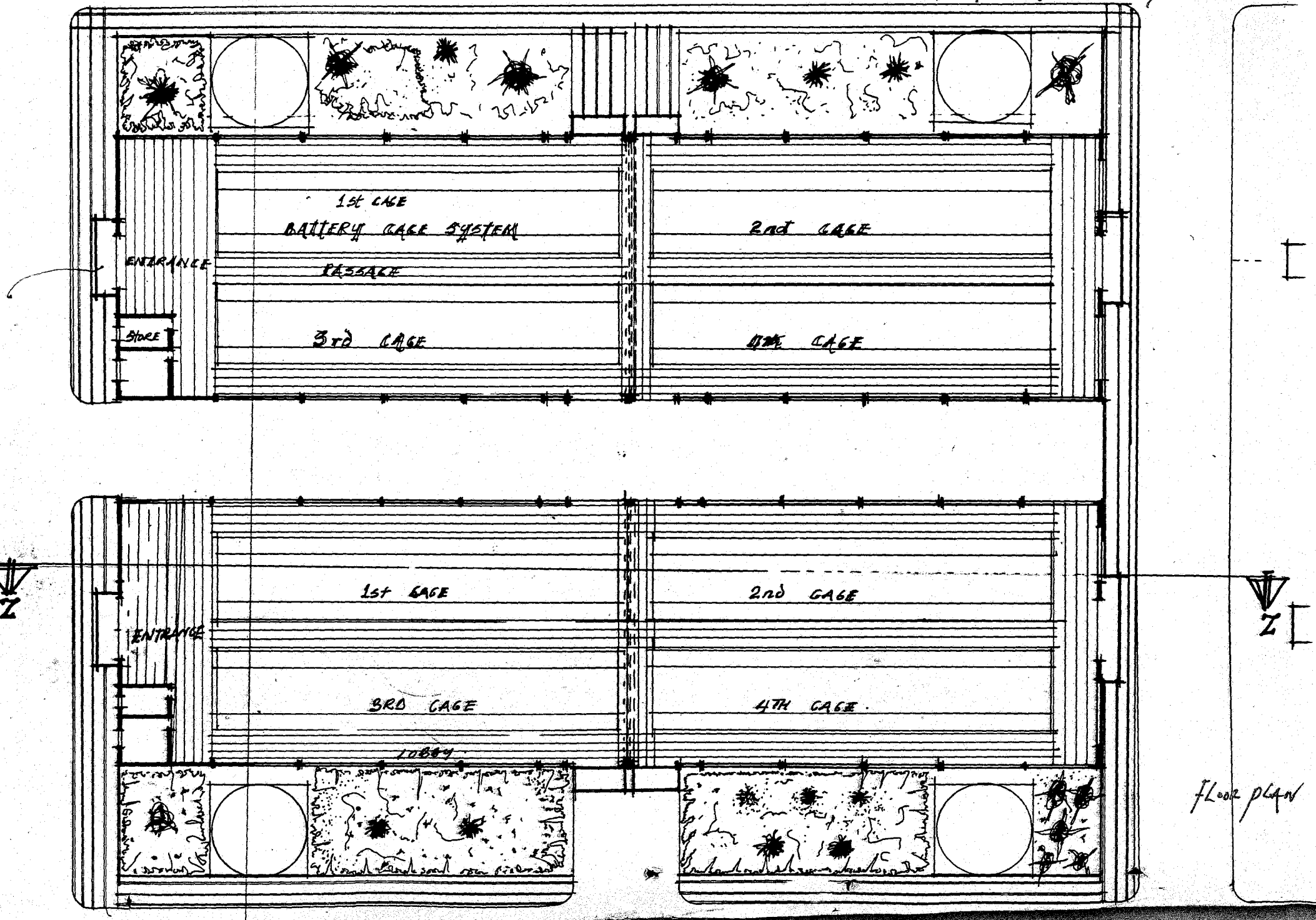


SECTION A-A

