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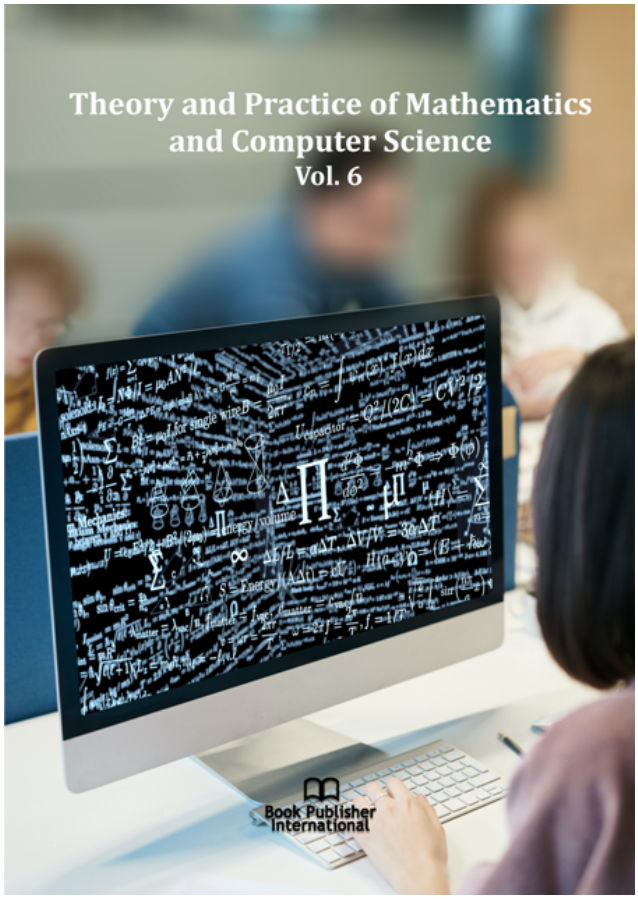

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A Statistical Analysis and Artificial Neural Network Behavior on Wind Speed Prediction: Case Study

K. Mahesh

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Abstract

The increased use of energy and the depletion of the fossil fuel reserves combined with the increase of the environmental pollution have encouraged the search for clean and pollution-free sources of energy. One of these is wind energy. The wind power industry has seen an unprecedented growth in last few years. The surge in orders for wind turbines has resulted in a producer's market. This market imbalance, the relative immaturity of the wind industry, and rapid developments in data processing technology have created an opportunity to improve the performance of wind farms and change misconceptions surrounding their operations. This research offers a new paradigm for the wind power industry, data-driven modeling. Each wind Mast generates extensive data for many parameters, registered as frequently as every minute. As the predictive performance approach is novel to wind industry, it is essential to establish a viable research road map. This paper proposes a Statistical analysis and data-mining-based methodology for long term wind forecasting (ANN), which is suitable to deal with large real databases. The paper includes a case study based on a real database of five years of wind speed data for a site and discusses results of wind power density was determined by using the Weibull and Rayleigh probability density functions. Wind speed predicted using wind speed data with Datamining methodology using intelligent technology as Artificial Neural Networks (ANN). MATLAB R2008a Neural Network Toolbox used for the training the ANN back propagation algorithm and a PROLOG program is designed to calculate the monthly and Annual mean wind speed. The Statistical analysis of wind speed prediction shows that Weibull distribution is more suitable than Rayleigh distribution and by seeing the values of the k we can conclude that Higher values of k imply a sharper maximum in the frequency distribution curve and consequently a lower wind power density.

Keywords: Wind speed prediction; datamining; ANN; Weibull; Rayleigh; backpropagation training algorithm; PROLOG

Literature Review of IoT based Home Automation System

Publisher: IEEE

R Sivapriyan ; K Manisha Rao ; M Harijyothi **All Authors**

Abstract: Home automation system is gainif a significant research attention in recent years. It helps us in leading a comfortable life and quality of lifestyle is gradually uplifte... **View more**

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Abstract:
Home automation system is gainif a significant research attention in recent years. It helps us in leading a comfortable life and quality of lifestyle is gradually uplifted. The different methodologies used in this system have been discussed. In modern days, a smartphone having an android application is used to supervise and control the appliances present in the home automation system. In this paper different types of communication methodologies such as GSM, IoT, Wi-Fi, and bluetooth are reviewed. The pros and cons of these techniques along with their features have been presented. Based on this paper the user can choose the best suitable methodology depending upon their personal needs and specifications for implementing an efficient automation system.

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Contents

I. Introduction

Home automation is evolving the quality of human life at an unprecedented rate. This eliminates the need of labour and also helps in the consumption of electricity thereby saving energy. The motive of this paper is to supervise and operate the appliances through different methodologies from anywhere in the world just by using an android application. In this paper the various techniques of automation methodologies used in homes are compared with their speed, cost and other functions. It highlights the drawbacks and advantages of each method [1]. Over the years there have been many definitions for home automation [2]. These definitions endure the phenomenon of the components of technology highlighting its functions and need to meet the aim of smart home. There are numerous definitions given by a variety of people which may be overlapping each other but the common points of everyone can be narrowed to services, technology and the desire to meet the user's demand. Home automation system also helps the elderly or the handicapped people. It is easier for them to operate or control all the house appliances with an android application. In addition to this home automation system also helps in reducing the energy consumption within an area. There are a lot of threats to environment which are emerging nowadays such as global warming, change of climate and volatility in the prices of energy which has helped in developing the home automation system. As shown in Fig. 1, the use of automation system through different mediums has made it possible to reduce the consumption of energy [2]. Home automation also provides opportunities to create new fields in architecture, computing and engineering. The wireless technology introduced various connections namely bluetooth, IoT, Wi-Fi and GSM each of which have their own advantages, disadvantages, applications and the specifications [3]. Home automation system is a rapidly developing field but it has not evolved much due to high expenditure [4]. This paper presents the control of appliances through an android application which helps to overcome the drawbacks of traditional smart home control. The traditional home automation control system that has been used widely includes bottom push buttons, PCs and infrared remote controls. The usage of these will consume more power and energy. They are the least efficient and require more expenditure. The advantage of using android as a platform is that it is easy to understand. Also, it can use any medium such as bluetooth, IoT, Wi-Fi and GSM to execute the commands given by the user [5].

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Mobile based home automation using Internet of Things(IoT)
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Published: 2015

Home automation using Internet of Thing
2016 IEEE 7th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON)
Published: 2016

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Arduino-Nano Based Low Cost Power Converter Learning Kit

Publisher: IEEE

R Sivapriyan ; K.V. Ajay ; N Ashwath Koorse **All Authors**

Abstract: This paper presents the low-cost power converter learning kit for power electronics lab in the undergraduate electrical engineering course. This paper also examines the l... **View more**

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Abstract:

This paper presents the low-cost power converter learning kit for power electronics lab in the undergraduate electrical engineering course. This paper also examines the learning outcome of an Arduino Nano and MOSFET based converter learning kit. With help of this converter kit, the student can learn the working and control of all types of basic power converter circuits which is present in their electrical engineering undergraduate curriculum. This is a plug and play kind of learning kit with minimum connection changes required to convert from one type of power converter to other types of power converter circuit. This learning kit facilitates to learn and control all type of basic power converter circuits like the chopper, inverter, AC voltage controller, and rectifier. It supports the single phase as well as the three-phase power conversion and control. The total cost of the basic converter kit is less than Rs.1400 i.e., which is less than $20. The effective usefulness and ease in use of the kit are evaluated by the feedback from the third year students of electrical engineering course. The collective feedback result shows the low-cost converter kit is much helpful to understand the basic concepts of the power converter circuit.

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Contents

I. Introduction

The power electronics engineering laboratory deals with power conversion and power control circuits [1], [2]. The important learning outcome of the power electronics laboratory is to understand the basic power conversion and power control circuits [3]–[12]. In the laboratory curriculum, there are four types of basic power conversion circuits are present. This conversion and control circuit is Chopper, Inverter, AC voltage controller and Rectifier. The power converter learning kit facilitates to the students of electrical engineering course to understand all type of above-mentioned power conversion circuits. It also gives the hands-on experience to understand the controlling of the power converter circuits. With help of learning kit, the students can control or convert the three-phase or single phase supply AC into DC supply and DC to DC conversion also they can learn the three-phase inverter circuit in 120° as well as 180° modes of operations. This low-cost converter kit consists of a power conversion circuit and control circuit. The power conversion circuit consists of six power electronics switches and the control circuit consist of an Arduino Nano microcontroller. The electrical insulation between the power conversion circuit and the control circuit is achieved with help of the opto-coupler.

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Study of Effective Feature Combination for Fault Diagnosis of Bearings in Motors

Publisher: IEEE

B R Nayana ; P Geethanjali **All Authors**

Abstract: Condition monitoring for bearing faults is remaining more vital in the present scenario. This study presents a simple approach for diagnosing various bearing faults of in... **View more**

Metadata

Abstract:
Condition monitoring for bearing faults is remaining more vital in the present scenario. This study presents a simple approach for diagnosing various bearing faults of induction motor, which uses effective statistical time domain features. The statistical time domain features like mean absolute value, zero crossing, waveform length, slope sign changes, simple sign integral and Willison amplitude are considered. The performance of features is studied with 6 feature ensembles (FEs) to identify the effective FE for fault diagnosis in the induction motor. This identification is based on the classifications that are performed by using linear discriminant analysis (LDA), naïve Bayes (NB), support vector machine (SVM) and logistic model tree (LMT) classifiers. Each feature ensemble is investigated for 5 datasets derived from a bench mark database for a maximum of 48 faulty conditions. The results indicate the FE constituting six features with SVM classifier outperforms other fault diagnosis techniques.

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Publisher: IEEE

Conference Location: Thoothukudi, India

Contents

I. Introduction

Condition monitoring of machineries have become inevitable over the last few decades. Though there are several faults to be dealt with, in regards to monitoring machineries, bearing faults occur in more prominent [1]. Accordingly, diagnosing the bearings plays a vital role in well-being of the machineries. In recent years, there is a significant development in fault diagnosis of induction machines by means of expert systems using artificial intelligence algorithms. Typically, pattern recognition methods are applied in expert systems to diagnose the faults considering time domain, frequency domain or time-frequency domain features exclusively or in combinations. The selection of effective features is important in identification of faults using pattern recognition scheme. The features like standard deviation, crest factor, peak value, kurtosis, shape factor, mean etc are extracted from time domain [2]-[4] for condition monitoring and found that time domain features considered for diagnosis are not effective. Similarly, periodogram, power spectrum, power spectral density and relatively similar frequency domain features were also studied [5]-[6]. However, characteristics of each fault exhibits different frequency patterns and hence frequency domain features are not significant to diagnose the faults. The advantage of non-stationary nature of vibration signals is taken into consideration and hence it is dealt with time-frequency domain. Wavelets transforms (WT), spectrograms etc. are the different time-frequency domain analysis approaches that are considered for extracting the features to identify the bearing faults [7]-[11]. However, adjustable windowed Fourier transform energy leakage during signal processing is the major drawback of WT analysis [12]. Another, known drawback of utilizing WT is the selection of suitable base function to decompose the signals in the respective frequency bands without losing information. Nevertheless, there is a need for reducing the number of features hence, necessitates dimensionality reduction methods prior to classification.

