



Original Article

Study on the need for Sustainable Development in Educational Institutions, an ecological perspective – A case study of College of Engineering- Guindy, Chennai, India

Received Date: Jan/01/2011

Accepted Date: Mey/09/2011

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ABSTRACT

Sustainability has become the key word of the developing world and it is evident in many of the issues the growing economy is facing nowadays. Sustainability is the need of the hour for the Indian economy to support our future generation with a cleaner, safer environment. Legal framework implemented by the governing bodies such as Pollution Control Board is also supporting the implementation of sustainable Development by new enforcements introduced then and there, but it's questionable as to the effectiveness of this frameworks. Most of the enforcements are focusing to imply the sustainability in industries or equivalent organizations but not putting thrust on all polluting bodies-educational institutions is one among them. Recent growth in educational scenario in India which had increased the number of educational institutions to a large extent also increased the effect on environment by their activities. Growth of the educational sector and the number of institutions catering various fields of education is needed for India but the growth should be optimized in a way such that it is sustainable and eco-friendly. Various methods are developed recently to find out the exact problems associated with the environment. Geographical Information System (GIS) is one among them taking a big leap in the recent years in the area of environmental problem identification. This paper provides the details of the environmental impacts of educational institutions with case studies and also suggests a sustainable framework to make them environmental-friendly by the use of (GIS).

Keywords: *Sustainable Development, GIS, Optimization, Framework, Legislation*

INTRODUCTION

Ecology is being associated with the growth of any industry, organization or even a nation and it is no more a low key issue and its sustainability has become the buzz word of the developing world and it is evident in many issues. Sustainable Development is a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but in the indefinite future. The term was used by the Brundtland Commission which termed what has become the most often-quoted definition of sustainable Development as Development that "meets the

Needs of the present without compromising the ability of future generations to meet their own Needs." As early as the 1970s "sustainability" was employed to describe an economy "in equilibrium with basic ecological support systems". Ecologists have pointed to the "limits of growth" and presented the alternative of a "steady state economy" in order to address environmental concerns [Jeroen C.J.M. , Van den Bergh , Peter Nijkamp; 1994]. Sustainable Development implies using renewable natural resources in a manner which does not eliminate or degrade them, or otherwise diminish their usefulness for future generations. It further implies using non-renewable (exhaustible) mineral resources in a

manner which does not unnecessarily preclude easy access to them by future generations. Sustainable Development also requires depleting non-renewable energy resources at a slow enough rate so as to ensure the high probability of an orderly society transition to renewable energy sources. Sustainable Development ties together concern for the carrying capacity of natural systems with the social challenges facing humanity. Sustainable Development is defined as a pattern of social and structured economic transformations (i.e. Development) which optimizes the economic and societal benefits available in the present, without jeopardizing the likely potential for similar benefits in the future. A primary goal of sustainable Development is to achieve a reasonable and equitably distributed level of economic well-being that can be perpetuated continually for many human generations. The field of sustainable Development can be conceptually divided into four general dimensions: social, economic, environmental and institutional. The first three dimensions address key principles of sustainability, while the final dimension addresses key institutional policy and capacity issues

A nation's growth starts from its educational institutions, where the ecology is thought as a prime factor of Development associated with environment. Educational institutions nowadays are becoming more sensitive to environmental factors and more concepts are being introduced to make them eco-friendly. To preserve the environment within the campus, there are various viewpoints that several Universities are applying in order to tackle their environmental problems such as promotion of the energy savings, recycle of waste, water reduction, etc. Eco- Campus is one such concept or principle introduced to make the Universities environmentally sustainable.

