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SWAMI VIVEKANANDA SCHOOL OF DIPLOMA
(A UNIT OF SANAKA EDUCATIONAL TRUST)

2023

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EDITORIAL

On behalf of Swami Vivekananda School of Diploma, I am pleased to announce the launching of the first Volume of technical magazine untidily with our three Departments Civil Engineering, Mechanical Engineering and Electrical Engineering and to make it available to everyone. We will be launching the technical magazine every year on the month of June.

This technical magazine aims to disseminate achievements in research and developments, while featuring new breakthrough in the field of engineering and technology.

The entire editorial team did their best to provide a platform for distinguished faculties, researchers and students to share the latest accomplishment and propagate the knowledge gained from their technical endeavors.

We are open to explore the opportunities for making this technical magazine an exciting and definitive forum for attracting and publishing contributions that are innovative and transformative.

At the end I would like to thank editorial board members, faculties, students, and all the stakeholders and hope that our collective efforts stimulate further progress in this domain of activity with strong determination at both Copernicus index and Scopus Index in the next five years, and I am hoping that our students and faculties of swami Vivekananda School of diploma would contribute their immense innovative ideas to this magazine every year, they are free to bestow their materials to any of our committee members. I am Glad to introduce our committee members as follows:

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4. *Mr. Debmalya Chakraborty, Lecturer, Mechanical Engineering Department*

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RELAY AND LDR-BASED AUTOMATIC RAILWAY SIGNAL AND GATE CONTROLLING SYSTEM

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ABSTRACT: -The goal of this study is to take efforts toward implementing an automatic railway signaling system and an automatic gate control system that uses electromagnetic relays. The railway signaling system is responsible for train movement safety as well as train control and efficient administration. This device will assist us in avoiding accidents at level crossings and on lines shared by two trains. With the use of sensors and LDR, this system will prevent any human error in the signaling system. The system's ability to determine whether blocks are occupied or otherwise impeded, and to communicate that information to oncoming trains, results in autonomous functioning. Unlike more current traffic control systems, which require external control to establish a flow of traffic, the system works without it. The relay will be connected to the traffic lights that show whether a train is moving or stopping. The block signaling system governs the signaling system.

KEYWORDS— automatic railway signaling system, automatic gate controlling system, LDR, block signaling system

INTRODUCTION: - The railway signaling system is essential for monitoring the railway network and preventing accidents. In a country with the world's largest railway network, such as India, the railway signaling system must be extremely efficient and quick to react. The automatic railway signaling system aids in the acquisition of quick-reacting signals and the avoidance of human errors in signal control.

In this project there are 4 alerts among stations aside from the sign of the platform. All those alerts are managed with the aid of using electromagnetic relays which might be utilized in 3 mild sign block circuit. To manipulate the railway crossing gate LDR and LASER alerts are used. Automatic block signaling machine includes a sequence of alerts that divide a railway line into a sequence of phase or blocks. For the railway crossing the signaling machine is semi-computerized and forestalls or slows down the educate motion in presence of occupied track at the extent crossing.

OBJECTIVE: - The main objective of this project work is to avoid any human errors in the signalling system which will avoid the occurrence of accidents due to negligence. The use of relay helps to increase the speed of response of the system and also increases the range of protection. The LDR and LEASER system is used as an alarming system which will trigger the buzzer if there is any fault on the track or if there is any other train on the same track.

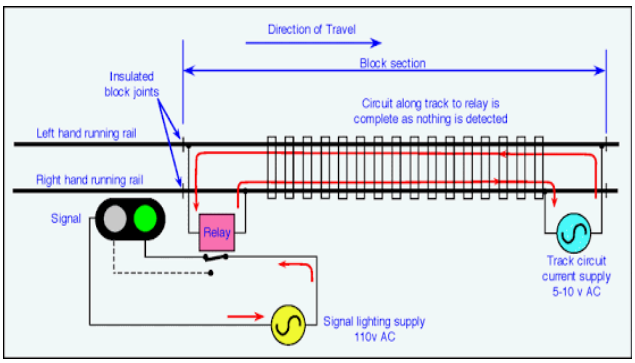

Figure 1: Signalling System.

THEORY: - In block signalling system just one train can reside a piece of a track or specific block. The block is set by the track circuit. From fig 2 we are able to see how the train axle help to finish the circuit and form a brief circuit path preventing this to flow further showing the position of the train and this controlling action is done by electromagnetic relay.