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Machine condition monitoring and fault diagnosis based on support vector machine

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Published: 2010

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Soft Switched Bi-directional Power Converter for Photo Voltaic System

L. Sahaya Senthamil[1], R.Sivapriyan[2], C.V. Mohan[3], P. Sundaramoorthi[4]

{elsahayam@gmail.com[1], sivapriyan@gmail.com[2], mohan_eee@sirmvit.edu[3], sundarped.sundar66@gmail.com[4]}

[1]Professor, Department of Electrical and Electronics Engineering, PSNA College of Engineering and technology, Dindigul, India, [2]Associate Professor, Department of Electrical and Electronics Engineering, Sir MVIT, Bangalore, India, [3]Associate Professor, Department of Electrical and Electronics Engineering, Sir MVIT, Bangalore, India, [4]Associate Professor, Department of Electrical and Electronics Engineering, Nehru College of Engineering and Research Centre, Thrissur, India

Abstract. This work proposes the implementation of a bidirectional current-fed soft switched converter for solar photo voltaic system is examined and covered with information. Effective function of the bi-directional buck-boost topology is guaranteed by continuous-duty buck-boost circuit under large voltage spectrum. In battery charger mode, phase shift modulation and pulse width modulation control are employed. In order to allow the MOSFETs to have zero voltage switching, a feedforward loop was applied to the charging mode of the battery. Compared with the conventional bidirectional soft switched converter, this one would definitely be better suitable for designing such magnetic components. This bi directional converter is implemented for a solar structure and experiment results are obtained.

Keywords: Bi Directional Converter, Solar Photo Voltaic, Soft Switching, Maximum Power Point Tracking.

1 Introduction

The application of solar photovoltaic is a modern concept and therefore must be applied by different method and technique. Electronic controls are used for the operation of thermal power plants. It is important to contain high performance transformer. Boost converters have lots of uses in high current, heavy loads settings. Solar photovoltaic power generation module is a strong choice for high voltage bus systems since it transforms sunlight into electricity. Since Converters that are actually feeding current are more powerful than conventional Converters that are actually feeding voltage, they have less limitations. Present limiting feature is important when interacting with very broad currents. This is that the former has more flaws than the latter. Transformer parasitic are very efficient in addressing Switching issues. and heavy switching losses of LCC. The earliest mechanical coupling between trains is a soft switched converter. There are different forms of soft switched series and parallel converters. This new breakthrough can be implemented by the researchers in many forms. The major categories of LC resonating converters are LCF-type, LC-type, LLC-type, LCC-type, CLLC-type, etc. The frequency varies to balance the rate of usage.

I3CAC 2021, June 07-08, Chennai, India

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2 Solar Photovoltaic System

The proposed topology for solar PV scheme can be seen in Figure 1. The most critical aspects of the device are solar panel and MPPT/ Bi directional loop.

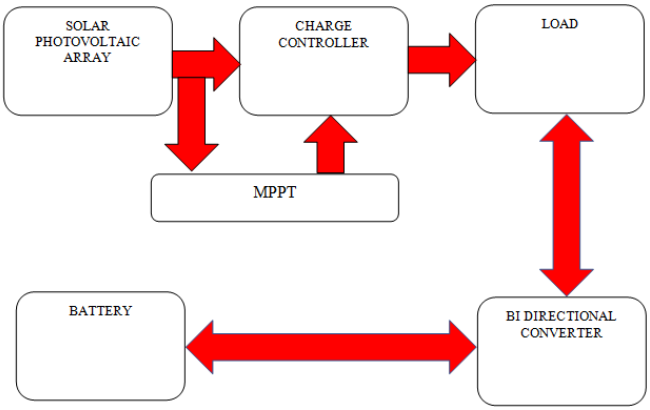

Fig. 1. Block diagram of proposed system with bi directional converter

3 Modelling of Solar PV Module

The sun's power density at 50 km altitude is roughly 1,373 kilowatts per square metre. part of the electricity provided to the world by the Planet is emitted into the environment by radiation. The solar lighting decreases to I kW/m2 at the surface of Earth at noon in the tropics. Solar panels turn sunlight into electricity. A photovoltaic device is the fundamental feature of a solar cell. Solar cells will take sunlight's energy directly and turn it into electrical electricity. Solar power is technologically used to transform sunlight into electrical energy. Solar photovoltaic cells (PV) generate electricity. Electricity may be used to power anything such as tv, microwave, drinking water pumping, illumination etc. A simpler alternative circuit of a solar cell is seen in figure 2. A solar cell generator is paired with a variable resistor. Current is flowing through the diode when the contacts are connected. The light hitting at the cathode induces photocurrent (Iph). The largest existing threshold for solar cell is 1/second. If the diode junction voltage rises, a percentage of the output current passes into the diode, where the voltage falls by the equal number. Output voltage is zero when load resistor is not attached. From Diode Parameter Equation, at RDS=0 relationships can be determined.

Currently, one photovoltaic cell produces a photovoltaic dc in the form of a shifting dc. For converters to operate properly, each panel must be attached in parallel. Solar installation consisting of more than one solar cell and one solar cell module. The equations governing solar cell are

$$I_D = I_0\left(e^{\frac{V_{PV}}{\propto V_T}} - 1\right) \quad (1)$$

$$I_{PV} = I_{SC} - I_0\left(e^{\frac{q(V_{PV}+I_{PV}.R_S)}{\propto KT}} - 1\right) - \frac{V_{PV}+I_{PV}.R_S}{R_{Sh}} \quad (2)$$

$$V_{PV} = \propto V_T ln\left[\frac{(I_{SC} - I_{PV})}{I_0} + 1\right] \quad (3)$$

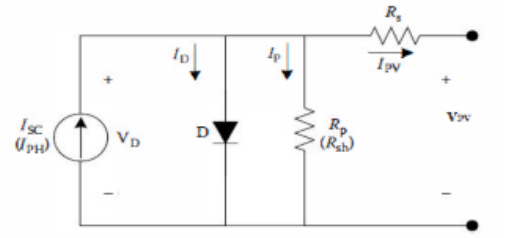

Fig. 2. Solar photovoltaic cell equivalent circuit

Where,
I_D = Current flowing through the diode
T = photovoltaic cell temperature
I_0 = reverse bias current under saturation
V_{PV} = voltage of the solar panel
K = Boltzmann's constant =1.380 × 10^{23}
V_T = voltage at a particular temperature
I_{PV} = panel current
Q = charge of electron
V_T = KT/q
I_{SC} = current of the photon
α = factor of ideality

When it comes to the production of current and voltage from solar electricity, the output depends on the temperature and irradiance. The solar PV module is designed to work at a specific performance under ideal conditions. The full power drawn from the PV cell is critical to enhancing the efficacy of the solar cell. Several studies have been performed on MPPT methods for estimating maximum solar panel power. The voltage technique under open circuit is the most affordable one and economic ways to be applied. Therefore, the open circuit voltage system shall be used in execution.

3.1 Constant Voltage MPPT Algorithm

The ultimate aim may be realized by controlling current or voltage or both. The fastest and cheapest way of applying the LED lighting is with the constant voltage method. Figure 3 represents the MPPT voltage algorithm.

Vpv and Vmp have a direct bond that gives Vpv = kVmp Anywhere Vmp is the maximum power point voltage. The k factor has a range of 0.71 to 0.78, which helps one to use the above formulas to calculate the VMPP and set it as a guide. The panel is measured by calculating the

immediate voltage input from the solar panel and then matching it with the locus voltage. Next, the discrepancy between the two is used to evaluate whether there is some defect.

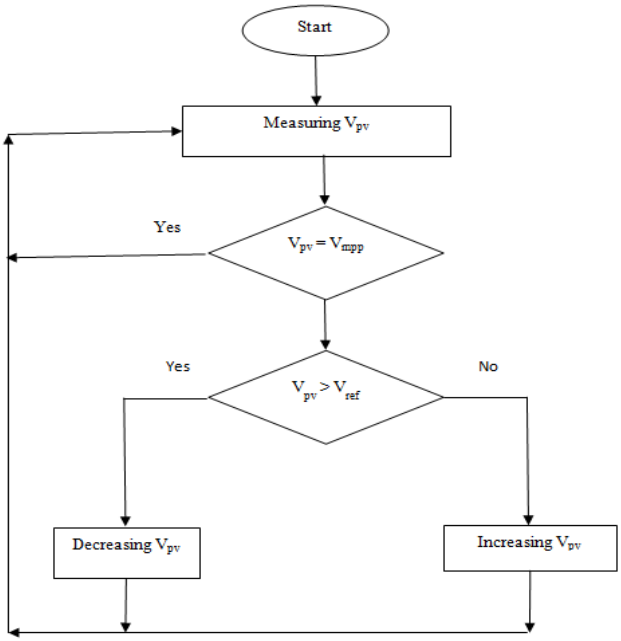

Fig. 3. Constant Voltage MPPT Algorithm

3.2 Bi-directional DC- DC converter

The CFBRC comprises a series attached buck boost converter and a soft switched converter circuit for discharging battery. In action, the soft switched converter with LLC tank converts into a soft switched converter when attached to a constant voltage source, as seen in Fig. 1. The pairs of switches S1, S2 and S3, S4 form two complete full-bridge circuits. The two buck-boost circuits are composed by linking Lb1 and Lb2 to the ends of the legs of the bridge. As with interleaved systems, the two boost-buck converters operate 180° out of phase. Meanwhile, a full-bridge transformer consisting of a soft switched inductor, a soft switched capacitor, and a magnetizing inductor is formed by utilizing a series inductor, a series capacitor and a series magnetizing inductance. The auxiliary-capacitor is charged from the battery and is the voltage that powers the engine. Same Voltage over the bus. In the figure, duty period D is operated by Service S1 and complementary Service S4 .

S1 and S3 have the same job period, but are based off each other 180°. Voltage of the battery would still stay the same. Besides, at this period the secondary side changes, S5~S8 are synchronously rectified and the oscillation frequency of the open-circuit voltage is changed. φ1 is having the angular phase-shift for charging battery in this mode. The angular phase change between S5 and S8 lies between S5 and S1Through using feed-forward method to handle the latest ZVS converter can be run in a typical context. In comparison, the capacitor voltage and battery voltage are both the same.