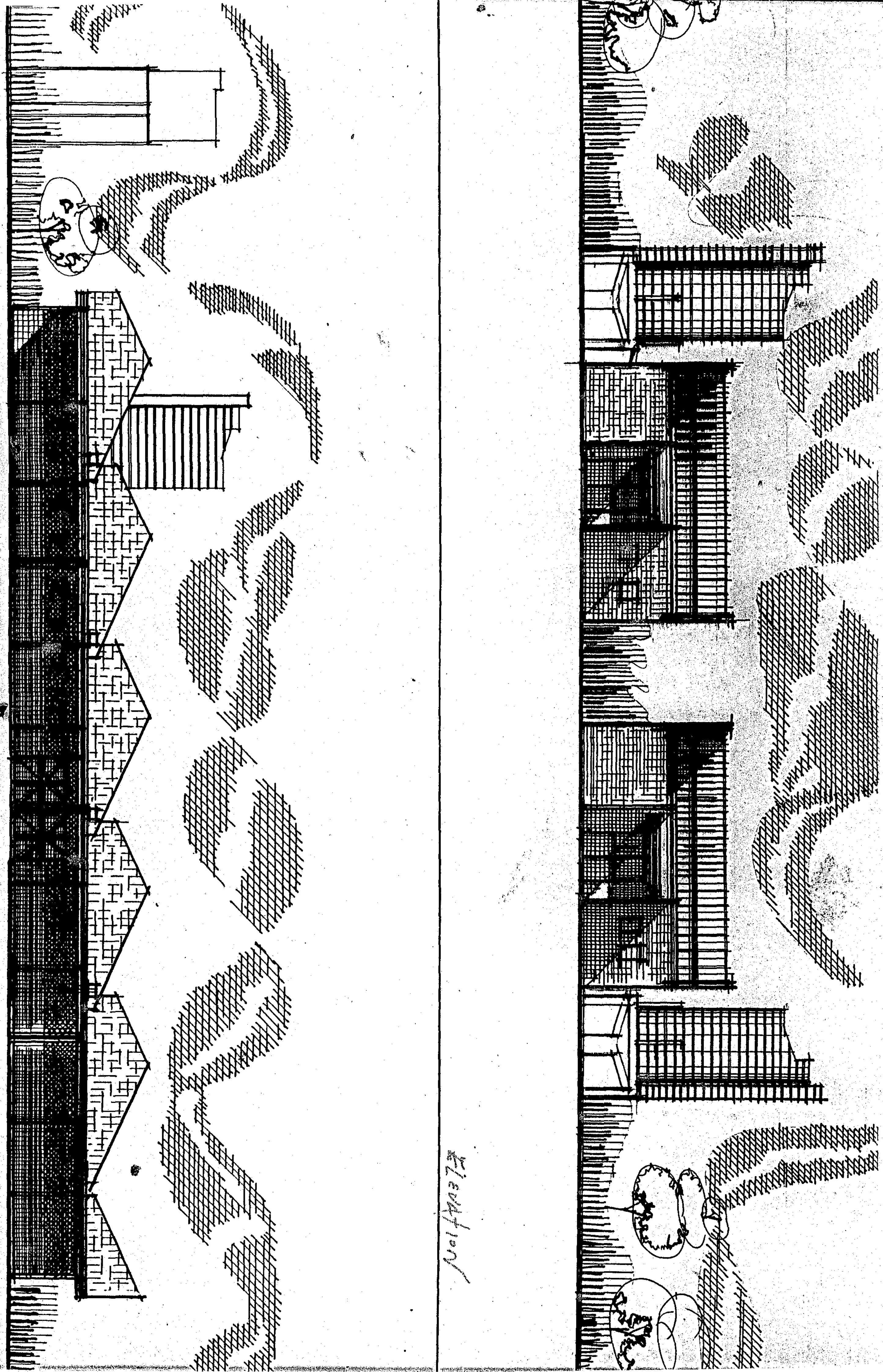


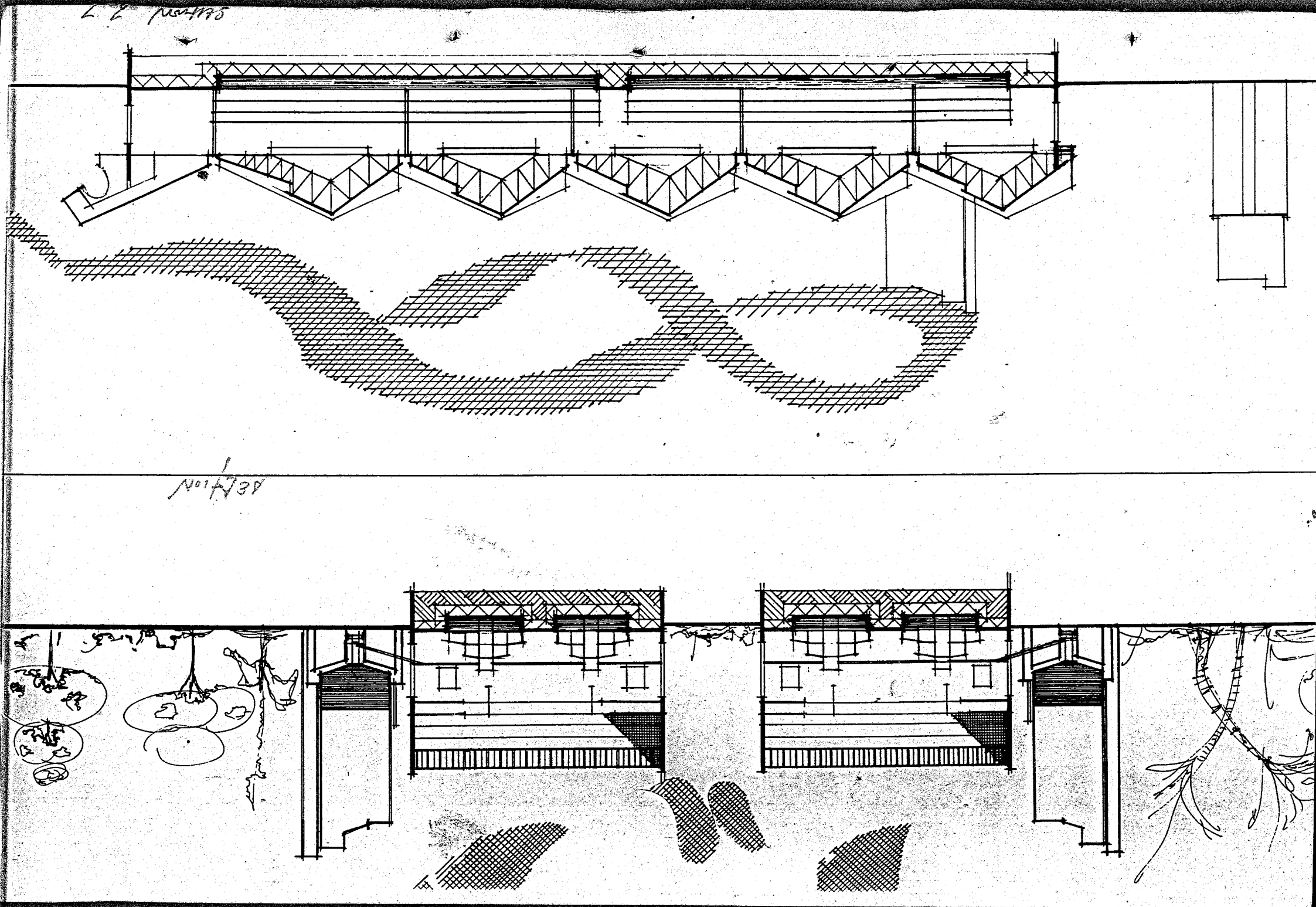