The operation of the relay depends on the movement of the train on the track circuit. Thetrack consists of two lines; one in all the road is usually in negative potential and therefore the other line contains a small air gap in between two parts. This gap helps in avoiding magnetic saturation within the lines hence reducing the equivalent impedance of the track. the full body of the train is at negative potential and therefore the overhead line gives 25 KV supply. All the relays are given positive potential.

When the train pace connecting the 2 parts of the track circuit it supplies the relay and hence it controls the signal/s connected to the relay. This relay controls the signal/s by the assistance of three block signalling system.

There are mainly three signal colours that are used (1) red light signifying to prevent (2) traffic light signifying to hamper the train (3) green light meaning the following track is obvious and good to travel.

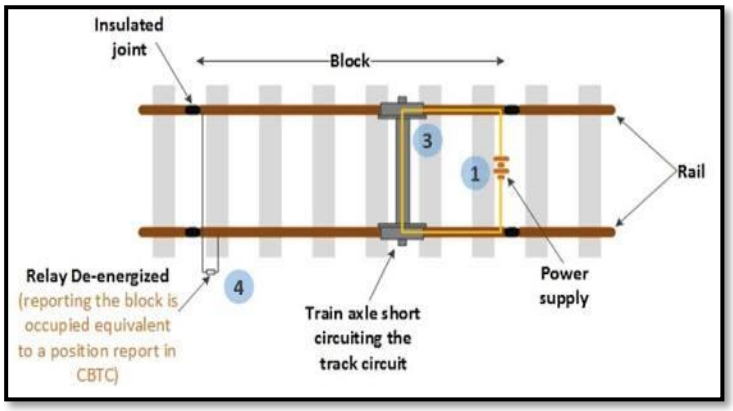

Figure 2: Mechanism of track circuits to energies the relay.

The gate of the extent crossing must be monitored whenever a train is nearby to avoid accidents. It's common to listen about an accident at the railway crossing. Railway gates are opened or closed manually by a gate keeper, the information about arrival of train for opening or closing of door is received from nearby station. But some railway crossings are totally unmanned and plenty of railway accidents occurs at these unmanned crossways. To avoid the human intervention at level crossings completely, automation of the railway gate control is required. In this project there is a signal before the level crossing which is showing the driver whether the track is clear or not. The gate is semi-automatic and is governed by LASER and LDR. For an occupied track the laser beam does not falls on the LDR hence the motor does not starts and the gate does not close, the signal will be red and once the track is cleared the signal will turn green and the motor starts the gate closes. Fig 3 shows the flow chart of how the gate is controlled by LDR and LASER.

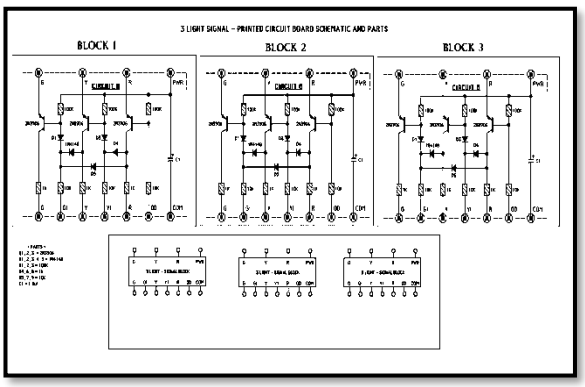

Figure 3: 3 Block system circuit.

Fig 3 shows the 3-block circuit diagram which is been controlled by the electromagnetic relay. The signalling system is controlled by the 3-block system and the relay.

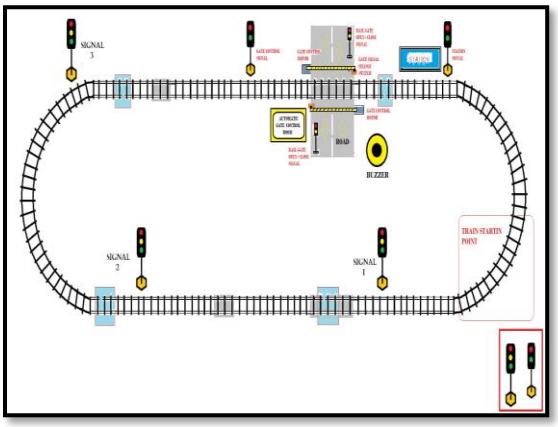

Figure 4: Schematic diagram of railway track.