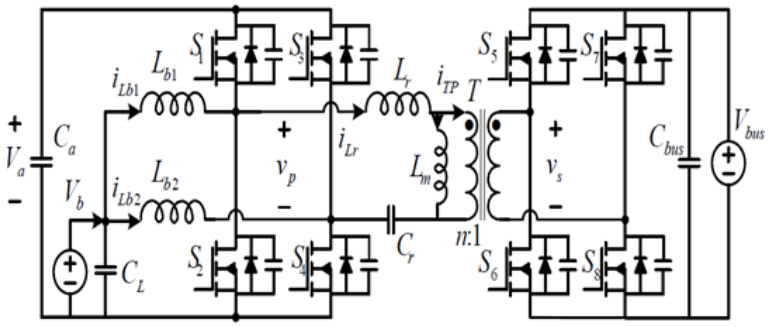

Fig. 3. Bi-directional Converter Circuit

This can be monitored to manage φ1 and task cycle D. In order to determine the operational conditions of the mode of charge and discharge, it is reasonable to conclude that D<0.5.

3.3 Preventive and monitoring technique.

Control technique such as the battery charging and discharge mode of the CFBRC is applied in this section. PWM power and switching frequency is equivalent to the soft switched frequency f. Charge current is regulated to maintain DC voltage bus stable as the battery voltage varies. The sinusoidal wave is an indicator of the reciprocating current. In this way, the CFBRC can function optimally over the diverse input voltage range. We use phase shift power in the charging mode of the battery. To reduce switch frequency, the step between S5 and S8 is established as a persistent rate to ensure the soft switching of the lagging switches at the same time. Regulation of the battery voltage is utilizing step φ1 between C5 and A1.

4 Experimental Results

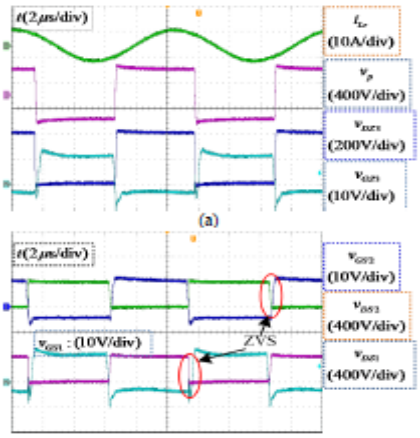

Fig. 5. Waveforms in discharging mode with Vb=200V

To prepare for this experiment, a 1500-W micro-grid prototype was constructed with range of battery voltage from 150V to 240 V, 400V voltage bus and capacitor voltage rated 400V.

During battery discharging, the frequency decreases from 85 kHz to 95 kHz, and in battery charging, it goes from 125 kHz to 145 kHz. The voltage rule for a battery is represented in Figure 5 and figure 6.

This indicates that when the lights were switched on, the drain-to-source voltage had already gone down. ZVS can be mutually realized by all the participants of the discussion. Currently, the flipping frequency spectrum is between 85 kHz and 95 kHz and the soft switched frequency has maximum functionality. Figure Image. This graph reflects the hypothetical effects of charging at a voltage of 200V. The two voltages at the monitor will be ZVS. Within the range from 125kHz ~ 145kHz, the switch frequency band significantly decreases the electrical signal distortion.

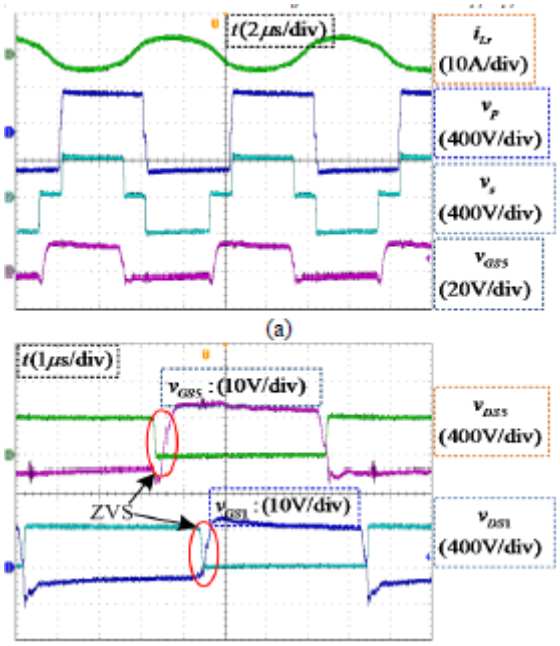

Fig. 6. Waveforms in charging mode with Vb=200V

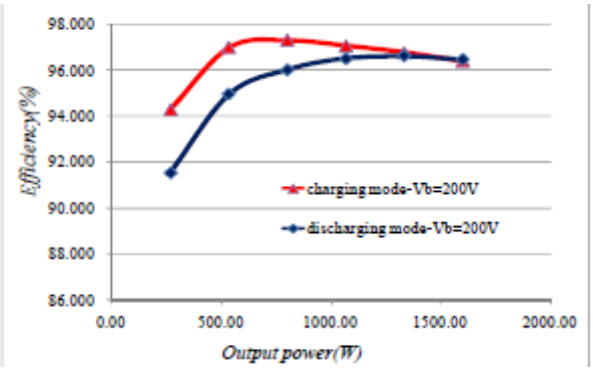

Fig. 7. Battery discharge/charge performance tested

The downside of the SRC's broad frequency spectrum variation. Experimental results help the theoretical study. Figure 7 shows the battery performance under tested condition. These graphs show that at 11 V, the battery is working dramatically. The converters in the entire load range will function reliably

5 Conclusion

The projected current fed soft switched bi directional converter performance is experimented and evaluated. This converter has reduced switching frequency, soft switching for all switches, minimum switching loss and wide range of gain related to other soft switched converters. The soft switched tank circuit of the converter acts as an integrated part of transformer causing reduction in power circulating in the converter and excellent efficiency. Thus, this passive bi directional converter is much suitable for solar photo voltaic application.

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Research Article

Soft Switched Bi-directional Power Converter for Photo Voltaic System

L. Sahaya Senthamil[1,*], R. Sivapriyan[2], C.V. Mohan[2], P. Sundaramoorthi[3]

1: Professor, Department of Electrical and Electronics Engineering, PSNA College of Engineering and technology, Dindigul, India

2: Associate Professor, Department of Electrical and Electronics Engineering, Sir MVIT, Bangalore, India

3: Associate Professor, Department of Electrical and Electronics Engineering, Nehru College of Engineering and Research Centre, Thrissur, India

*Contact email: elsahayam@gmail.com

Abstract

This work proposes the implementation of a bidirectional current-fed soft switched converter for solar photo voltaic system is examined and covered with information. Effective function of the bi-directional buck-boost topology is guaranteed by continuous-duty buck-boost circuit under large voltage spectrum. In battery charger mode, phase shift modulation and pulse width modulation control are employed. In order to allow the MOSFETs to have zero voltage switching, a feedforward loop was applied to the charging mode of the battery. Compared with the conventional bidirectional soft switched converter, this one would definitely be better suitable for designing such magnetic components. This bi directional converter is implemented for a solar structure and experiment results are obtained.

Keywords bi directional converter solar photo voltaic soft switching maximum power point tracking

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Arduino-Nano Based Low Cost Power Converter Learning Kit

Publisher: IEEE

R Sivapriyan ; K.V. Ajay ; N Ashwath Koorse **All Authors**

Abstract: This paper presents the low-cost power converter learning kit for power electronics lab in the undergraduate electrical engineering course. This paper also examines the l... **View more**

Metadata

Abstract:

This paper presents the low-cost power converter learning kit for power electronics lab in the undergraduate electrical engineering course. This paper also examines the learning outcome of an Arduino Nano and MOSFET based converter learning kit. With help of this converter kit, the student can learn the working and control of all types of basic power converter circuits which is present in their electrical engineering undergraduate curriculum. This is a plug and play kind of learning kit with minimum connection changes required to convert from one type of power converter to other types of power converter circuit. This learning kit facilitates to learn and control all type of basic power converter circuits like the chopper, inverter, AC voltage controller, and rectifier. It supports the single phase as well as the three-phase power conversion and control. The total cost of the basic converter kit is less than Rs.1400 i.e., which is less than $20. The effective usefulness and ease in use of the kit are evaluated by the feedback from the third year students of electrical engineering course. The collective feedback result shows the low-cost converter kit is much helpful to understand the basic concepts of the power converter circuit.

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Contents

I. Introduction

The power electronics engineering laboratory deals with power conversion and power control circuits [1], [2]. The important learning outcome of the power electronics laboratory is to understand the basic power conversion and power control circuits [3]–[12]. In the laboratory curriculum, there are four types of basic power conversion circuits are present. This conversion and control circuit is Chopper, Inverter, AC voltage controller and Rectifier. The power converter learning kit facilitates to the students of electrical engineering course to understand all type of above-mentioned power conversion circuits. It also gives the hands-on experience to understand the controlling of the power converter circuits. With help of learning kit, the students can control or convert the three-phase or single phase supply AC into DC supply and DC to DC conversion also they can learn the three-phase inverter circuit in 120° as well as 180° modes of operations. This low-cost converter kit consists of a power conversion circuit and control circuit. The power conversion circuit consists of six power electronics switches and the control circuit consist of an Arduino Nano microcontroller. The electrical insulation between the power conversion circuit and the control circuit is achieved with help of the opto-coupler.

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An Overview on Single/Multi Output Isolated Resonant Converter Topologies for Vehicular applications

Publisher: IEEE

Reshma P Eldho ; Anchal Chhabra ; C P Ragasudha **All Authors**

Abstract: The applications of DC-DC Converters in the field of electrical and electronics domain is increasing day-by-day. It has applications on areas such as energy storage based... **View more**

Metadata

Abstract:
The applications of DC-DC Converters in the field of electrical and electronics domain is increasing day-by-day. It has applications on areas such as energy storage based charging circuitry, distributed power generating stations, power supplies and so on. As a result, the enhancement of existing technologies for better performance, response, stability and control capabilities is mandatory. Moreover, converters at higher frequencies are used on large scale as it makes the system less bulky and thus improves the power density. Resonance is another feature which enhance the system performance by reducing the switching losses. With the increasing inclination towards Electric vehicle, it is appropriate to take up an elaborate review to understand and summarize on the various isolated topologies and the commonly utilized resonant switching configurations for better converter design and development. The paper presents a detailed study on the current isolated resonant topologies used in vehicular applications. The review mainly focuses on series resonant converter and LLC resonant converters, as it is the commonly used topologies.