SECTION D-D

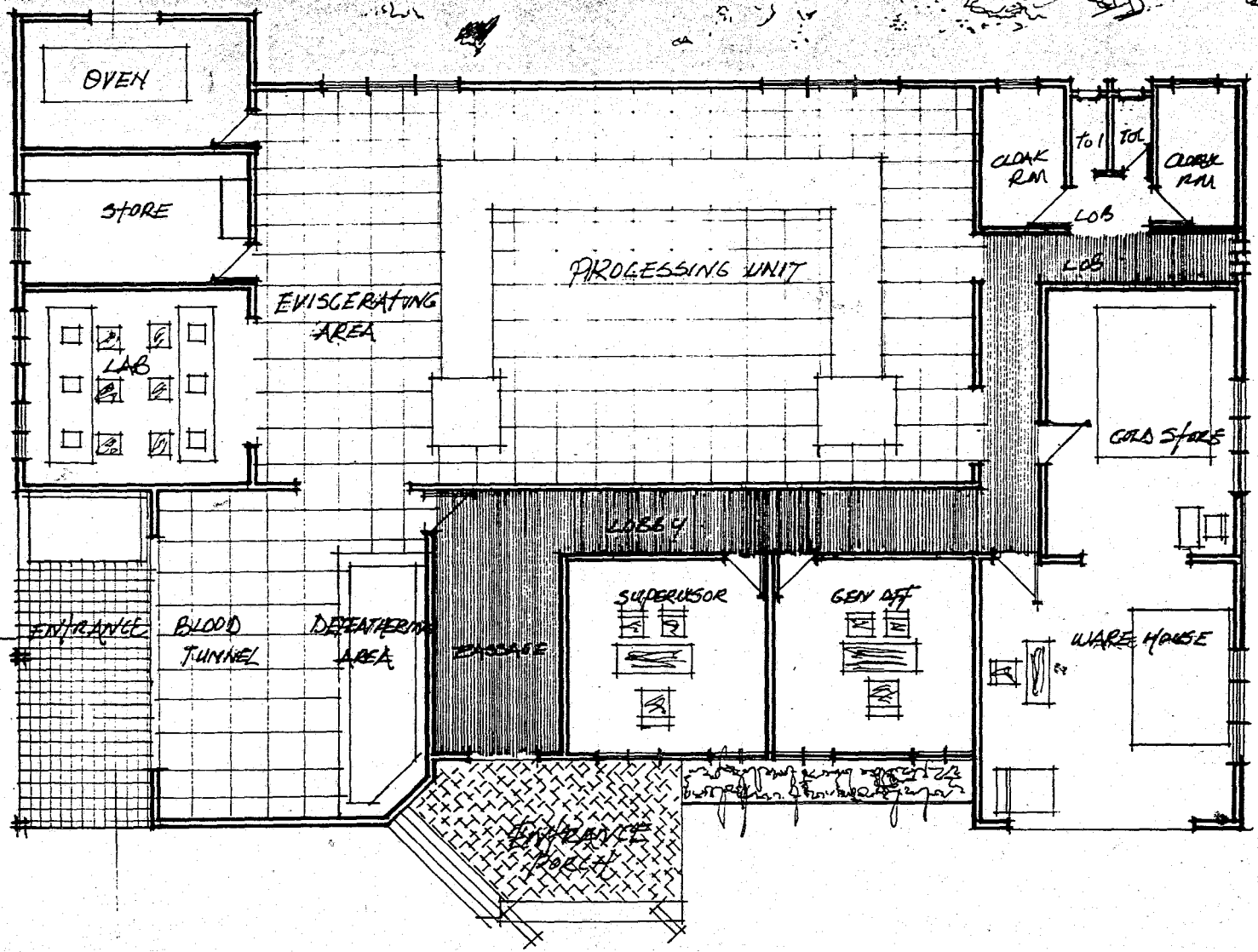
POULTRY SHED (HOUSE)