Fig 4 describes the working of this project. The train starts from the station or shed if the signal is green, once the last compartment touches the track circuit the signal changes to red. When the train is in between the station signal and signal 1 the train will be in first block of the three-block system. The signal 1 is green and station signal is red. Once the train is in between the signal 1 and signal 2 the train is in block 2. Signal 1 is now red and signal 2 is now green and the station signal is yellow. Again, for block 3 the signal 3 will be green and signal 2 is red and signal 1 is yellow.

The gate of the level crossing needs to be monitored whenever a train is nearby to avoid accidents. It is very common to hear about an accident at the level crossing. Railway gates are opened or closed manually by a gate keeper. The information about arrival of train for opening or closing of door is received from nearby station. But some railway crossings are totally unmanned and many railway accidents occur at these unmanned level crossing. To avoid the human intervention at level crossings completely, we need to automate the process of railway gate control.

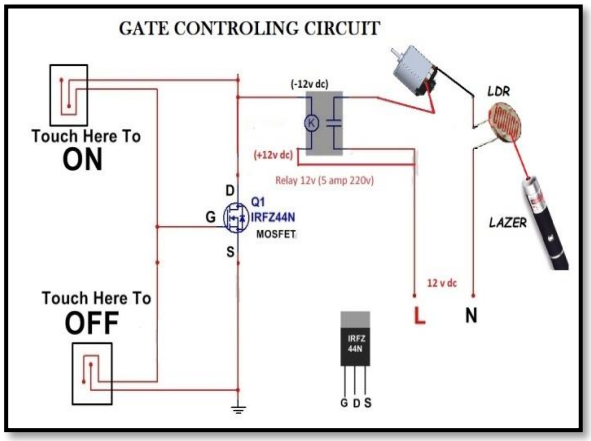

Figure 5: Gate control circuit.

In this project there is a signal before the level crossing which is showing the driver whether the track is clear or not. The gate is semi-automatic and is governed by LASER and LDR. For an occupied track the laser beam does not falls on the LDR hence the motor does not start and the gate does not close, the signal will be red and once the track is cleared the signal will turn green and the motor starts the gate closes. Fig 7 shows the flow chart of how the gate is controlled by LDR and LASER. Fig 5 shows the gate control circuit.

By the help of delay timer circuit, the duration of green signal at the station can be the signal will be green for two minutes in this project. Fig 6 shows the delay circuit of the station signal.

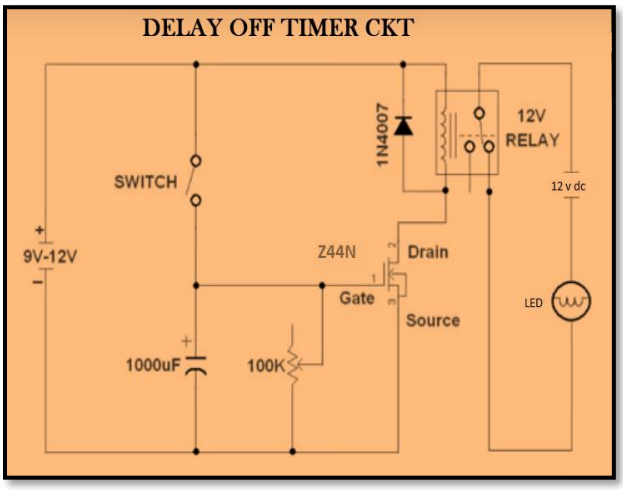

Figure 6: Delay timer circuit for station signal control. controlled.

The whole operation of this project is shown by the help of a flow chat shown in fig 7.