Sustainable Development in campuses

Eco-campus or Ecological Campus has its meaning in itself. The meaning of eco-campus has been expressed in its targets and objectives. By all means, eco-campus means "environmental sustainability within the school". School is a center for the generation of education; moreover, it is also a research center where the students and teachers attempt to develop the best strategy for achieving their purposes [Miao Chang; 2008]. Due to this reason, the Development of eco-campus has been pointed out and established recently. Eco-campus concept mainly focuses on the efficient uses of energy and water; minimizing waste generation or pollution as well as economic

efficiency. Eco-campus focuses on the reduction of the University's contribution to emissions of greenhouse gases, procure a cost effective and secure supply of energy, encourage and enhance staff and student energy issues, also promoting personal action, reducing the University's energy and water consumption, reducing wastes to landfill and integrate environmental considerations into all contracts and services considered to have significant environmental impacts. While these various measures are promoted synthetically and systematically, an "Environmental Management System" is introduced, in order to realize assuredly the "Eco-campus" which considered environment, and clarified the posture of a University to society. It aims at establishing the organization which may be evaluated objectively. Most recently, the concept of cleaner production (CP) has entered the global environmental arena. CP fits within pollution prevention's broader commitment toward the prevention rather than the control of pollution. Cleaner production means the continuous application of an integrated preventive environmental strategy to processes and products to reduce risks to humans and the environment. For production processes, cleaner production includes conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and wastes before they leave a process.

Pollution prevention is an approach which can be adopted within all sectors, whether it is a small service operation or a large industrial complex. CP, on the other hand, directs activities toward production aspects. Unlike in the past when pollution was simply controlled, P2 and CP programs attempt to reduce and/or eliminate air, water, and land pollution. Therefore, the P2 and CP approaches benefit both the environment and society. Economically, P2 and CP can actually reduce costs and in some cases, generate profit. Both approaches are practical and feasible, and can consequently contribute to a sustainable future[Miao Chang ;2008].

Cleaner production, pollution prevention, etc. are all subsets of the concept of sustainable Development, which states the basic problem that the other concepts attempt to address: There are limits to what the environment can tolerate, and society needs to ensure that Development today does not cause environmental degradation that prevents Development tomorrow. There are many issues here but the role of industry and industrial pollution is obvious. Industrial systems and individual companies will need to make changes

in order to prevent future generations from being unable to meet their own needs. Sustainable Development is thus the long-term goal of individual companies rather than a business practice.

Eco-campus approaches must be implemented step by step. First of all, data collection has to be conducted in order to find out what the status of the campus is. After collection of all information and data, the next step is the determination of problematic areas and finding out of what the reasons are. The final step would be to propose the way that can solve the issues, in order to achieve the sustainable Development. Eco campus is a concept implemented in many Universities across the globe to make them sustainable because of their mass consumption of resources and creation of waste. Waste minimization plans inside the Universities for solid and wastewater is now mandatory to maintain the cleanliness inside the Universities. The number of Universities in the near future will be doubled and it is ripe time to emphasize the creation of Eco campuses and it is implementation for making the Universities sustainable.

Educational scenario in India

India with the second largest population in the world is now one of the fastest growing economies with a rapid growth in GDP. In the past few decades the need for trained man power is rapidly increasing in the industrial and other fields to support our countries technological growth. This has led to the establishment of more and more technological and educational institutions in India. India has a large number of Universities, colleges, and other institutions and the number has been growing rapidly in the past few decades. In Tamilnadu itself more than 2000 educational institutions are now operating to cater to the needs of students from various areas of study.

Environmental problems associated with educational institutions

It is well known that educational institutions consume resources like water, electricity, forest products and generates wastes like many industries. Establishment and operating of Universities are not covered by any of the environmental laws in India [Vandhana Devi; 2005]. As a result, the importance of making the Universities operate with self-consciousness in the utility of resources inside the campus is least understood. Colleges and Universities that adopt the attractive but abstract goal of sustainability are intellectually honest only if they go on to devise

operational approaches to meet that goal. Improved environmental performance is laudable, but may or may not be equivalent to sustainability. University performance can be definitely linked with sustainability: energy use, water use, use of land, purchase of products and treatment of them at the end of their useful lives, and emissions to air, water, and land. For each, a quantitative target can be defined and defended. Colleges and Universities that meet these targets can legitimately call themselves "sustainable".