Keywords
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Contents

I. Introduction

Electric vehicle being an extremely complex system integrates numerous systems including architecture, controller, electronics, the interface with the grid and/or renewable sources. Renewable energy systems has been generally embraced for various applications like electric vehicle, hybridized renewable systems and so on. The power generation/conversion using these unstable RES cannot be predicted as the generation of power depends upon the climate; subsequently, to get the better of this issue, an energy storage device ought to be utilized that can allow bulk storage with fast response when required. The charging infrastructure needs to be designed carefully to satisfy the wide variation in the unpredicted input from the renewables. The scope of this paper is to analyse different converter topologies employed in electric vehicle. Employing RES in electric vehicle allows increasing feasibility and reliability while considering for the future[1]. The vehicle-grid direct charging can be done with three levels of grid voltages and currents. Normal/slow charging EVs require 2kW-3kW whereas dc fast charging utilizes 100 or more kWs. The two sorts of batteries used in electric vehicles are high voltage battery storage for the vehicle traction and the low voltage battery storage as an auxiliary supply for powering the electric loads such as air conditioning, lights and so on. The power from the electric grid systems can be driven through a two-stage/isolated converter for higher power ratings and voltages. Isolated converter topologies increase the complexity and cost of the power conversion unit [2]. Galvanic isolation and probability to include more than one port at different voltage levels are the critical advantages of Isolated multi-port converter[3]. However, to achieve the multiple output voltage in dc-dc converter, critical control strategies are necessary. Complex systems find difficulty in the power flow control. Moreover, the number of power switches also increases with the number of ports. Numerous non isolated topologies are utilized for low voltage conversions making it a feasible compact and low cost solution for converters. As a result, as the number of ports becomes more it is better to add separate isolation transformer to reduce the complexity in control [4].

More Like This

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An improved high-power DC/DC Converter for distributed power generation
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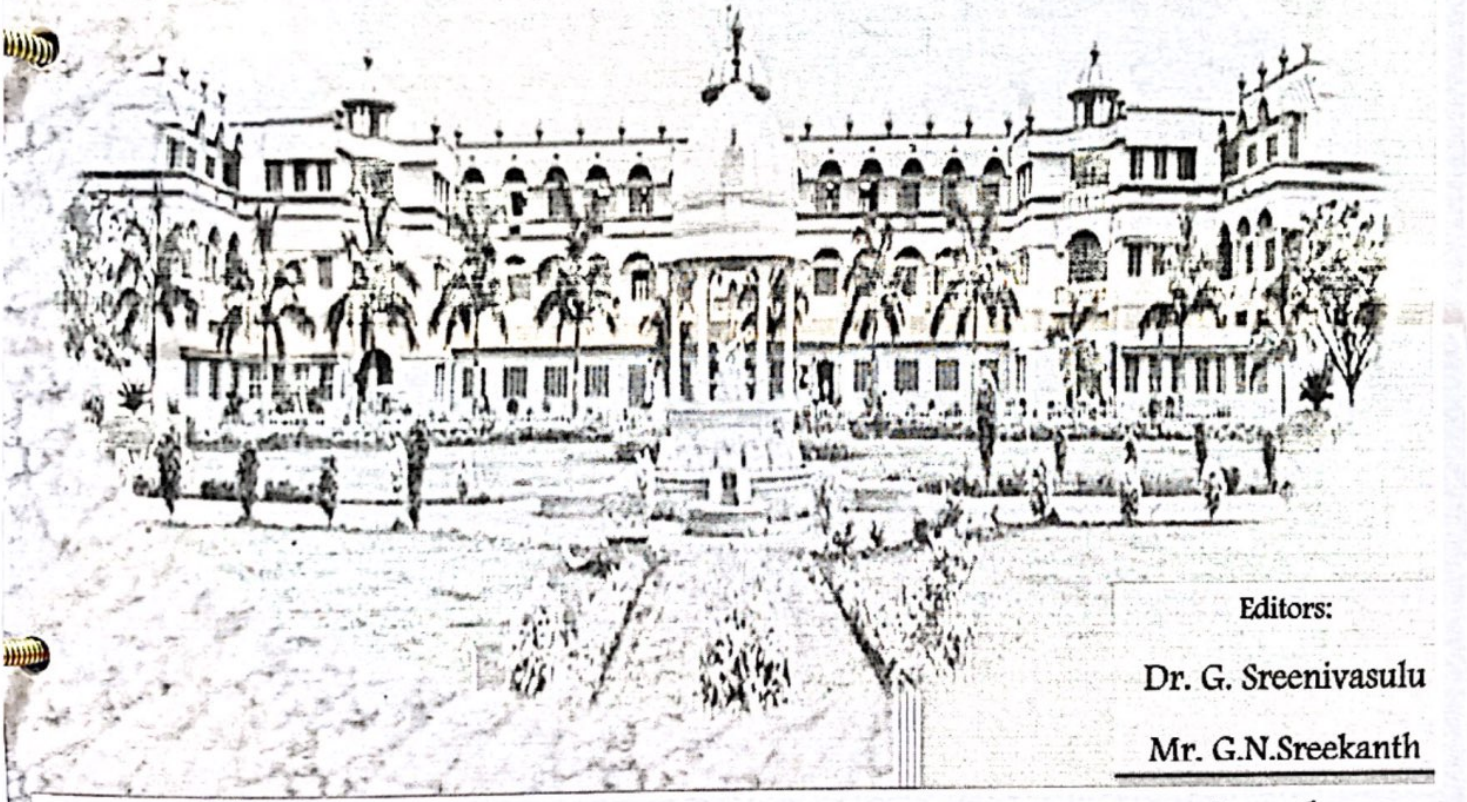

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Studies on Prevention of Landslides

Dr. Ravikumar. H [1]
Associate Professor,
Dept of Civil
Sir M.Visvesvaraya Institute of Technology (VTU)
Bengaluru, India
dr.ravikumarh17@gmail.com

Sharanabasava[2]
UG Student
Dept of Civil Engineering
Sir M.Visvesvaraya Institute of Technology (VTU)
Bengaluru, India
dandgesharan1999@gmail.com

Swaroop O J [3]
UG Student.
Dept.of Civil Engineering
Sir M.Visvesvaraya Institute of Technology (VTU)
Bengaluru, India
Swaroop.oj619@gmail.com

Rakshith M Gowda[4]
UG Student
Dept of Civil Engineering
Sir M.Visvesvaraya Institute of Technology (VTU)
Bengaluru, India
rmgowda48@gmail.com

Syed Imdad[5]
UG Student
Dept of Civil Engineering
Sir M.Visvesvaraya Institute of Technology (VTU)
Bengaluru, India
imdadsyed968@gmail.com

***Abstract*—Landslides are a major problem all across the world especially in the slopy areas where the natural tendency of the soil is to create debris with the gravitational force. This paper presents critical review on analytical studies and Experiments studies of prevention of landslides and an attempt has been made to analyse and to conduct Experiments the prevention methods few of which have already been done are proposed with new improvisations and few new methods are to be proposed.The main focus of studies was done for Kodagu District whichlies in the south western part of Karnataka state and part of the mighty Western Ghats were drainage patterns and Emphasis on eco-friendly methods of prevention through vegetation has been suggested and new methods of prevention of landslides are suggested and also an attempt, using new innovation has been done to the prevention through the proposal of finite element analysis.**

Keywords: *climate change, Rainfall Distribution, Kodagu District, Stability Analysis, drainage*

I. INTRODUCTION

Landslides occur in all hilly terrains in response to a wide variety of conditions and triggering processes like heavy rainstorms, cloudbursts, earthquakes, floods, cyclones and haphazard human activities. CRED data indicates 8,658 human casualties due to landslides and avalanches between 1990 and 1999 but it appears to be significantly under-estimated. As landslides are frequent and widespread, the annual cumulative losses worldwide amount to tens of billions of USD in terms of lost property, environmental damage, repair works, and the maintenance of defense measures (source: Page 61, World Atlas of Natural Hazards by Bill McGuire, Paul Burton, Christopher Kilburn and Oliver Willets). The frequency of landslides is strongly influenced by the return periods of triggering events like rainfall and earthquakes.

More than 5000 people are buried alive under landslides and economic losses of >4 bn USD are suffered every year globally. Continent-wise, Asia suffers the maximum damages / losses due to landslides and among the Asian countries, South Asian nations are the worst sufferers and even among South Asian countries, India is one of the worse affected by landslides. As individual landslides usually affect limited local areas and residents, damage resulting from landslide hazards was not recognized as a problem of national importance and were not addressed on a national basis. The absence of coordinated national approach to mitigating the detrimental effects of landslides resulted in a reduced ability of the States and Local Government agencies to apply the important lessons learnt, often at considerable expense, in other parts of the country.

As a result there is a need to address this problem both at national and local levels therefore In this paper studies an initiative istaken to address the problem at local district level in kodagu, district of Karnataka where a number of landslides have been occurred.

II. TRADITIONAL METHODS OF SLOPE STABILITYANALYSIS

Most Research on soil mechanics or geotechnical engineering will include reference to severalalternative methods of slope stability analysis. In asurvey of equilibrium methods of slope stabilityanalysis reported by Duncan (1996), the characteristics of a large number of methods were summarized, including the ordinary method of slices(Fellenius, 1936), Bishop's Modified Method(Bishop, 1955), force equilibrium methods (e.gLowe& karafiath, 1960), Janbu's generalized procedure of slices (Janbu, 1968), Morgenstern andPrice's method (Morgenstern & Price, 1965) andSpencer's method (Spencer, 1967).Although there seems to be some consensus thatSpencer's method is one of the most reliable, research continue to describe the others in somedetail, and the wide selection of available methodsis at best confusing to the potential user. Forexample, the controversy was recently revisited byLambe& Silva (1995), who maintained that theordinary method of slices had an undeservedly badreputation.Adifficulty with all the equilibrium methods isthat they are based on the assumption that thefailing soil mass can be divided into slices. This inturn necessitates further assumptions relating to sideforce directions between slices, with consequentimplications for equilibrium. The assumption madeabout the side forces is one of the main characteristics

that distinguishes one limit equilibrium method from another, and yet is itself an entirelyartificial distinction.