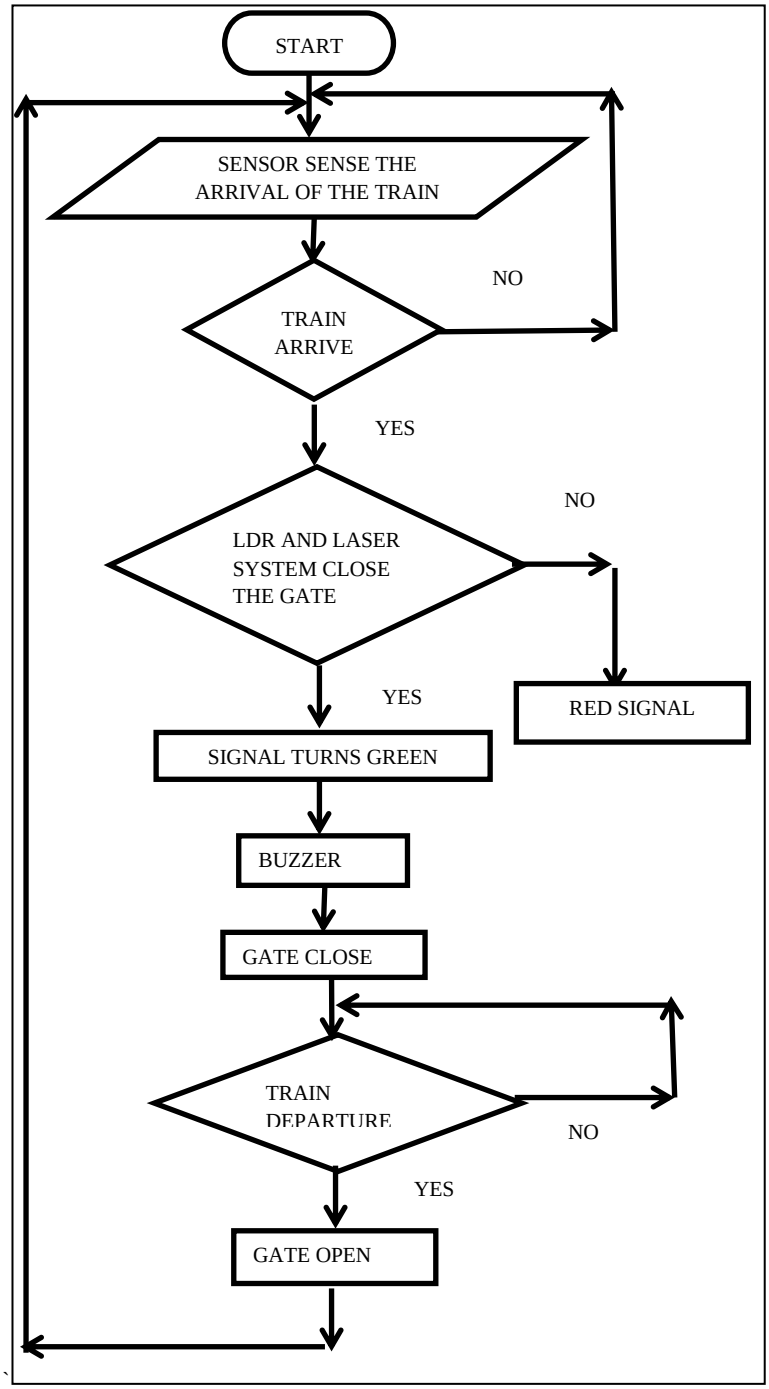

Figure 7: Flow chart of the gate operation using LDR and LEASER.

HARDWARE MODEL

Railways transportation is considered as the cheapest mode of transportation over all other means of transportation but in our day-to-day life we come across many news of accidents occurring on the railway tracks or at the level crossing. This occurs mainly due to the carelessness in manual operations or lack of workers. This project helps in removing the problems faced by the current system.

The components that are used are

1. LDR
2. Electromagnetic relay
3. Laser
4. Transformer
5. Rectifier circuit using diode
6. Smoothing
7. Regulator
8. Vero Board
9. Soldering iron
10. LED
11. NPN transistor
12. Resistor
13. Capacitor
14. Servo motor.
15. Power supply

Figure 8: Circuit Control Box

The tracks are covered with aluminum foil to make it conductive. When the last coach of the train crosses the platform signal the signal next to the platform turns green by the help of the relay.

CONCLUSION: - This project has many advantages such as it will reduce number of accidents occurring at the railway level crossing, it will improve the accuracy and reduce errors occurring due to

manual operations. It will reduce the collision of train and also superintend the route of a particular train which will remove any delay of the train to reach its destination.

Security can be implemented by placing tracker in the train in order to monitor the location of the train in case of any issue. By this mechanism, presence of a gatekeeper is not necessary and automatic operation of the gate through the motor action is achieved. Electromagnetic relay performs the full operation i.e., sensing, changing the signals. The circuit is simple and easy to build.

FUTURE SCOPE: - This system can be modernized with the help of Artificial Intelligence. The entire track consists of number of IR modules.