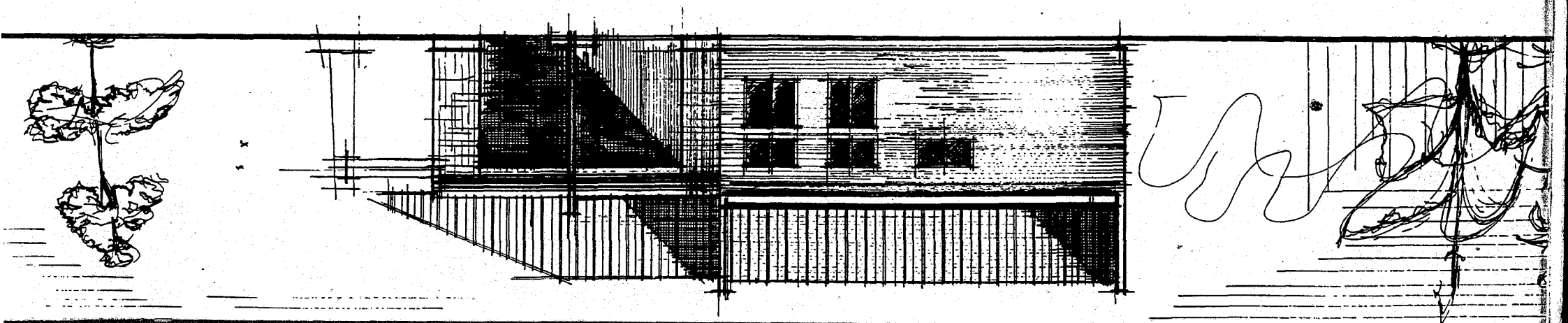
FLOOR PLAN

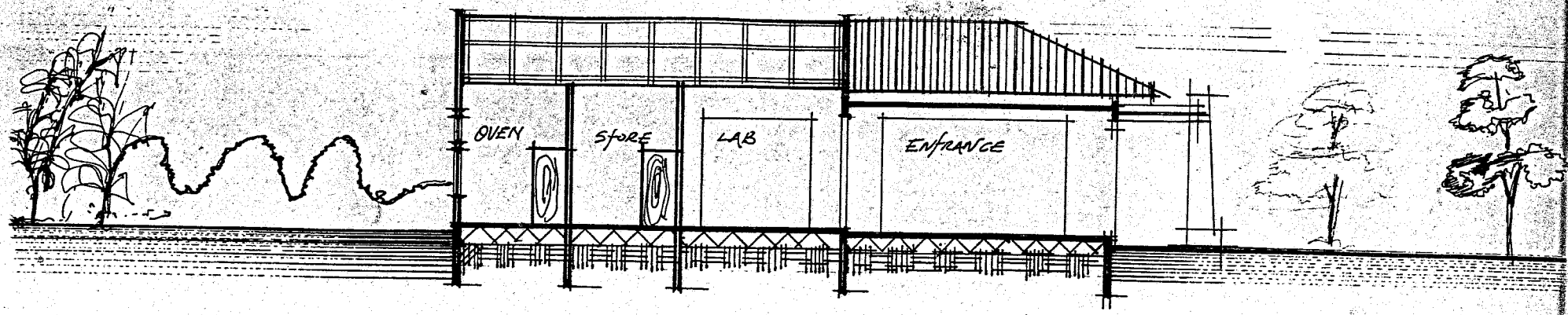


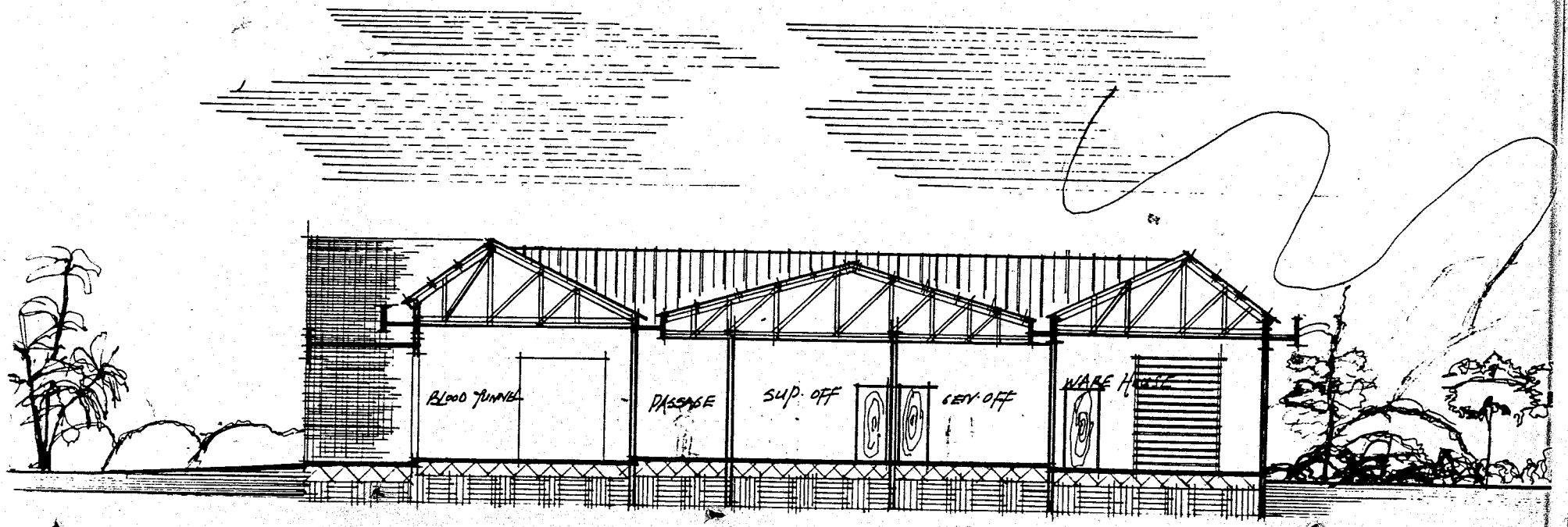