Implying sustainable Development in educational institutions

To study the possible ways to convert the campus into Eco campus and to apply the principles of sustainable utilization of resources, the first step is to identify the resource utilization inside the campus by using various techniques or by conducting a detailed audit. The primary investigation can be done to check the usage of electricity, water consumption, solid waste generation, non-solid waste generation, hazardous or bio medical waste generation (in medical colleges), noise level etc. A detailed audit can also be done inside the campus for a certain period which is decided according to the nature of the institution and the results can be used to identify what exactly goes on inside the campus, what the current usage pattern is and the level of consumption. Electricity and water usage is to be given importance since both are commodities and the reduction in the usage of these will ultimately increase the economic conditions. This can be accompanied by a survey among the students and staff members to check their general awareness about improving the environmental performance of the campus.

MATERIAL & METHODS

Case study

To study the above details a study was conducted at the College of Engineering, Anna University, Guindy Campus in which all the areas including administrative locations, classrooms, residential areas, Sports facilities, canteen, library and recreational areas were studied in different audits. In the study area various environmental components were studied and analysed for the improvement of the sustainability inside the campus and to reduce the resource utilization pattern inside the University.

The studies conducted are:

- Electricity consumption pattern
- Water consumption pattern
- Noise Audit

- Social responsibility studies

The data collection is done for a period of 6 months and in various stages of the educational year to check the detailed usage pattern of various resources, the details studied are used for the analysis.

Energy Audit

Energy audit primarily is focuses on having efficient campus electricity consumption. The actions that will have significant electricity savings and reduction in the power factor and also provision of a more efficient refrigerating system, as well as water distribution were determined. The following actions were carried out, real time readings of electrical energy consumption was taken in energy meters installed inside the campus at various locations, refrigerated water system operation wherever necessary. Ductable split A/C's and other cooling units inside the campus was studied for the emission of CFC's Lighting concepts in class rooms, laboratories, Computer rooms, Conference halls, Libraries, and other utility areas was be studied for the luminance and the comfort of the user by various methods and the techniques for lower power consumption was arrived by comparing it with literatures and brain storming session. : i.e. substitution of lower power consumption methods instead of high power consumption techniques in all areas of the campus. Meter readings, (campus electricity consumption details) were utilized for the calculation. Each selected building were monitored for their power consumption rate on three separate periods; (1) examination period, (2) weekend, and (3) semester break period and the results were identified. The details calculated after the energy audit were given in the table 1 from which the total annual energy consumption of Anna University is calculated.

With the studies conducted it was found that the power consumption of Anna University is as follows:

- Total electricity consumed per month (Average) = 103198 kWh
- Cost of Electricity per month (Average) = Rs. 1,76,911.00

This detail excludes unaccounted energy utilized in the form of power generator usage and miscellaneous uses. The above tables clearly prove the way the energy is utilized inside the campus for its operations and the amount spend on each department..

With the collected information it is also evident that the major electricity usage relates to the air conditioners inside the campus which is

also the potential source of CFC emission, which is to be controlled to make the campus a Green campus. . The usage pattern is given in figure1.

The advice is to use the air conditioners more effectively and only in areas of necessity so that the power utilization is saved primarily for other major operations of the University The amount spent on electricity is also to be reduced since it is greater than the amount spend on any other resources [Vandhana Devi; 2005]. Special measures are to be taken to prevent energy loss and wastage, A student guide sheet for the effective use of electricity is to be provided by the university authorities.