III. FINITE ELEMENT METHOD FOR SLOPE STABILITYANALYSIS

Duncan's review of FE analysis of slopes concentrated mainly on deformation rather than stability analysis of slopes; however, attention wasdrawn to some important early papers in whichelasto-plastic soil models were used to assess stability. Smith & Hobbs (1974) reported results $Ø_u$ =0 slopes and obtained reasonable agreementwith Taylor's (1937) charts. Griffiths(1980) extended this work to show reliable slopestability results over a wide range of soil propertiesand geometries as compared with charts of Bishop& Morgenstern (1960). Subsequent use of the FEmethod in slope stability analysis has added furtherconfidence in the method (e.g. Griffiths, 1989;Potts et al., 1990; Matsui & San, 1992). Duncanmentions the potential for improved graphical results and reporting utilizing FE, but cautionsagainstartificial accuracy being assumed when theinput parameters themselves are so variable.Wong (1984) gives a useful summary of potential sources of error in the FE modeling of slopestability, although recent results, including thosepresented in this paper, indicate that better accuracy is now possible.Advantages of a FE approach to slopestability analysis over traditional limit equilibriummethods can be summarized as follows: (a) No assumption needs to be made in advanceabout the shape or location of the failuresurface. Failure occurs `naturally' through thezones within the soil mass in which the soilshear strength is unable to sustain the applied shear stress. (b) Since there is no concept of slices in the FEapproach, there is no need for assumptionsabout slice side forces. The FE methodpreserves global equilibrium until `failure' is reached.(c) If realistic soil compressibility data are avail-able, the FE solutions will give informationabout deformations at working stress levels.(d) The FE method is able to monitor progressivefailure up to and including overall shearfailure.Brief description of the finite element model. The programs used in this paper are basedclosely on Program 6.2 in the text by Smith &Griffiths (1998), the main difference being theability to model more general geometries and soilproperty variations, including variable water levelsand pore pressures. Further graphical output cap-abilities have been added. The programs are fortwo-dimensional plane strain analysis of elastic-perfectly plastic soils with a Mohr-Coulomb failurecriterion utilizing eight-node quadrilateral elementswith reduced integration (four Gauss points perelement) in the gravity loads generation, the stiffness matrix generation and the stress redistributionphases of the algorithm. The soil is initially assumed to be elastic and the model generates normaland shear stresses at all Gauss points within themesh. These stresses are then compared with theMohr-Coulomb failure criterion. If the stresses at aparticular Gauss point lie within the Mohr-Coulomb failure envelope, then that location is assumedto remain elastic. If the stresses lie on or outsidethe failure envelope, then that location is assumedto be yielding. Yielding stresses are redistributedthroughout the mesh utilizing the visco-plastic algorithm (Perzyna, 1966; Zienkiewicz& Cormeau, 1974). Overall shear failure occurs when a sufficient number of Gauss points have yielded to allowa mechanism to develop.The analyses presented in this paper do notattempt to model tension cracks. Although `no-tension' criteria can be incorporated into elasto-plastic FE analyses (e.g. Naylor &Pande, 1981), this additional constraint on stress levels complicates the algorithm, and, in addition, there is stillsome debate as to how `tension' should properlybedefined. Further research in this area is war-ranted.

Definition of failure:There are several possible definitions of failure,e.g. some test of bulging of the slope profile (Snitbhan& Chen, 1976), limiting of the shearstresses on the potential failure surface (Duncan &Dunlop, 1969) or non-convergence of the solution(Zienkiewicz& Taylor, 1989). These are discussedin Abramson et al. (1995) from the original paperby Wong (1984) but without resolution. In theexamples studied here, the non-convergence optionis taken as being a suitable indicator of failure.When the algorithm cannot converge within auser-specified maximum number of iterations, theimplication is that no stress distribution can befound that is simultaneously able to satisfy boththe Mohr-Coulomb failure criterion and globalequilibrium. If the algorithm is unable to satisfythese criteria, `failure' is said to have occurred.

IV. METHODOLOGY

As per the analysis done on the study area from various reports and journals it was found that Kodagu (formally known as Coorg) district lies in the south western part of Karnataka state and part of the mighty Western Ghats. The district with its distinctive geomorphological, geological, hydrological and meteorological characteristics has long been known for landslide events in selected areas during certain months of a year, especially during monsoons. The topography of the region is sensitive and any changes in the land use - land cover pattern causes landslides or slope failures affecting the population and infrastructures. Thus, the district along with its scenic beauty and pleasant climatic conditions is also becoming prone to natural hazards. Infrastructural development such as construction of new roads and widening of the existing roads, houses, hotels, homestays etc. that involve the modification of slopes, disturb the equilibrium attained by the nature. Majority of slopes alongthe high ways pose significant risk dominantly from rainfall-induced slope failures. (Janardhana et al., 2016). Duringheavy rains in monsoon seasons, the slope forming material gets saturated by the water resulting in increase in pore water pressure and decrease in effective cohesion which effectively acts as a triggering factor for slope failures. The heavy rainfall of monsoon of 2018 caused several landslides in Kodagu district especially in and around Madikeri

V. SITE STUDY AND RECOMMENDATION

As per the above study the authors recommends a drainage model by selecting site in the study area.The below fig.1 shows the image of the selected area and figure 2 shows the location.

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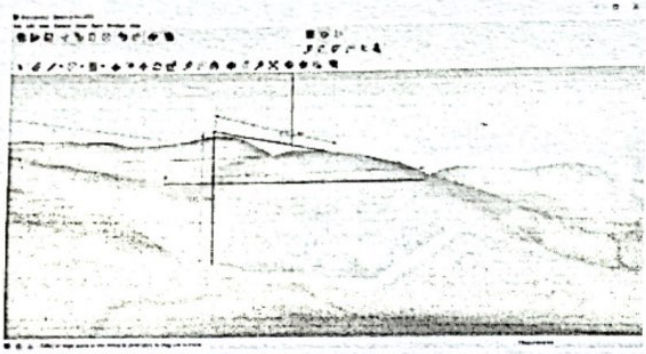

Fig 1 shows the image of selected

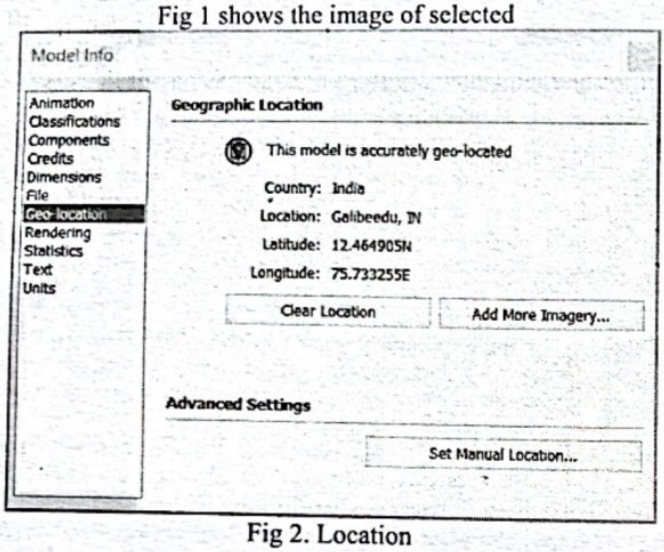

Fig 2. Location

Fig 2 showing location obtained from google SketchUp

State: Karnataka Village: GalibeeduDistrict: Kodagu Latitude: 12.464905 NLongitude: 75.733255 E

Recommendation:

- All the cracks have to be filled with Epoxy grout for small cracks and water proof concrete for large cracks.

The below figures 3 and 4 show an example of cracks and filling cracks with grout.

Fig 3

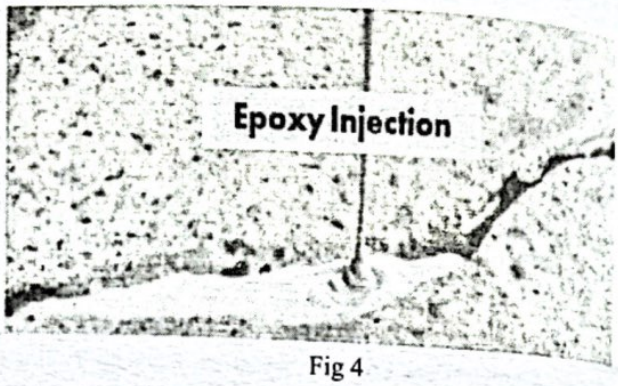

Fig 4

- Drainage system has to be designed and constructed to collect and remove precipitation water and should be discharged to the nearest stream.

The proposed drainage system consists of **Berm drain** (horizontal) , **Cascade drain** (stepped vertical drain) and **Toe drain** in which the water flows from slope surface to horizontal drains running along the slope and then to stepped vertical drains which then flows to the toe drain which is connected to the nearest stream.

- French drains should be provided by giving equal spacing to remove the soil water which has been percolated into the slope.

French drainage consists of placing a porous pipe below the ground surface at a certain depth and covering it with gravel, then the pipe is connected to nearest horizontal or vertical drain.

The below fig 5 show the French drainage system

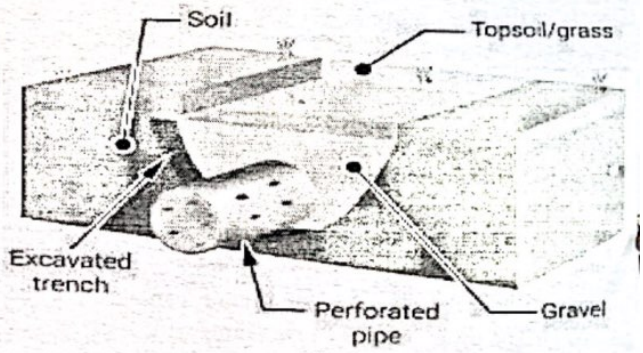

Fig 5

Using boulders, rock fragments of the surrounding rocks and steel wire mesh of high strength. A wall has to be constructed known as gabion retaining wall. To give support to the slope mass and prevent it from movement.

Below figures6 and 7 show an example of toe support using rock material.

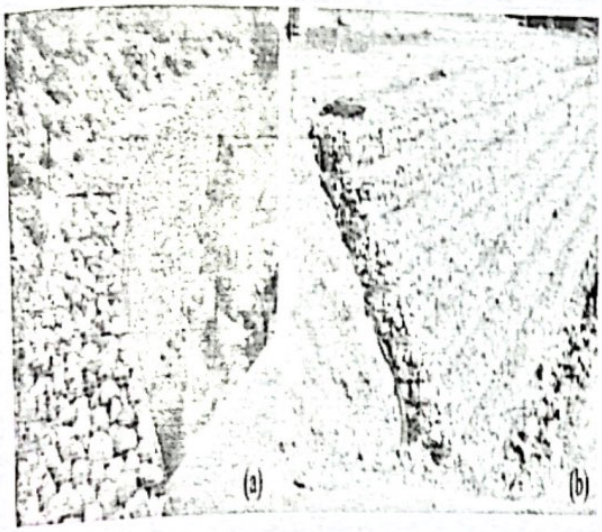

Fig 6 Fig 7

VI. DESIGN OF DRAINAGE SYSTEM

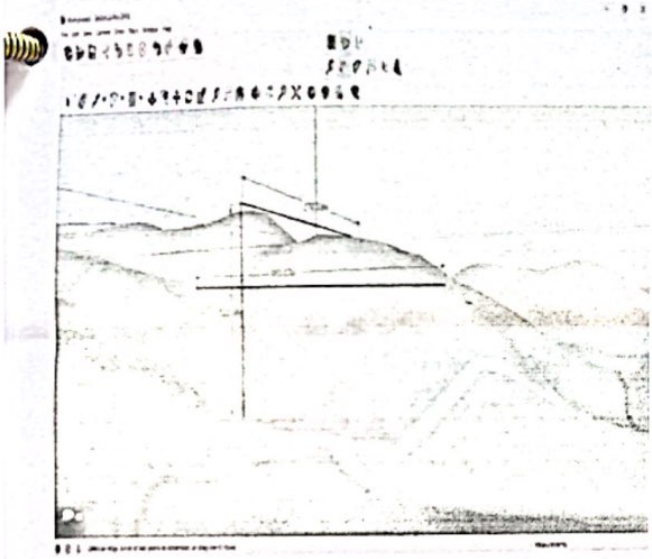

Fig 8 Satellite image

The above figure 8 is the satellite image of the site which is obtained from google SketchUp.