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A PRELIMINARY INVESTIGATION INTO THE EFFECT OF USING COAL FLY ASH FOR REINFORCEMENT OF BLACK COTTON SOIL

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ABSTRACT: -Near about 53 million hectares of land area in India are made up with Black Cotton soil (Expansive soil). The property of these expansive soils, in general, is that they are very hard when in dry state, but they lose all of their strength when in wet state. In light of this property of expansive soils, these soils pose problems worldwide that serve as challenge to overcome for the Geotechnical engineers.

One of the most important aspects for construction purposes is soil stabilization, which is used widely in foundation and road pavement constructions; this is because such a stabilization regime improves engineering properties of the soil, such as volume stability, strength and durability. In this process, removal or replacing of the problematic soil is done; replacement is done by a better-quality material, or the soil is treated with an additive.

In the present study, using **fly ash** obtained from **Kolaghat Thermal Power Plant, West Bengal**, stabilization of black cotton soil obtained from **Paschim Medinipur, West Bengal** is attempted. With various proportions of this additive i.e., 10%, 20%, 30%, 40% & 50%, expansive soils is stabilized. Owing to the fact that fly ash possesses no plastic property, plasticity index (P.I.) of clay-fly ash mixes show a decrease in value with increasing fly ash content.

In conclusion, addition of fly ash results in decrease in plasticity of the expansive soil, and increase in workability by changing its grain size and colloidal reaction. Tested under both soaked and un-soaked conditions, the California Bearing Ratio (CBR) values of clay with fly ash mixes were observed. Analysis of the formerly found result exposes the potential of fly ash as an additive that could be used for improving the engineering properties of expansive soils.

Keywords: Black Cotton Soil, Fly Ash, Plasticity Index, California Bearing Ratio, Swelling.

INTRODUCTION: -

1.1 BLACK COTTON SOIL: - Black cotton soils, which are also called as expansive soil or swell-shrink soil, have the predisposition to shrink and swell with variation in moisture content. As a result of this variation in the soil, significant distress occurs in the soil, which is subsequently followed by damage to the overlying structures. During periods of greater moisture, like monsoons,

these soils imbibe the water, and swell; subsequently, they become soft and their water holding capacity diminishes. As opposed to this, in drier seasons, like summers, these soils lose the moisture held in them due to evaporation, resulting in their becoming harder. Expansive oils in the Indian subcontinent are mainly found over the Deccan trap (Deccan lava tract), which includes Maharashtra, Andhra Pradesh, Gujarat, Madhya Pradesh, and some scattered places in Odisha. These soils are also found in the river valley of Narmada, Tapi, Godavari and Krishna. The depth of black cotton soil is very large in the upper parts of Godavari and Krishna, and the north-western part of Deccan Plateau. Basically, after the chemical decomposition of rocks such as basalt by various decomposing agents, these are the residual soils left behind at the place of such an event. Cooling of volcanic eruption (lava)and weathering another kind of rock–Igneous rocks–are also processes of formation of the type of soils. Rich in lime, alumina, magnesia, and iron, these soils lack in nitrogen, phosphorus and organic content. Consisting of high percentage of clay sized particles, the color of this soil varies from black to chestnut brown. 20% of the total land area, on an average, of this country is roofed by expansive soils. These soils are suitable for dry farming and for the growth of crops like cotton, rice, jowar, wheat, cereal, tobacco, sugarcane, oil seeds, citrus fruits and vegetables; there a son behind it is owed to the moisture retentive capacity of expansive soils, which is high. In the semi-arid regions, just in the last couple of decades, damages due to the swelling- shrinking action of expansive soils have been observed prominently in form of cracking and break-up of roadways, channel and reservoir linings, pavements, building foundations, water lines, irrigation systems, sewer lines, and slab-on-grade members.

1.2. COAL FLY ASH: - A waste material extracted from the gases emanating from coal fired furnaces, generally of a thermal power plant, is called coal fly ash or simply fly ash. One of the chief usages of volcanic ashes in the ancient ages were the use of it as hydraulic cements, and fly ash bears close resemblance to these volcanic ashes. These ashes were believed to be one of the best pozzolans (binding agent) used in and around the globe. The demand of power supply has exponentially heightened these days due to increasing urbanization and industrialization phenomena. Subsequently, this growth has resulted in the increase in number of powers supplying thermal power plants that use coal as a burning fuel to produce electricity. The mineral residue that is left behind after the burning of coal is the fly ash. The Electro Static Precipitator (ESP) of the power plants collect these fly ashes.