Water audit

Water is the biggest over head in any campus, process or operations and its essential for any business. A water audit can identify productive use and needless waste such as leaks prevention, reduced consumption, and money savings. A comprehensive water audit was done to uncover any costly inefficiency in the water distribution, utilization system that results in money literally being poured down the drains. The water audit will eliminate the flaws in the unwanted utilization, and waste of water inside the University campus. The water audit was carried out and total water consumption, cost, consumption per capita, and other usage of water inside the campus. A comprehensive waste water characterization was done or the available reliable data used for the calculations and analysis. This was done by calculating the following

- Real time water source finding – University water supply data was taken from the Estate office or from the different departments and the storage methods was analyzed.

- Trends of water usage for Gardening, Laboratory, Canteen, official purposes was calculated by taking real time readings with the departments of the University and with secondary data available in Estate office.

- Per capita water consumption in the University for the past one decade was arrived with the data calculated and secondary data.

Water Audit is estimated calculated on the basis of the following method:

Water Lost = Water supply – Wastewater discharge*Wastewater discharge

Water Lost = (operational time of the pumps, h/day) × (pumps' capacity, m³/h)

Water usage pattern

To find out the usage of water for the university activities the detailed water audit was conducted and the flow of water from the starting point is analysed. Anna University's daily water consumption was found to be 7-8, 00,000 liters per day including hostels, gardening, canteen and other usages. The only source of water is corporation supply of 8, 00,000 liters per day provided in continuous supply. The internal water sources like bore well are stopped temporarily and the main water supply was used all over the campus.

The incoming water was connected in the main sump and distributed to other sumps and overhead tanks for distribution. The main water usage sources inside the campus are the hotels/dormitories, canteens and main buildings owing to the number of dwellers and this accounts more than 65% of the total water usage. The water flow pattern inside the University is given in figure 2

Water consumption details

Total in flow = 8, 10,000 litres per day.

Water available at end point = 7, 70,000 litres per day.

Net loss = 35 – 40,000 litres per day in the form of loss, wastage, unaccounted, etc.

This is evident from the readings taken from all over the campus for the water audit and in most of the areas of the University it is found that the water usage is mostly unaccounted for or wasted. The method of pumping presently used by the authorities is crude and there is no standard procedure for the pumping as of now. With this pattern of pumping it is found that calculating the water usage requirements for each and every building or usage is difficult and inaccurate. To eliminate this a standard method of pumping is to be adopted throughout the campus and the total water supply is to be exactly equal to the water need of the University campus since water is one of the prime resource which is to be effectively used. This indicates that there is a loss of approximately 15-20 % which occurs owing to the crude operating procedures. It was found that effective usage of water inside the campus is the need of the hour and to achieve this both social and technological approach is to be followed to avoid wastage of water and to get effective point to point utilization. The major source of water inside the campus is found to be corporation water supply and saving water aims at economical point of view also. The water intense buildings and areas were clearly demarked for easy

identification, where the prime focus is to be implemented.

The water intensive buildings and areas were also identified which will serve as an effective tool to identify the water wastage and the necessary areas of focus.

Noise Audit

The noise pollution inside the campus will affect the serenity of the campus and will create distraction among the students which will directly affect the teaching learning process. The noise pollution is mainly due to the vehicular movement, anthropogenic sounds, laboratory works, operation of generator's, machineries etc. A comprehensive study was undertaken inside the campus to calculate the noise level at various important locations, etc such as class rooms, pavements, laboratories, library location and the data analyzed for solutions. Noise meter readings were taken at various locations and near the sound sources such as generators, class rooms, canteen blocks, vehicular movement areas, hostel blocks, main building, conference halls, etc. The data available (secondary data) was utilized to the study noise pollution inside the campus. Universities are places where very unwanted noise is one of the important factors to be avoided to provide a quiet atmosphere for studying. To analyse the present noise level inside the campus which will serve as one of the most important factor to determine the aesthetic aspect of Anna University detailed Noise Audit was done throughout the campus at certain periods of time. Noise level readings (db) were taken using noise meter and the readings were tabulated in table 4.13.