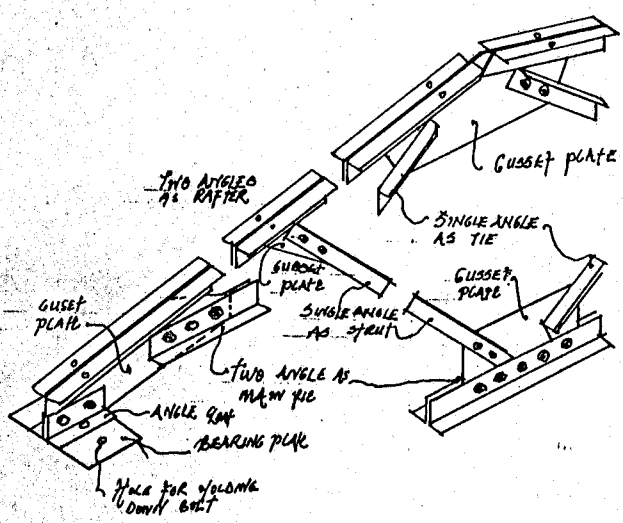


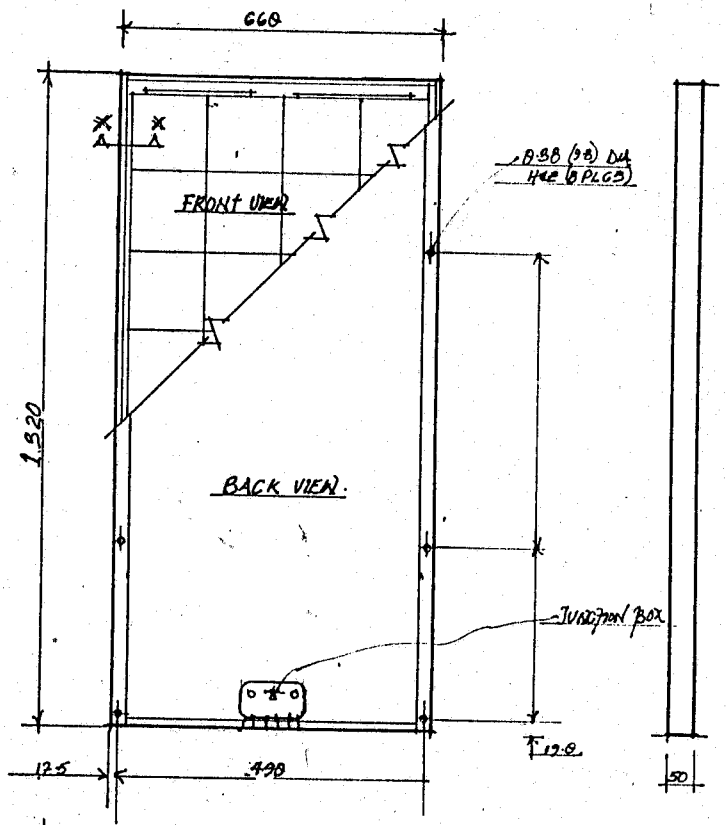
PROCESSING UNIT.