Production of fly ash comes with two major concerns – safe disposal and management of fly ash. Because of the possession of complex characteristics of wasters which are generated from the industries, and their hazardous nature, these wastes pose a necessity of being disposed in a safe and effective way, so as to not disturb the ecological system, and not causing any sort of catastrophe to human life and nature. Environmental pollution is imminent unless these industrial wastes are pre-treated before their disposal or storage. Essentially consisting of alumina, silica

and iron, fly ashes are micro-sized particles. Fly ash particles are generally spherical in size, and this property makes it easy for them to blend and flow, to make a suitable concoction. Both amorphous and crystalline nature of minerals are the content of fly ash generated. Its content varies with the change in nature of the coal used for the burning process, but it basically is a non-plastic silt. For waste liners, fly ash is a potential material that can be employed; and in combination with certain minerals (lime and bentonite), fly ash can be used as a barrier material. In present scenario, the generation of this waste material in picture (fly ash) is far more than its current utilization. In other words, we are producing more of fly ash than we can spend.

1.1.1 Generation and Disposal

Usage of coal in thermal power plants for the generation of steam is a common practice. A method that was proved to be non-energy efficient was used in the past, where coal in form of lumps were expended in the furnaces of the boilers to generate the evaporated content: steam. Thus, in order to optimize the production of energy from coal mass, the thermal power plants began to use pulverized coal mass instead of the afore mentioned content.

In this process, firstly, his pulverized coal is infused into the combustion chamber, where the instant but efficient burning of fuel happens. The ash formed as a result of this is called the fly ash, and this fly ash contains molten minerals. The steam around this molten mass, when the coal ash travels with the flue gases, results in the spherical shape of the fly ash particle. Next, the employment of the economizer recovers the heat from the steam gases and fly ash. As a result of this process, the temperature of the fly ash shows a sudden reduction in value.

If this temperature fall is rapid, then the resulting structure of the fly ash material is amorphous. However, if the temperature drop during this cooling process is gradual, then the fly ash assumes a more crystalline in nature. This shows the implementation of the economizer, and how it improves the reactivity process. In the process where fly ash is not subjected to the economizer, it forms a 4.3% soluble matter, and its pozzolanic activity index clocks to 94%. Whereas, during the process where the fly ash exposed to the economizer, its pozzolanic activity clocks to 103% and it forms an 8.8% soluble matter. In conclusion, fly ashes are separated from the flue gases by amechanical dust collector, which is commonly referred to as Electro Static Precipitator (ESP), or scrubbers.

Free of fly ashes, the rest of the flue gases are liberated into the atmosphere via the chimney.

With about 90%-98%, the efficiency of ESPs for the separation of finer and lighter fly ash particles is high. In general, the fly ash consists of four to six hoppers, named as field. The fineness of the fly ash particles collected are thus proportional to the number of fields available in an ESP. Therefore, the fly ashes that are collected from the first hopper has a specific surface area of about 2800 cm^2/gm, whereas the fly ash collected from the last hopper exhibit a greater specific surface

area, that is, 8200 cm^2/gm. With the scorching of pulverized coal, the resulting ash content forming during the process are either collected as fly ash or bottom ash. 80% of coal ashes that are removed from the flue gases are recovered as fly ash, whereas the remaining 20%, that are generally coarser in size,

are collected at the bottom of the furnace as **bottom ash**. Either in dry form, or its collection from a water-filled hopper, bottom ash is taken from the bottom of the furnace. When there is a sufficient amount of bottom ash in the water- filled hopper, beyond which its disposal becomes imminent before moving on to the next process, the transference can occur by water jets or water sluice to a disposal pond which. This disposed waste is then called as **pond ash**.

1.1.2 Classification of Fly Ash

The extracted ash from the flue gases via an Electro Static Precipitator, after the process of pulverization, is called fly ash. It is the finest of particles among bottom ash, pond ash and fly ash. With some unburned carbon, the fly ash chiefly consists of non-combustible particulate matter. These generally consists of silt-sized particles.

On the basis of a lime reactivity test, fly ashes have been classified into four different types, as given:

- Cementitious fly ash
- Cementitious and pozzolanic fly ash
- Pozzolanic fly ash
- Non-pozzolanic fly ash

With free lime content and negligible reactive silica, this fly ash is called as cementitious. As opposed to this, with negligible free lime content, and chiefly reactive silica, this fly ash is called pozzolanic fly ash. Both reactive silica and free lime are predominant in cementitious and pozzolanic fly ash. Neither free lime, nor reactive silica are present in non-pozzolanic fly ash. The distinguishable difference between cementitious fly ash and pozzolanic fly ash is that the cementitious fly ash hardens when it comes in connection with water, whereas the pozzolanic fly ash hardens only after the activated lime reacts with water. Cementitious & Pozzolanic Fly Ash and Pozzolanic Fly Ash are the types that are found widely.