All the measurements were made in SketchUp as seen in the figure.

Length =460.87 m

Slope dimensions (X,Y)

X=278.33 m Y=112.38m

Slope S =Y/X

S =112.38/278.33

S=0.403 ~ 0.4

Slant height =300

Slope=40%

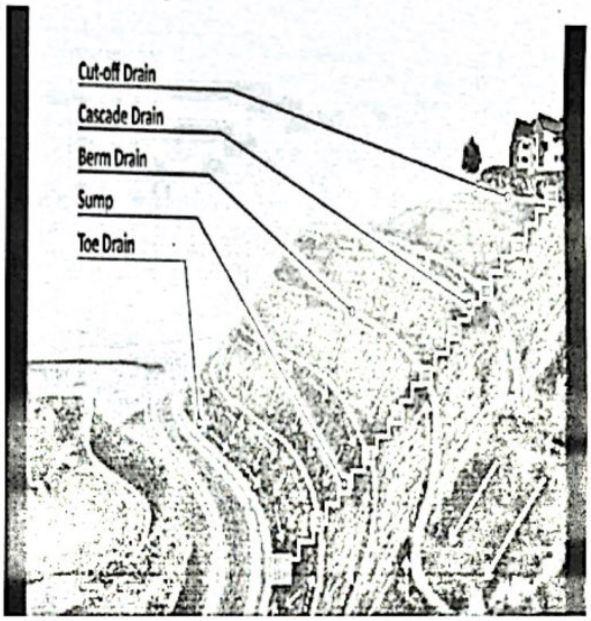

Fig 9 showing animated view of proposed drainage system

A. Drainage System

The figure 9 illustrates proposed drainage system consists of Berm **drain** (horizontal),**Cascade drain**(stepped vertical drain) and **Toe drain** in which the water flows from slope surface to horizontal drains running along the slope and then to stepped vertical drains which then flows to the toe drain which is connected to the nearest stream.

The author recommendsmaking four horizontal channels each at 60 metersspacing and a stepped vertical channel in the middle

- Abstract of Designs and Estimation

*Dimensions of Bermdrain (trapezoidal channel) as

1. Breadth =.44 m
2. Depth =.5m
3. Perimeter =1.5m
4. Side slope =1/2
5. Bead slope =1/50
6. Length =230m
7. Area =.62m2

Number of Berm Drains 8 (4 on each side)

*Dimensions of cascade drain (rectangular channel) as

1. Breadth=1.2m
2. Depth=.6m
3. Perimeter=2.4m
4. Length =300m
5. Area =.72m^2

One cascade Drain in centre

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Sl No	Particulars	No	Quantity	Unit	Rate, Rs	Amount, Rs	Explanation
1	Earth work			m3	150		L*A*N
	For Berm Drain	8	1140.80	m3			230*.62*8
	For Cascade Drain	1	216.0	m3			300*.72*1
			1356.8			203520	1356.8*150
2	M15 Concrete lining 75 mm With labour			m3	3300		T*P*L*N
	For Berm Drain	8	207	m3			.075*1.5*230*8
	For Cascade Drain	1	54	m3			.075*2.4*300*1
	Total		261			861300	261*3300
			Sub total			1064820	
			Additional for water, transport etc assuming 1.5%			15970	.015*1064820
			Total amount (Rs)			10,80,790 (Ten lakh eighty thousand seven hundred and ninety rupees)	

VII. Conclusion

Natural disasters can be powerful destructive elements and result in injuries, death and loss of property including homes and businesses. In Coorg, due to high intensity floods and landslides damages the roads, waterways, Coffee estates, Bus stand, Hotels, resorts and few attractions. Due to this the business become paralyzed and inflow of tourists to the Coorg become very less. Communities and individual business sufferedgreat financial hardships. Tourism planners, officials and developers have to spend time and money to reconstruct the attractions that are pleasing to the public. The inflow of tourists can be improved steadily by rebuilding the infrastructures and effectively implementing the above recommendations.

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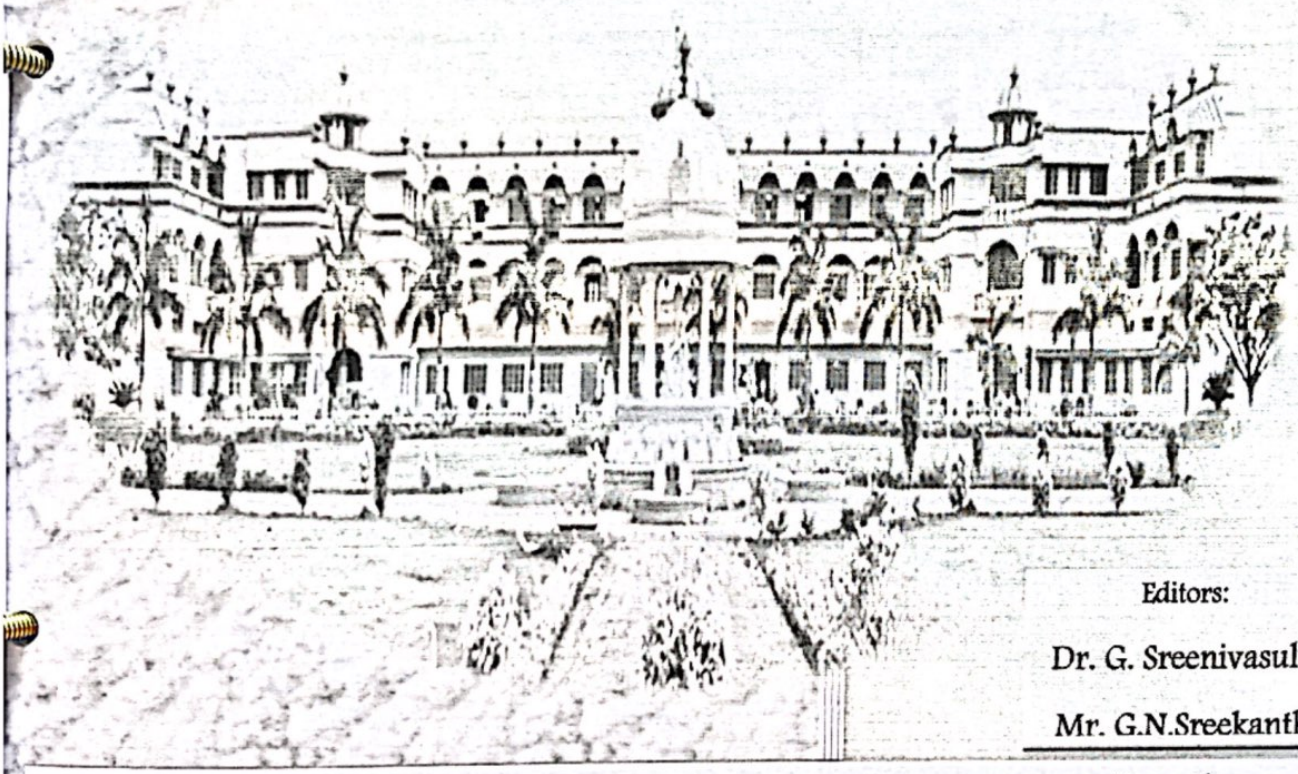

Editors:

Dr. G. Sreenivasulu

Mr. G.N.Sreekanth

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Design of Sustainable Buildings

Dr. Ravikumar. H
Associate Professor,, Dept. of Civil Sir M.Visvesvaraya Institute of Technology (VTU)
Bengaluru, India.
dr.ravikumarh17@gmail.com

Arjun.A
UG Student, Dept. of Civil Engineering Sir M.Visvesvaraya Institute of Technology (VTU)
Bengaluru, India.
shettyarjun100@gmail.com

Karthick.M
UG Student, Dept. of Civil Engineering Sir M.Visvesvaraya Institute of Technology (VTU)
Bengaluru,India
.karthickshobha123@gmail.com

M.J. Manoj kumar
UG Student ,Dept. of Civil Engineering, Sir M.Visvesvaraya Institute of Technology (VTU)
Bengaluru, India
mjmanojkumar201998@gmail.com

Rakshan.N
UG Student, Dept. of Civil Engineering, Sir.M.Visvesvaraya Institute of Technology (VTU)
Bangalore, India
rakshan12345@gmail.com

***Abstract*—Green building is a key architectural concept of the 21st century and it is the technique of constructing or transforming structures to become environmentally conscientious, sustainable and resource-efficient throughout their life cycle.The aim of a green building design is to minimize the demand on non-renewable resources, when in use, and maximize the reuse, recycling, and utilization of renewable resources. It maximizes the use of efficient building materials and construction practices; optimizes the use of on-site sources and sinks by bio-climatic architectural practices; uses minimum energy to power itself; uses efficient equipment to meet its lighting, air-conditioning, and other needs; maximizes the use of renewable sources of energy; uses efficient waste and water management practices; and provides comfortable and hygienic indoor working conditions. In this paper studies and analyses on few methods and designs have been carried out which can be installed and adopted in a building to improve the overall efficiency of the building and to make it more sustainable.**

***Keywords*-Sustainable Building, Sustainable Materials, Green House Gas (GHG); Rain Water Harvesting; solar energy, Grey Water Recycling and Reuse, Ventilation.**

I. INTRODUCTION

Climate is changing fast globally because of increased energy consumption and GHG emission. As per Indian Green Building Council (IGBC) Report, at present, conventional buildings contribute as much as one-third of total global greenhouse gas (GHG) emissions. The building sector contributes up to 30% of global annual greenhouse gas emissions and consumes up to 40% of overall energy. This impacts the climate change resulting in few effects such as water stress and reduction in the availability of fresh water, threat to agriculture and food scarcity, shift in area and boundary of different forest which is a great threat to bio-diversity. Tremendous growth in industrial sector and advancements in technology has increased the use of energy all over the world, causing an irreversible damage to the global environment; this will have an undesirable impact on the quality of life of the future generations. Water which is a vital resource for the occupants gets consumed continuously during building construction and operation. Therefore it is required to adopt few methods and techniques to conserve, recycle and reuse this water. Several building processes and occupant function generate large amount of waste. All these are polluting the environment and increasing Green House Gas (GHG).