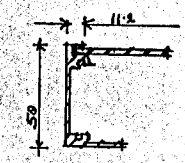



OVEN
STORE
LAB
ENTRANCE


BLOOD TUNNEL
PASSAGE
SUP. OFF
GEN. OFF
WARE HOUSE







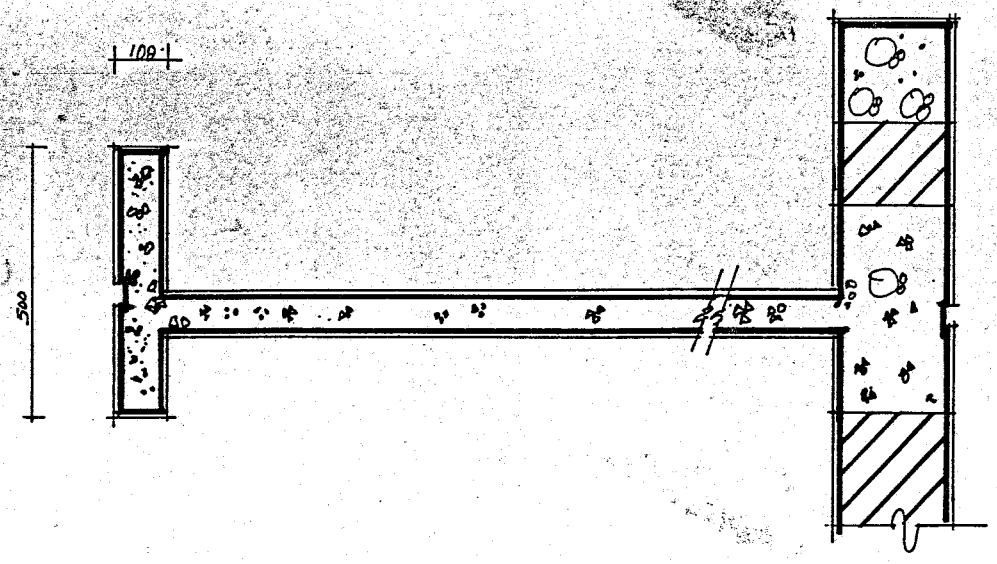
SECTION

MEGA WEIGHT

NAME	OLAMOLU F.B.E
REG NO	93/40094