Based on the chemical composition of fly ash, fly ash has been categorized into two categories, as given:

- Class C Fly Ash
- Class F Fly Ash

Burning of sub-bituminous type of coal and lignite, which contains more than 20% Calcium Oxide, gives the Class C fly ash. By ignition of anthracite and bituminous type of coal, Class F fly ash comes into the picture. This fly ash contains less than 20% Calcium Oxide.

1.1.3 Utilization of Fly Ash

The utilization of fly ash can be largely grouped into following three classes:

- The Low Value Utilizations, which includes back filling, structural fills, road construction, soil stabilization, embankment & dam construction, ash dykes, etc.
- The Medium Value Utilizations, which includes grouting, cellular cement, pozzolana cement, bricks/blocks, soil amendment agents, prefabricated building blocks, fly ash concrete, weight aggregative.
- The High Value Utilizations, which includes, fly ash paints, ceramic industry, extraction of magnetite, distempers, metal recovery, acid refractory bricks, floor and wall tiles, etc.

After these, there is still a large wastage of fly ash material observed; however, this has led to evolution of large number of for the management of fly ashes. Thanks to this, the utilization of fly ash has increased to 73 MT by the year 2012. Years 2010-2012 saw a wide acceptance of fly ash as a product that can be used in various purposes.

Presently, the production of fly ashes in India is about 130 MT/year, and this is expected to rise by 400 MT by the year 2016-2017, as stated by 2nd annual international summit for fly ash utilization 2012, scheduled on 17th-18th of January, 2013 at NDCC II convention Centre, NDMC Complex, New Delhi, India. As a palpable conclusion, the fly ash utilization in India is about 56%, as in 2010-2012, which leads to the fact that the rest 44% are waste material, dumped/disposed chiefly out in the open, and considering the adverse effect of this waste material on our environment, it is of necessity to utilize all of the fly ash produced by coal based thermal power plants. An increase of efforts has to be observed if we were to achieve a 100% utilization of this waste product.

If we were to execute the usage of fly ash properly in low value applications, morethan60% utilization of fly ash we currently produce can be seen. In present scenario, India is 65%-70% dependent on production of energy by coal based thermal power plants, which tallies the fly ash production of the country, as stated earlier, up to 130 MT/year.

1.3 Reaction mechanism of Fly ash and expansive soil

By itself, fly ash has little cementitious value, however, this changes in presence of moisture, with which it reacts chemically, and forms cementitious compounds. These compounds attributes to the improvement of compressibility and strength characteristics of a soil. Both classes of Fly ash (C & F) are pozzolans i.e., they contain siliceous and aluminous materials. Fly ash can thus produce an assortment of divalent and trivalent cations ($Ca2+$,3+, $Al3+$ etc.) under conditions that are ionized in nature, which in return can encourage flocculation of dispersed clay particles. Expansive soils can thus, be theoretically stabilized in an effective manner by cationic exchange with fly ash.

OBJECTIVE & JUSTIFICATION OF THE RESEARCH: -

Objectives of research

The objectives of the study are:

- To determine sub-soil characteristics of the black cotton soil.
- Identification of the sub-soil profile of black cotton soil.
- Determination of the soil design parameters of black cotton soil
- To study the effects of Coal Fly Ash on the Engineering properties of black cotton soil
- To check whether Coal Fly Ash can be used as a soil stabilizer or not.
- To check the ambit of reducing expansiveness and improving bearing capacity value by adding additives.
- To find out the best possible design mix proportion of soil and admixtures which gives maximum strength of stabilized soil compared to that of the original soil after adding admixtures.
- To determine the engineering properties for both un stabilized and stabilized soil for assessing the
  improvement of soil with stabilization, by the help of some common laboratory tests e.g., OMC, MDD, UCS, CBR test, both in unsoaked and soaked condition.
- To determine the free swell ratio values of expansive soil with varying fly ash content.
- Also, to establish the usage of Fly Ash as an additive, thereby helping utilize it which otherwise always lays as fine waste product from thermal power plants