Noise level readings were taken both indoor and outdoor of the classrooms, verandah, main noise sources such as generators, canteen, road sides (vehicle traffic), front side entrance, side entrance of the campus, near hostel blocks. The readings were taken in certain period of interval and specific timings such as mornings, evenings, afternoon, leave days, working days and specific readings were tabulated.

With the calculated readings it was clearly evident that Anna University campus is not much affected by the noise pollution but in certain areas standard measures are to be taken to bring down the noise level to ambient level. Areas such as Power house, Canteens, etc were to be isolated from the main utility areas such as class rooms, laboratories, library etc and special noise barricades are to be provided over the front side entrance or the wall height can be increased to a

certain level so that the impact of noise is minimized.

Vehicular traffic inside the campus is to be banned completely to preserve the noise pollutions inside the campus and the classrooms are to be provided with proper sound facilities such as noise absorbents inside the class rooms. When building new hostel blocks or class rooms special care is to be taken to locate them in an area where the noise level is minimum.

RESULTS & DISCUSSION

Social Developmental perspective

Even though all the studies were done and many solutions were provided for the sustainable utilization of resources and the effective reduction in any waste generation, the concepts was perfectly shaped if the social element is also added into the project such as educating the students and staff for the same . In this paper the solution to improve the social awareness among the students and faculties of the campus was analyzed and a solution to improve the present scenario was given. For analyzing this area initially a brain storming session was done with other department heads, staffs, students, with a questionnaire focusing primarily on the issues related to social awareness creation for the staffs and the students. Also a questionnaire about the current awareness on environmental preservation is prepared, given to representative sample of students and staff members.

Social Impact analysis

Universities were not just bricks and mortar; it's made up of the people using the facilities inside the campus. The maintenance and the resource utilization inside the campus is directly in the hands of the students and staff using the University resources for day to day operations. Most of the resource utilization is by the student community for their study aids such as laboratories, library, classrooms, etc and they play a major role in saving the resource utilization inside the campus. It's found after discussing with the concerned authorities that most of the students are unaware of the magnitude of resource utilization inside the campus for day to day operations and it's mandatory for the University authorities to inculcate knowledge among the student and staff community on the preservation and optimization of resources inside the university. This starts with small posters inside the class rooms for saving electricity and water which are major resources wasted inside the campus, which may directly results in huge savings to the

University authorities. Students should be made aware of the total amount of water and electricity usage inside the campus for the operations and they should be well known to the methods of savings it. Posters and hand outs were prepared for distributing to the students to increase the awareness among them about the resource savings that can be done by them using simple methods such as switching off lights and fans while leaving, using water properly without wastage in laboratories, canteens, toilets , etc. It's also suggested to the University authorities to make some simple rules as mandatory for the students to form a team of students in all courses to improve the methods of resource usage while in the University. This will be a major tool for resource optimization [Vandhana Devi; 2005] since the students will normally used to the conditions soon if it was practiced particularly in the hostel blocks students should be advised about saving electricity and water which are prime resources.

Using GIS for sustainable Development

Geographical Information System (GIS) is a tool to look at data that has a location. A GIS transforms data into information by integrating different data sets, applying focused analysis and providing output, in such a way that it supports decision making. It is tool for managing spatial information. The key objective of a GIS is the analysis of complex relationships contained in a database. These relationships, representing a multitude of geographic, descriptive and statistical data, must be readily accessible for a variety of queries and analyses. By exploring the spatial dimension, spatial analysis introduces a framework that can largely enhance decision making and problem solving.

Advantages of using GIS for environmental protection

GIS provides wider range of environmental protections applications such as

- Disaster Management
- Forest Fires Management
- Managing Natural Resources
- Waste Water Management
- Oil Spills and its remedial actions
- Sea Water - Fresh water interface Studies
- Coal Mine Fires

Environmentally, GIS technology can help assess large quantities of environmental sampling data. Most environmental problems are defined by boundaries and most corrective actions are driven by the spatial distribution of contaminants. The efficiency and rapid decision-making achieved by

using GIS is significant. Traditional environmental investigation techniques can also be enhanced using GIS. By using GIS inside the campus for identifying the various resources, their utilization it will be easy for the authorities to mark the areas of resource wastage and various measures of reducing them can be employed.