DEPT	ARCHITECTURE
LEVEL	600L

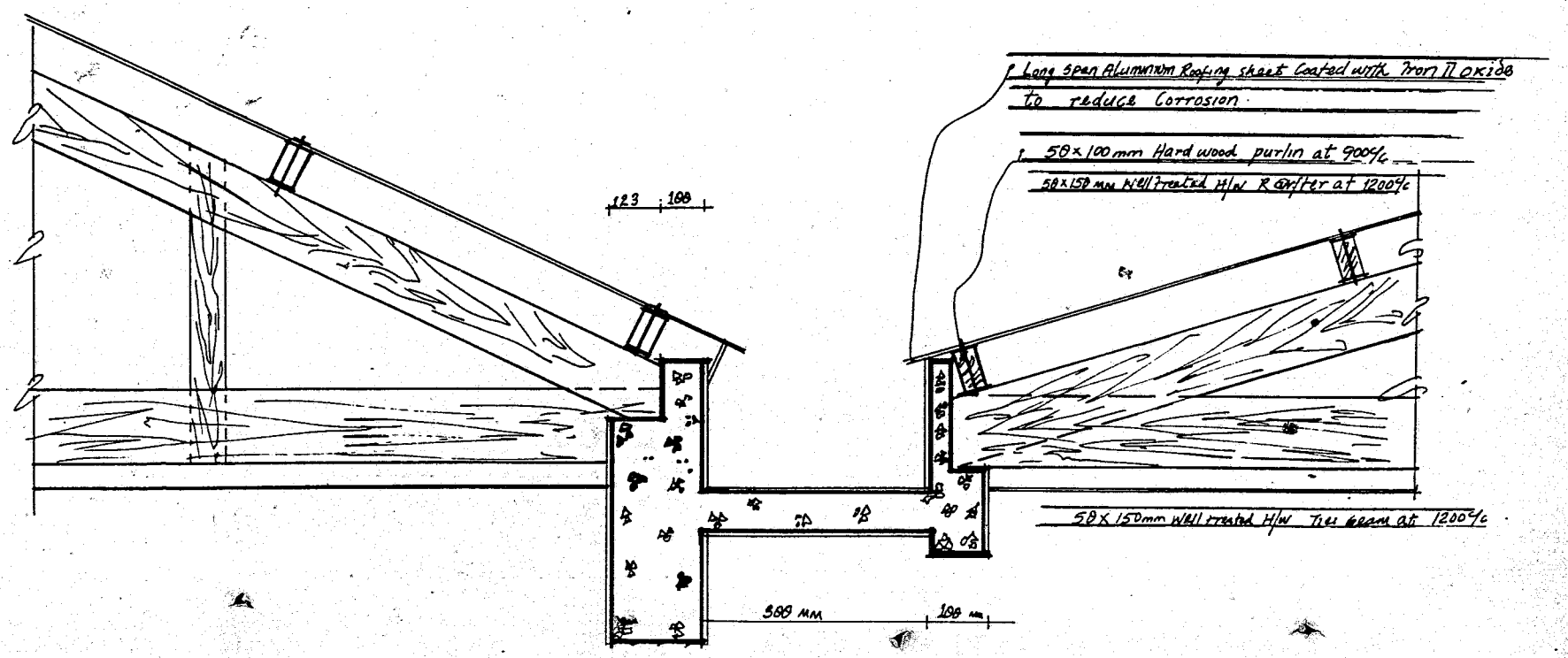
SOLAR F

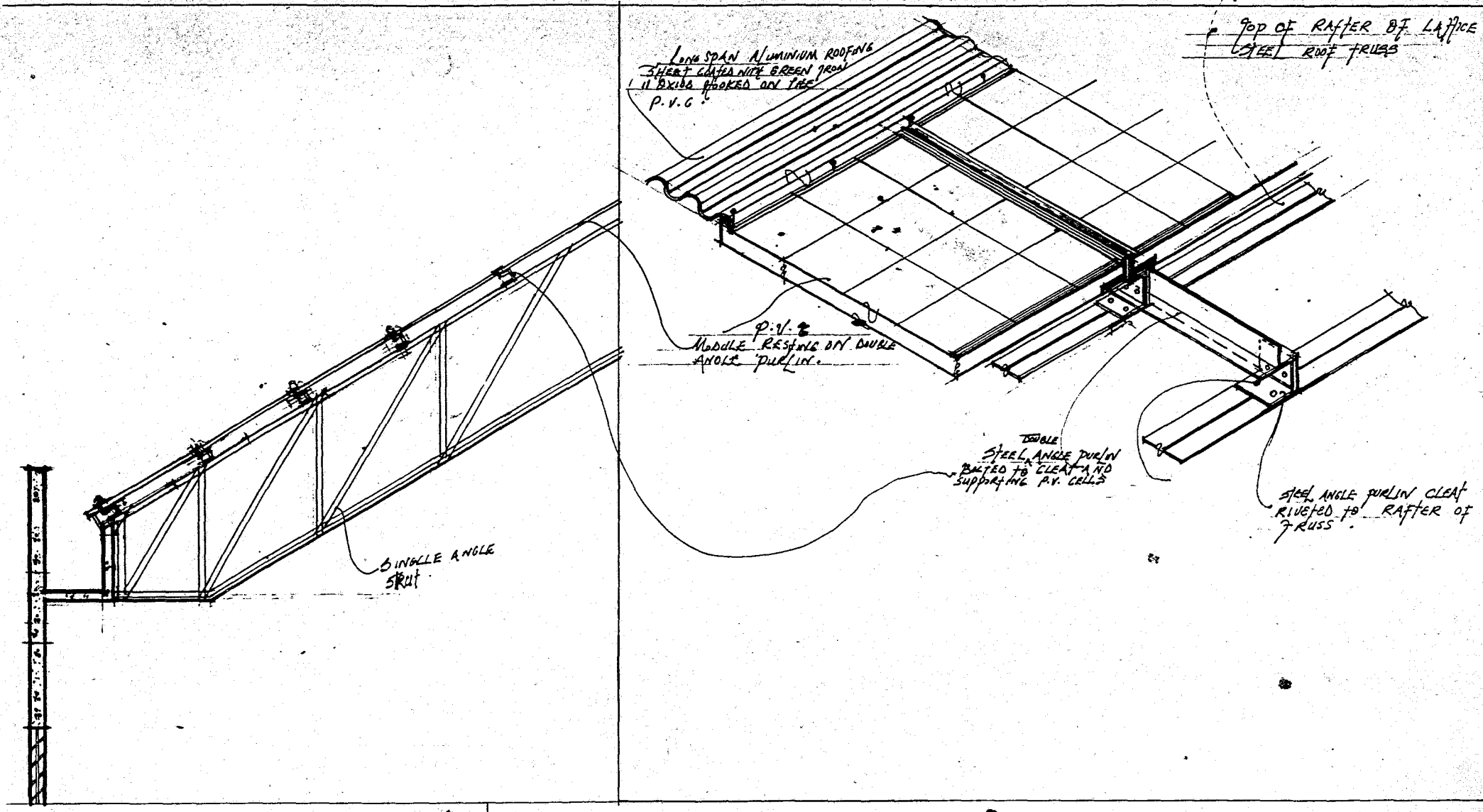
RESEARCH: PHOT



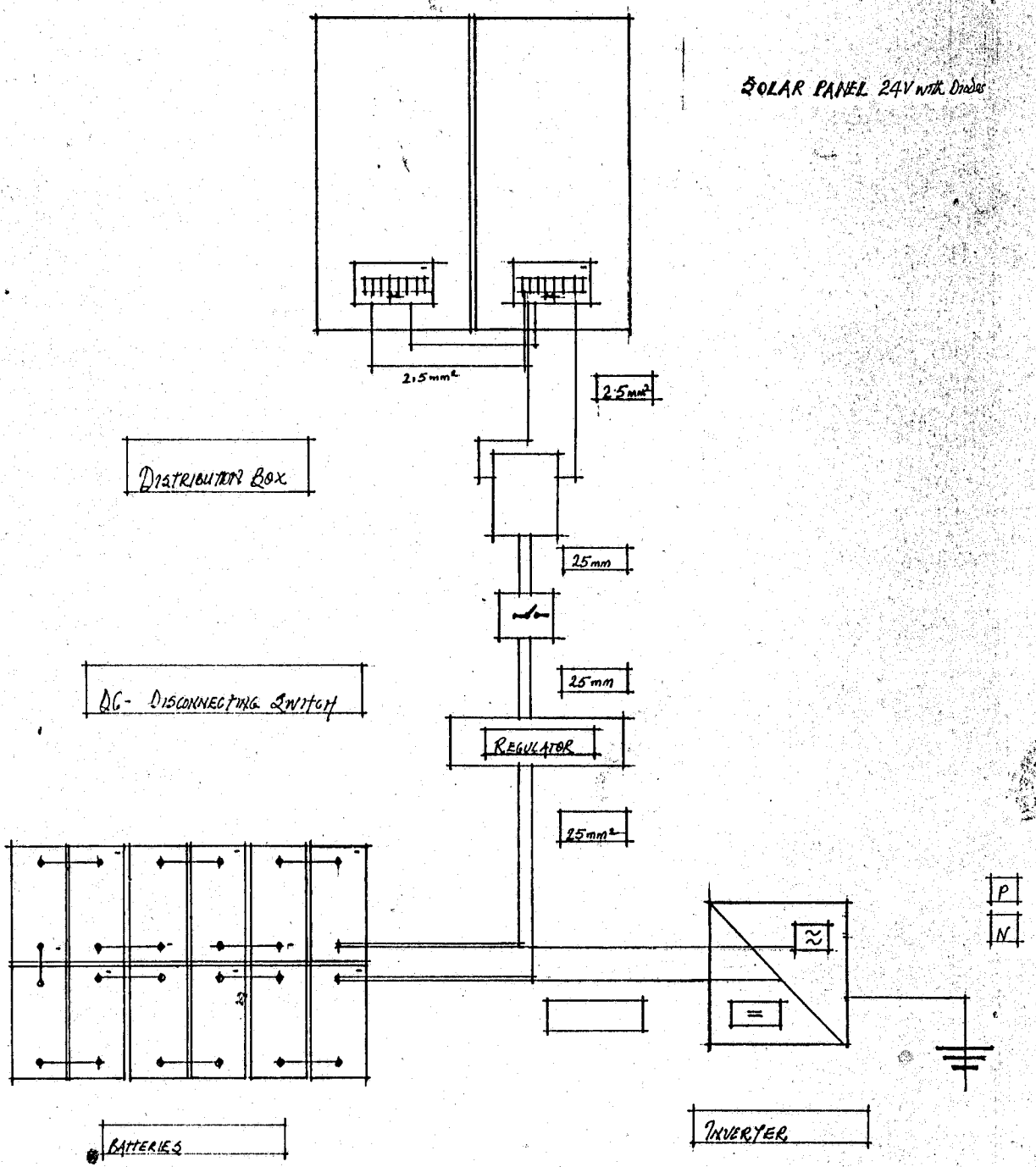
water from the
ishe.

5 cm (1:2:4)