Air pollution is one of the biggest climate crises facing our nations today. Northern India's recent crisis is a combination of many factors: exhaust fumes, construction dust, industrial emissions, forest degradation, and crop burning. Simply breathing certain city air is like smoking a pack of cigarettes a day which can actually cut off more than 10 years of lifespan of the people residing in these cities. All these environmental problems are affecting the quality of life and the health of the people.

At a global level the building sector has the largest potential for significantly reducing greenhouse gas emissions compared to other major emitting sectors.

Sustainable building approach is considered as a way for the building industry to move towards achieving sustainable development taking into account the environmental, socio and economic issues.Ecologically sustained development (or sustainability) is defined as development that improves the total quality of life in a way that maintains the ecological processes on which life depends.

The key process difference between green and conventional buildings is the concept of integration, whereby a multi-disciplinary team of building professionals work together from the pre-design phase through post-occupancy to optimize the building for environmental sustainability performance, and cost saving.

II. WATEREFFICIENT TECHNOLOGIES

Water efficiency refers to the decrease in the usage o water as well as decrease in the wastage of water. Wastage o water or its extra usage leads to drawing out of more wate from the fresh water resources, resulting in their depletion Thus, few water efficient technologies can be used t conserve potable as well as non-potable water and t ultimately save the already limited fresh water resource Few Water efficient technologies which can be used buildings mainly include water saving fittings and fixture rain water harvesting and recycling and reuse of grey water.

A study of household water consumption in differe areas revealed that almost 50% of the total water is used baths and toilet flushes. Thus, instead of using luxurious b water wasting fittings and fixtures, water saving ones can used. These include use of low flow shower heads and lo flushing toilets instead of bathtubs and normal flushes, whi use more water respectively. Other such fittings and fixtur

such as two-sectioned water closets, bidets, composting toilet systems, dry urinals, auto sensor water taps etc. But the major water saving is done by rain water harvesting and grey water recycling and reuse.

A. Rain water harvesting

In simple terms, rain water harvesting is the active collection and distribution of rainwater which rather than going to the sewage is put into use in daily life. Typically, rainwater is collected from the rooftops, deposited in a reservoir with filtration. Once the water is purified, it is can be used for cultivation, gardening, and other domestic uses. Rainwater is generally accumulated from roof tops. Then it is deposited in a reservoir with percolation. It is used for gardening, cultivation and domestic uses. The harvested water can also be used as ground water recharge.

Method of Rain Water Harvesting (RWH):

Rooftop rainwater harvesting: It is a system of collecting rain water where it falls. In rooftop harvesting roof becomes catchment area, and the rain water is collected by roof of house/building. The collected water is either stored into tanks or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in increasing the groundwater level of the area.

Methods of Roof Top Rain Water harvesting:

1) Storage of Direct Use: In this method rain water collected by roof is diverted to storage unit. The capacity of storage tank is decided by catchment area and intensity of rainfall. Each pipe should have wired mesh at mouth and first flush system followed by filtration unit before connecting to storage tank. Each tank should have provided with excess flow system. Excess water could be diverted to recharge system. Water stored in storage tank can be used for secondary purposes such as gardening, washing, etc. This is the most cost effective way of rainwater harvesting. The main advantage of collecting and using rain water during rainy season is not only save water from conventional resources but also helps to save energy incurred on transportation and distribution of water at the doorstep.

2) Recharging groundwater aquifers: Recharging of ground water aquifer can be done by various processes by ensuring the percolation of rain water instead of draining away from the surface. Methods of recharging ground water:

a) Recharging of bore wells

b) Recharging of dug wells

c) Recharge pits

d) Recharge Trenches

e) Soak away or Recharge Shafts

f) Percolation Tanks

3) Recharging of bore wells: Rain water collected by roof is diverted to filtration tank through pipes. After settlement of suspended matter water is diverted to bore wells to recharge deep aquifers. Capacity of settlement tank/filtration tank can be designed on the basis of catchment area, intensity of rainfall and recharge rate. To prevent clogging entry of suspended matter or solid should be prevented. First flush system should be provided to prevent contamination of water.

4) Recharge pits: Recharge pits are pits on any shape or size such as rectangular, circular, square constructed with brick or stone masonry walls having weep holes at regular intervals. Pit is covered with perforated topping covers. Bottom of pit is filled with filter media. The capacity of pit is depend upon catchment area, rainfall intensity and rate of recharge of soil. Usually size of pit is 1 to 2 m width and 2 to 3 m deep depending on the depth of pervious strata. This system is only suitable for shallow depth aquifers and small houses.

Components of Rooftop Rain Water Harvesting:

Catchments: Catchment is an area which collects rain water which fall over the surface. It may be terrace, courtyard, or paved or unpaved open ground.

Transportation: Water collected by catchment area is diverted towards the gutter provided at the edge of roofing system, and it is further shifted to down pipe through wired mesh to prevent entry of floating matter. Pipes should be provided with sufficient dimension depending upon intensity of rainfall.

First flush system: First flush is a provision made to flush off the water received in first shower. The first shower of rain may contain pollutants which contaminates storable or rechargeable water. It also helps in cleaning silt deposited in dry season. For flushing first shower simple manually operated valve is provided to down pipe to flush off first shower.

Filter unit: Filters are used for treatment of raw water by removing turbidity, colour, and microorganisms .There are some minute or dissolved impurities which always remain in water which cause contamination of ground/storable water if proper filter unit is not provided. After flushing of first shower, water is passed through the filter. There are various types of filter such as gravel, sand and 'netlon' mesh filter. These are designed and placed over the top of storage tank. It removes silt, dust, leaves and other organic matter and prevents entering in storage tank. The filter media should be cleaned daily after every rainfall event. If not cleaned periodically then they get clogged and prevent the easily entering of rain water into storage tank results in overflow of filter.

B. Grey Water Recycling and Reuse

Grey water refers to the domestic waste water which is drained out excluding the waste water from kitchen sink and the water closet as they have high concentration of organic matters. In order to conserve water, this water cannot be just drained out but should be recycled and reused. The benefit of using recycled grey water is that it is a large source with low concentration of organic matter. The bathroom grey water consists of waste water from showers, bathtubs and wash basins. It has a very low concentration of organic matter. The other sources of grey water are from washing of clothes, car washing, etc. According to various studies, an average household produces 140 litre of grey water per day. The various sources and their contribution are categorized in table below. The grey water from all these sources are collected and then treated to make them safe for non- potable use. These treatments include passing the grey water through sand filters or by using natural coagulating agents or by electro coagulation techniques and other biological and chemical treatments. It has been found that using recycled grey water can support the quantity of water required for water closets,

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car washing and garden watering. Grey water production: The table No 1 below lists the expected volume in litres from each grey water source.

Table No 1 Sources of waste water and its type

No.	Sources of waste water and its type		
	Source of waste water	*Types of waste water*	*Quantity/day/person*
1	Toilets	Black water	3 L
2	Bathing	Grey water	20-30 L
3	Kitchen	Grey water	5-10 L
4	Washing cloth	Grey water	15-20 L
5	Animals	Grey water	10-15 L

Grey water reuse methods can range from low cost methods such as the manual bucketing of grey water from the outlet of bathroom, to primary treatment methods that coarsely screen oils, greases and solids from the grey water before irrigation via small trench systems, to more expensive secondary treatment systems that treat and disinfect the grey water to a high standard before using for irrigation. The choice of system will depend on a number of factors including whether a new system is being installed or a disused wastewater system is being converted because the household has been connected to sewer.

A number of technologies which can be applied for grey water treatment worldwide varying in both complexity and performance are.

a) Primary treatment:-

1. Screening

2. Equalization

b) Secondary treatment:-

1. Gravel filtration

2. Sand filtration

3. Chlorination

Fig 1 Grey water Treatment Scheme

Fig 1 shows the schematic representation of grey wa treatment

III. EFFICIENT ENERGY USAGE

Energy efficiency is generally acknowledged as a tool attain reduction in greenhouse gas (GHG) emissions. T consumption of energy in buildings depends on factors l ambient temperature, weather condition, daylight hou building design; inherent efficiency of equipment used a installed efficiency of equipment used. Thus, dependence energy driven systems can be reduced through clim sensitive design where the building envelope respo favorably to the local climatic factors, by proper operatio maintenance of electrical equipment and appliances and appropriate material selection in construction process. A also with improved and optimized insulation, selecting energy efficient electric equipment for heating, ventila and air conditioning, energy consumption can be reduce 55 per cent which can cut 150 million tons of CO2 by 20

Energy conservation measures:

Implementation of ECBC:

Energy conservation Building Code (ECBC) developed by BEE Bureau of Energy Efficiency u Ministry of Environment Forest (MoEF), Govt. of India. building having a connected load of 100 kW or greater contract demand of 120 kVA or greater are come unde act. ECBC sets minimum standards for design construction through buildings components and sys This acts empowers the Governments to facilitate enforce efficient use of energy and its conservation, nc energy intensive industries, establishments and comm buildings as designated consumers and prescribe e consumption norms and standards for the Buildin specific requirements for the insulation of building en by considering surface reflectance, heat transfer and heat gain etc.

LED Light Bulb:

LED light bulb in lighting system can save ener consume less energy and can achieve energy eff effectively. LED light bulb use less energy to produc and the durable is longer than conventional incan bulb, whereas a conventional incandescent bulb number of energy to produce light and the durable is than LED light bulb .The LED light bulb preve production, therefore no need to use external energy use of air conditioner to reduce the internal temper will save energy to comply energy efficiency. Ener LEDs use only about 20%-25% of the energy.

Sensor System in Lighting System:

Lighting takes around 1/3 of electricity used in b and it is a biggest area that can present to enhanc efficiency and decrease energy use. Sensor system system also known as automated lighting system system used motion or movement detection and se operate and normally placed on the ceiling.

Passive Design:

Passive design is also a way of reduce energy cor and increase energy saving to comply with energy e Passive design includes orientation, placement of shading, size and shape, planning and des

construction features. Passive design such as orientation of windows can help to create daylight and natural ventilation or cross ventilation. Thus, they can reduce the use of external energy such as artificial lighting like light bulb and air conditioner to reduce the indoor temperature. Moreover, to prevent the high indoor temperature, the windows are tinted, to screen out the sunlight enter the building, the glass itself which can reduce heat and only 70 to 80% sunlight.