CONCLUSION

Each resource conservation measure should be given top priority inside the University campus and the proposal to conserve resources was to be implemented immediately. Universities being the one of the largest consumer of electricity, water and other consumables main focus are to be given to conserve these resources and to optimize the utilization of resources inside the campus. By doing the same Universities will become Eco-Campus which will be an example for other industries to follow. Noise level inside the campus is found not be a main problem inside the campus even though it seems to be and its evident from the readings taken at various points inside the campus but its suggested that the main source of noise such as generators, heavy equipments are to be isolated from main study areas such as class rooms, library. Energy being a main commodity is to be saved precisely inside the campus and its main utilization should be on core applications such as laboratory equipments, and other appliances. Air conditioners are consuming more energy and its to be replaced by cost effective solutions wherever viable. Awareness among the students and staff members of the University to conserve the resource utilization is to be improved considerably which will have direct impact over the resource conservation.

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Table 1. SUMMARY OF ELECTRICITY BILL

Sl. NO	MONTH	HT5 (kWh)	HT547 (kWh)	TOTAL (kWh)
1	JULY	75839	28200	104039
2	JUNE	73950	31690	105610
3	MAY	70500	25010	95510
4	AUGUST	75730	27940	103670
5	SEPTEMBER	81730	31890	113620
6	OCTOBER	71730	25010	96740
Total				619189
(Indian Rupees)				

Table 2. Noise level inside the campus

Sl.No	Location	Remarks	Noise level (db)
1	Class Room (Main Building)	Silent Slight noisy	53.7 58.6
2	Ladies Hostel Backside Near Boys Hostel		54.3-55.0 48.2-56.2
3	Canteen Near Hostel	Location 1 Location 2 Location 3	67.2 66.9 59.6
4	Flight crossing (Low Flying) Near CES Building	Boeing type Emberar Wide Bodied Four Engine type	72.6 68.3 76.4 82.6
5	Flight Crossing	Boeing type Emberar	68.6 69.2
6	Vehicle Passing	Car Bike	67.2 – 67.8 63.0
7	Near Running Machine	Near Hall of Guinness Inside Workshop Normal labs	66.2 78.2 62.4
8	Near Garden	Normal time	49.0 – 54.2
9	Near Class rooms	Working time Second time	51.6-57.8 48.6-62.4
10	Inside Canteen Building	Afternoon	84.6-88.6
11	Main Building (Location1) (Location 2) (Location 3) (Location 4) (Location 6) (Location 7) (Location 8) (Location 9) (Location 10)	Near SBI Bank Left Side front Left Side rear Central Portion 1 Central Portion 2 Central Portion 3 Central Portion 4 Near Swimming Pool Front side rear	82.4 – 85.0 48.1-53.6 46.0-48.3 52.0-53.6 45.2-47.6 46.2-47.8 58.4-60.1 58.6-61.4 56.0-59.4
12	Noisy Class room	Main Building	78.6
13	Inside Office Room	Main Building	46.2-67.8
14	Near Road Side	Main entrance	84.8-89.2
15	Near Road side	Kotturpuram Side	82.8 – 88.0
16	Near Vice Chancellor Office	Location 1 Location 2 (Road Side) Generator Running	68.7-74.2 84.4-88.2 88.6
17	Near NCC Office	Lunch Time	58.6
18	Near Generator room	Location 1	87.8
19	Near Library	Afternoon	48.3-56.4
20	Near Hostel Wing	Location1	51.2-52.0