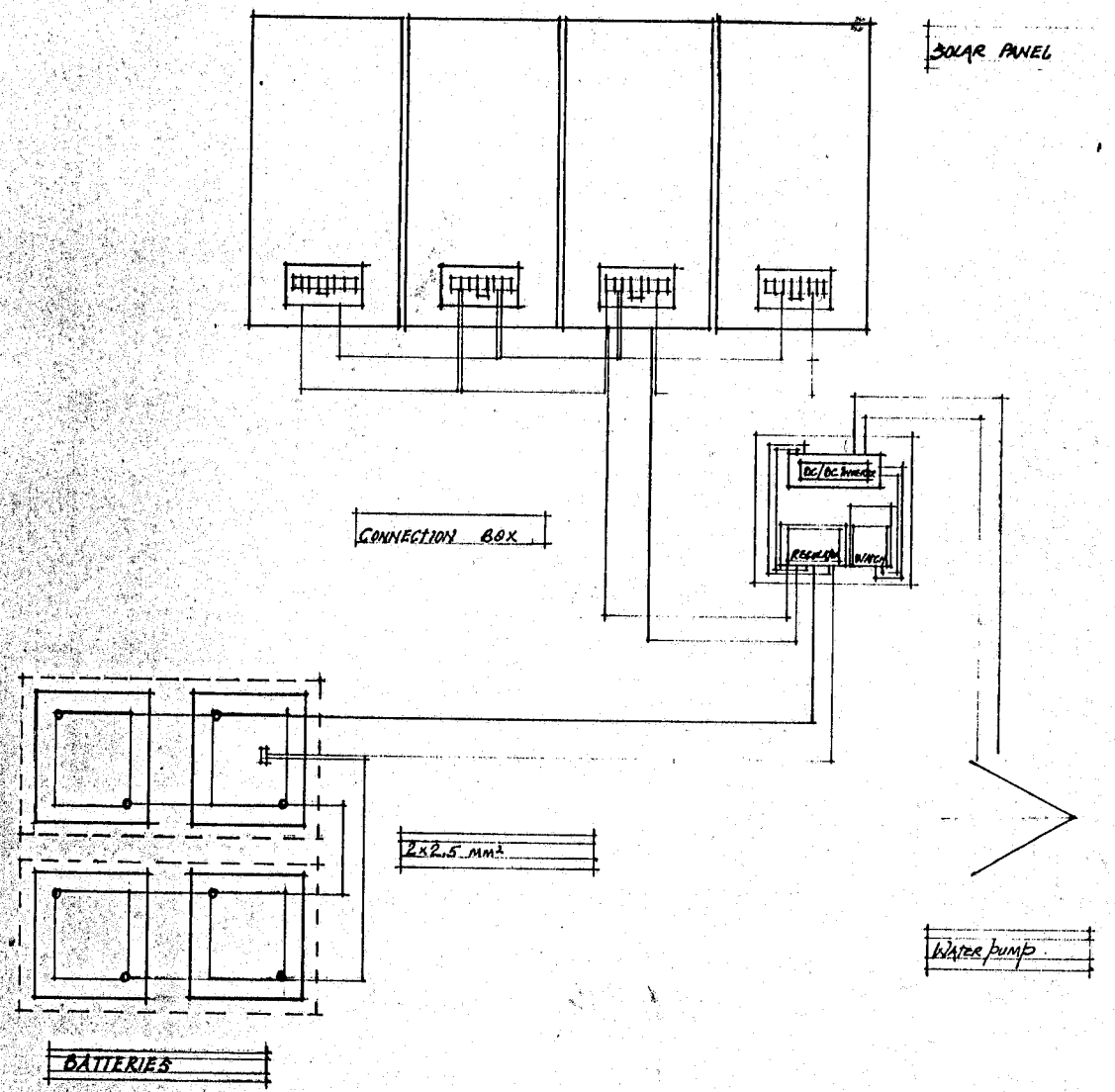


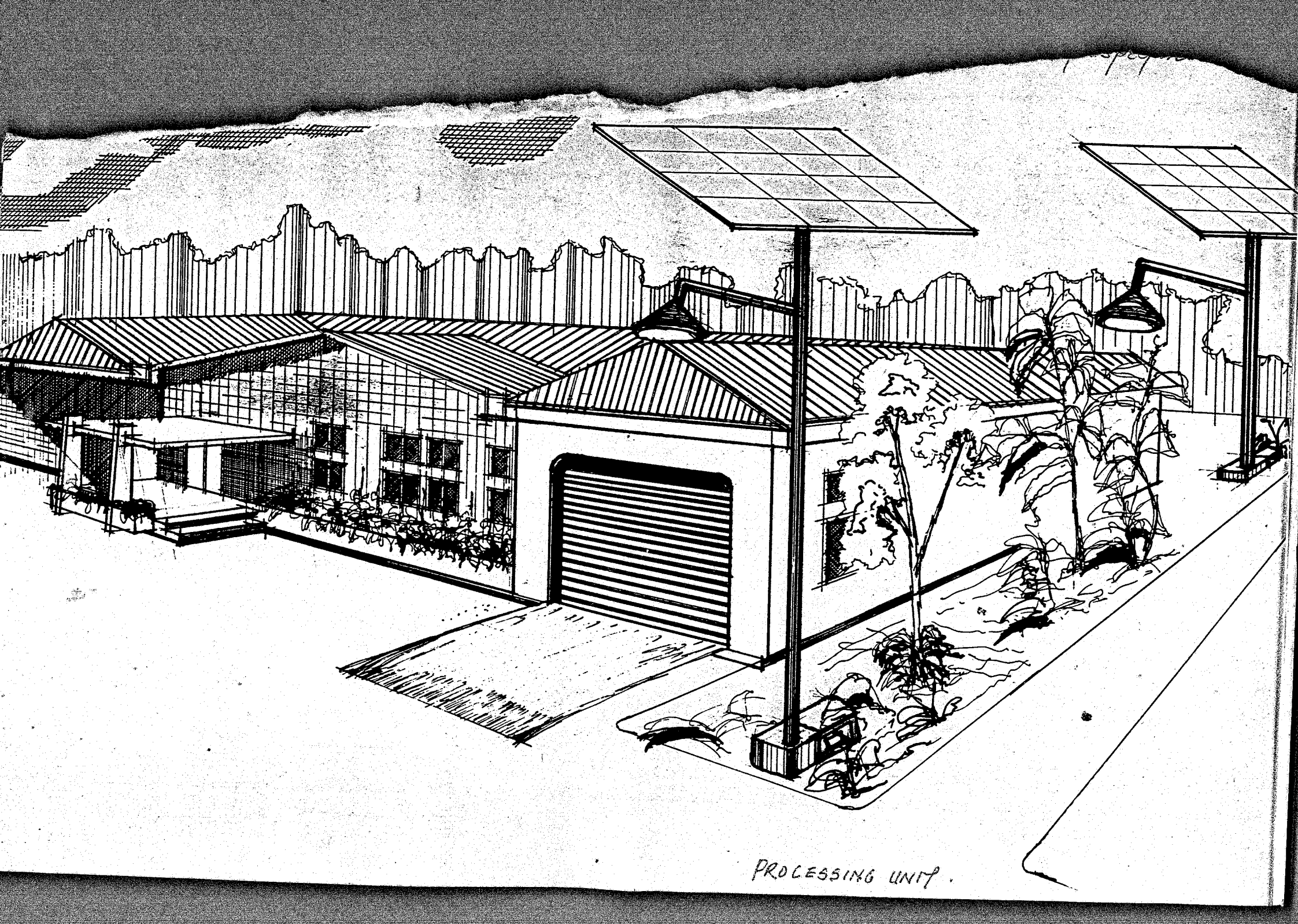

Top of RAFTER OF LATTICE STEEL ROOF TRUSS
LONG SPAN ALUMINIUM ROOFING SHEET COATED WITH GREEN IRON OXIDE HOOKED ON TILE P.V.C.
P.V.C MODULE RESTING ON DOUBLE ANGLE PURLIN.
DOUBLE STEEL ANGLE PURLIN BOLTED TO CLEAT AND SUPPORTING P.V. CELLS
STEEL ANGLE PURLIN CLEAT RIVETED TO RAFTER OF TRUSS.
SINGLE ANGLE STRUT

SOLAR ELECTRIFICATION (LIGHTING)



WATER PUMP SYSTEM





PROCESSING UNIT.