Building Automation Systems:

The trend of going green in aspects of life has been emerged significantly across the globe including India. This offers good opportunities for the building automation systems for HVAC, lighting. Building automation strategies which are adopted for are the lighting management systems with the occupancy based sensors, dimmers, integrated building management systems with the appropriate integration of the HVAC, diesel generator sets, lighting safety and security systems, elevator management systems. The energy efficiency objective should be integrated right at the design stage, which will enable the developer to design the building by incorporating maximum natural light, enhanced HVAC design etc., This will aid in reducing the energy consumption.

Renewable Energy Sources: There are many options for using renewable energy at home including solar panels and small wind turbines. Solar panels are the most popular form of renewable energy today. They may be used to generate heat, electricity, and indoor and outdoor lighting. A small wind turbine for pumping water or for other applications may also be used.

Zero net emissions in existing and new buildings: Zero net emissions are accounted for Zero-energy buildings. Zero energy buildings are defined as buildings that produce as much energy as they consume over a full year. 'Zero energy' states that the energy produced on-site through renewable sources (such as wind, sun) is equal to the energy used by the building when annual accounting is done. A simplistic formula representing is as follows.

(Electricity consumption per year–Electricity generated from Renewable sources)* Emission factor= Annual Carbon emissions per building---(1)

Passive Day lighting Strategies: The goal of day lighting is to collect enough daylight in the summer to turn off electric lights and collect as much as possible in the winter to help heat the building. Here are a few design elements that are used to bring in as much natural daylight as possible:

Building orientation: Light direction is important. Light that comes from the south is usually best for day lighting as sunlight is consistent throughout the day and year. This orientation can also be used for solar heat gain. Light that comes from the north is the next best, as the sunlight is as consistent as the south, just in a lower quantity. Light that comes from the east and west should be avoided if possible. Sunlight at these orientations is harsh, it only occurs during half the day, and the height of the sun changes throughout the year, making sunlight harder to control.

Windows: To bring as much light into the building as possible, windows with tall head heights are used. They can also use uniform windows (horizontal ribbon windows) across the entire façade to light the space evenly.

Skylights: Skylights allow daylight to enter from above, which is useful in spaces at the centre of the building where light from windows can't reach. As with windows, uniform skylight spacing results in uniform lighting.

External Shading Systems: At certain times of the day at each orientation, the light will be too bright and may produce a strong glare inside the building. To prevent this, custom external shading systems are designed to protect windows and other transparent openings. These systems usually include a combination of horizontal and vertical elements, but vary depending on the geographical location, climate, and building orientation.

Light shelves: A reflective horizontal shelf placed above windows reduces glare and directs light deeper into the space.

Solar tubes: These channel sunlight from the roof through a narrow opening. During the day, they look like ordinary ceiling lamps, but they are powered by the sun rather than electricity. These work well when placed directly above desks, where people need plenty of light.

Light wall colours: Light, reflective paint helps light to bounce around the room and makes the space feel brighter.

Low energy materials:

Insulating concrete forms (ICFs): are rigid plastic foam forms that hold concrete in place during curing and remain in place afterwards to serve as thermal insulation for concrete walls. The foam sections are lightweight and result in energy-efficient, durable construction. ICFs consist of insulating foam, commonly expanded polystyrene (EPS) or extruded polystyrene (XPS). The three basic form types are hollow foam blocks, foam planks held together with plastic ties. ICFs can be used to form various structural configurations, such as a standard wall. They provide backing for interior and exterior finishes. ICF walls are designed as reinforced concrete, having high wind and seismic resistance.

Structural Insulated Panels: Manufactured from a layer of foam insulation which is sandwiched between plywood or cement panels. It is fire resistant and this material will help reduce energy bill greatly. SIPs share the same structural properties as an I-beam or I-column. The rigid insulation core of the SIP acts as a web, while the sheathing fulfills the function of the flanges. SIPs also acts as a sound proofing material.

Low-E Windows: also known as "high performance" windows, are another great substitute for normal glass which will help in reducing heat during summer and block infrared radiation. They have a clear coating of metal oxide. It also helps keep the heat in during the winter. They can reduce heat flow by up to 50%.It works on the principle of allowing selective wavelength of light to pass through it. Low - E glass does not work by literally reflecting light. It absorbs the light falling on it emits its own radiation.

Use of solar energy in buildings:

Use of solar energy in place of current systems which work with fossil fuels reduces the existing CO2 and other polluters, and cost and cuts dependence on other countries. In addition, it reduces the dangers caused by gas poisoning (asphyxiation) and explosion, saving in time of gas,

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electricity and other energies' bill payment. Solar energy possibilities are a function of different climatic areas in which study of such factors as characteristics of sun radiation, rainfall, humidity, temperature condition, amount and condition of wind, and insulation specifications are indispensable.

Methods of using solar energy:

- Direct method (sun's light directly enters the building through window).
- Indirect method (the wall storing solar energy-thrombus wall and water wall).
- Pool or basin on the roof.

IV. DESIGN FOR HUMAN ADAPTATION

Indoor Environment Quality:IEQ encompasses the conditions inside a building—air quality, lighting, thermal conditions—and their effects on occupants. Strategies for addressing IEQ include those that protect human health, improve quality of life, and reduce stress.

Most of us spend up to 90% of their time indoors. Pollutants in an indoor environment can increase the risk of illness. Levels of pollutants may be 60% higher in indoors than outdoors in cities with a lot of air pollution.

Effective strategies improving occupants comfort.

Use day lighting.

- Install operable windows.
- Give occupants temperature and ventilation control.
- Give occupants lighting control.
- Conduct occupant surveys.
- Provide ergonomic furniture.

Using Natural Ventilation for Sustainability: Natural ventilation is a healthy and cost effective way to save energy and provide fresh air for building occupants. It is defined as using passive strategies to supply outdoor air to a building's interior for ventilation and cooling without using mechanical systems. The primary purpose of natural ventilation is to allow the outside ambient weather to provide low humidity, moderate temperature wind currents as an alternate cooling source for the building and provide air circulation throughout. Therefore, the productivity gains on the building occupants amount to an increase of 10-18%.

Wind ventilation: Through the use of air pressure differences, wind ventilation can pass through openings such as operable windows, rooftop vents. In effect, the windward side (inlet) receives the positive wind pressure that pushes towards the building. The leeward side (outlet) or the negative wind pressure contrarily pulls the positive wind flow. The placement and sizing of openings is identified to maximize the wind's direction and achieve the benefits of cross ventilation. Leeward side or outlets shou have larger openings for lower pressure zones, whi windward side or inlets should oppositely have small openings to induce higher pressure. The orientation an massing of the building envelope play a significant role i wind ventilation.

Wind loads strike the upper floors more than the lowe levels. Baffles and wing walls can be used to funnel breeze accordingly to avoid stagnant corners.

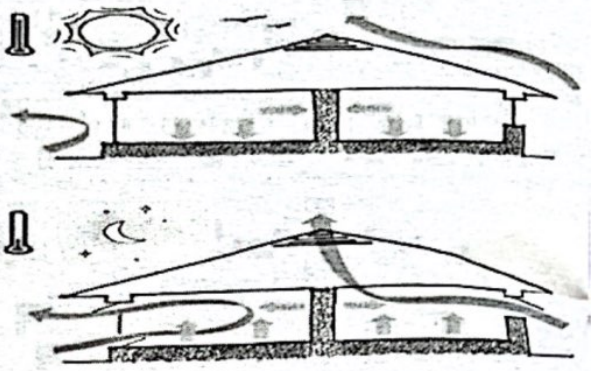

Fig 2: Night purge ventilation

Night purge ventilation: Flushes the heat gains from the day and cools the thermal mass by opening the windows at nigh as shown in fig 2. This method is effectively useful in areas where climate has high-temperature differential from day to night. Therefore, this passive system mitigates the environmental impacts by lessening the carbon footprint and energy emissions from using HVAC systems. Lowe expenditures are seen as this cost-effective measure cut back on electricity, health and operating costs.

Thermal comfort: Thermal comfort is obtained by reducing temperatures to adequate levels and by increasing natura ventilation within the building. Take advantage of th natural surrounding opportunities such as wind. Adop passive strategies having large space layout and openings i order to favor wind circulation, natural ventilation. Therm comfort is achieved by using proper insulation materials an thicknesses into building's exterior walls. Not only will save energy but also has the potential for good acoust comfort. Few materials which can be used are:

Cellulose Fiber: Cellulose fiber insulation is an eco-friend thermal insulation material made from recycled paper fibe It offers good thermal properties and has a low embod energy. Cellulose fiber insulation will be added to enclos walls and unfinished floors as loose-fill, dense-packed wet spray.

Denim: A form of cellulose fiber (cotton) made of the scr and clippings from denim. This eco-friendly insulation higher-than-average — about 30 percent — acoustic ratin decreasing sound transmission and increasing so absorption qualities, while also providing a high rate thermal performance, between R-13 and R-30.

FIBARO Heat Controller: Smart thermostats such as FIBARO Heat Controller can be used which predict occupant's behavior and calculate usual and preferred temperatures. This algorithm will enable to adapt the indoor temperature based on the occupant's daily rhythm. For example, the smart device will reduce the energy consumption during working schedules and restart right before the occupants re -enters their home.

HVAC systems: HVAC stands for Heating, Ventilation, and Air Conditioning. They are the systems that keep occupants warm in the winter and cool and fresh in the summer. They also are the systems that filter and clean indoor air to keep occupants healthy and maintain humidity levels at optimal comfort levels.

Vertical gardening: Vertical gardens are a great way to both maximize the limited space and reclaim disregarded space by transforming empty space into something aesthetically pleasing and creatively stimulating. They provide thermal insulation and also insulate and cool buildings, providing a kind of safety blanket that protects the building. Plants also reduce stress of the occupants. Vertical gardening can also be used to grow small plant fruits, vegetables and herbs in urban settings, creating sustainable and local control of food sources. Plants also improve indoor air quality as they remove harmful VOCs and other harmful toxins like benzene and formaldehyde.

V. CONCLUSION

As the building sector accounts for the 40% of the global carbon emission, the green construction techniques have an unprecedented opportunity to make a major contribution to new global carbon reduction targets. Even though costs of sustainable buildings are higher, it will be paid back in significant time, in the form of savings. The operational savings through energy and water efficiency could range from 50-75%.This will ultimately serve to improve not only the energy performance of buildings but will also assist the country to conserve energy and natural resources by increased recovery and recycling of few things.

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