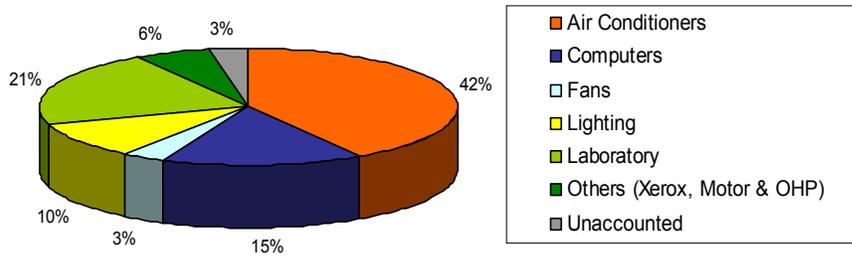


Fig1. Energy usage pattern inside a University

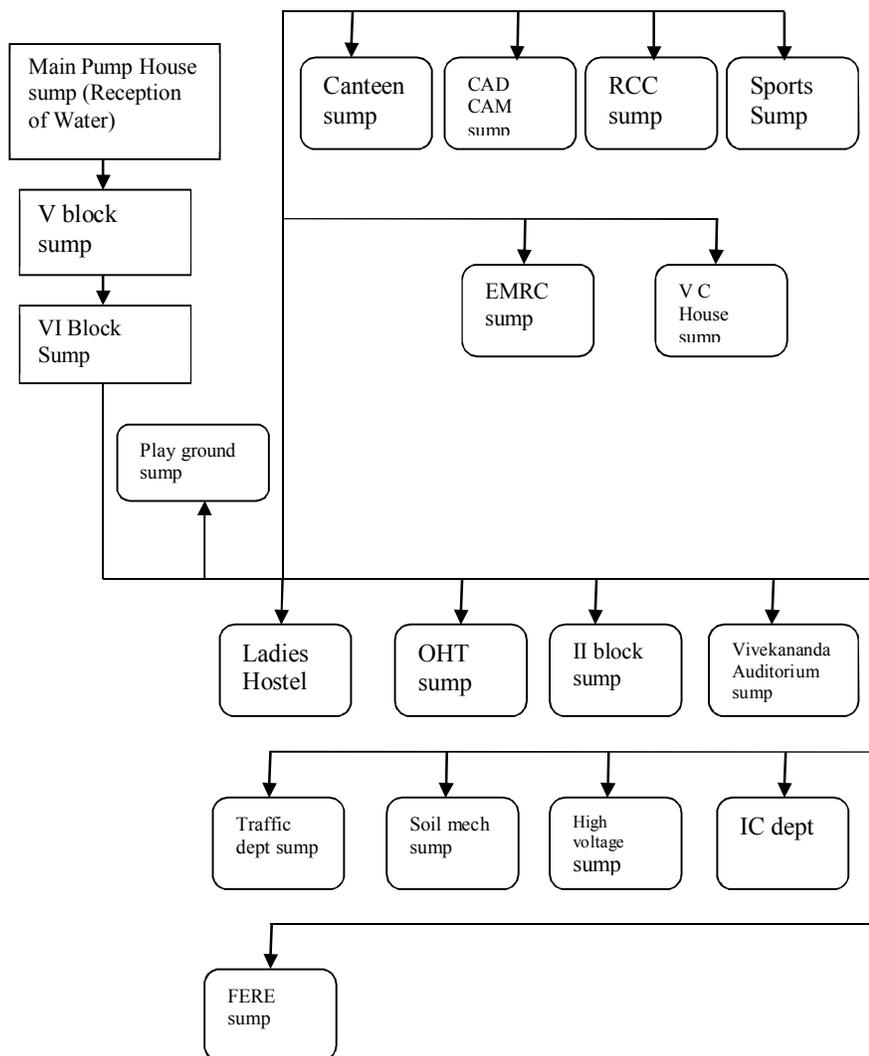


Fig2. Distribution of water inside the campus