Justification of Research

Almost 20% of land in India is roofed by expansive soils. With the rapid growth in industrialization and urbanization, land scarcity appears to be an imminent threat. Construction of civil engineering structures on expansive soils, however, pose a major risk to the structure in itself, because of the greater degree of instability in these kinds of soil. Tallied in billions of dollars per year is the loss in property every year globally owing to the instability in the expansive soils. On the other hand, disposal of fly ash has become a growing issue. India, as a developing country, is highly dependent on coal based thermal power plants for production energy, and this dependency isn't going to falter anytime soon. Pulverization of coal in these power plants produces many waste materials, including fly ash. As of 2012, the generation of fly ash rose to 130 MT/year. However, only 56% of this generated fly ash waste were only utilized. The residual fly ash is disposed of in places, and this poses threat to health, and also there duction in land area

that can be otherwise utilized for purposes other than the disposal of fly ash. Keeping both the issues in mind, this research of reinforcing black cotton soil using fly ash is justified.

LITERATURE REVIEW

For the relative investigation of stabilization of black cotton soil, the accompanying study is executed.

2.1 Origin and occurrence of expansive soil

Clay mineral is the key element which divulges the swelling characteristics to any ordinary non-swelling/non-shrinking soil. Montmorillonite, out of several types of clay minerals has the maximum amount of swelling potential. In-situ formation of chief clay minerals occurs under alkaline conditions, or sub-aqueous decomposition of blast rocks can be seen the origin of such soil – expansive soil. This type of soil can also be formed due to weathering under alkaline environments, and under adequate supply of magnesium or ferric or ferrous oxides. Given there's a good availability of alumina and silica, the formation of Montmorillonite is favored.

2.2 Nature of expansive soil

Swelling in clays can be sub-categorized into two distinctive types, namely:

- Elastic rebound in the compressed soil mass due to reduction in compressive force.
- Imbibing of water resulting in expansion of water-sensitive clays.

Swelling clays are the clays that exhibit latter type of swelling, where the clay minerals with largely inflating lattice are present. One of the fundamental characteristics of clayey soil is that they display little cohesion and strength when wet, but they become hard when devoid of water. However, all of them do not swell due to wetting action. Decrease in ultimate bearing capacity at saturation, and large differential settlement due to this occurs. Thus, clayey soils exhibit foundation problems.

2.3 Identification and classification of expansive soils

Some laboratory tests are available for the identification purposes of swelling soils. By differential thermal analysis, microscopic examination, and X-ray diffraction. The presence of Montmorillonite in clay minerals allows the judgement of the expansiveness of the soil. This aspect is however very technical in nature. A simple aspect, as opposed to the aforementioned methods, is the free-swell test, that's done in the laboratory. This test is conducted by adding 10 gm of dry soil, passing through a 425 μ sieve into two separate 100 cc graduated jar – one filled with water, and the other with kerosene. Swelling occurs in the jar containing water. The swelled volume of the soil is then noted (After 24 hours period), and subsequently, the free swell index values, in percentage, are calculated. Good grade, high swelling, commercial Bentonite has been reported to have free swell values varying from 1200%

to 2000%. In general, the swelling potential of as oil is related to plasticity index. With corresponding range of plasticity index, various degrees of swelling capacities are as indicated through the following table:

Swelling potential	**Plasticity Index**
Low	0-15
Medium	15-24
High	24-46
Very High	>46

Table 1: Swelling potential vs. Plasticity Index

Several factors participate in deciding whether or not a soil with high swelling potential exhibit swelling characteristics.

One of these factors, that occupy greatest importance, is the difference between soil moisture content at the time of construction, and final (equilibrium) moisture content finally achieved under various conditions allied with the complicated structure. The soil has a high swelling capacity if the equilibrium moisture content is higher than the soil moisture content. Large swelling pressure may develop as a result of the upheaving of the soil or structure, causing swelling.

2.4 Methods of recognizing expansive soils

Grouped into three categories, following are the methods of recognizing expansive soils:

- Mineralogical identification
- Indirect methods, such as soil suction, activity and index properties
- Direct measurement.

Impractical and uneconomical in practice, methods of mineralogical identification still hold importance in exploring basic properties of clay minerals. Direct measurement, out of the remaining two categories, offers the most useful data. By their shattered or fissured condition, or obvious structural damage to existing buildings caused by such soils, potentially expansive soils are usually identified in the field. To classify expansive soil, potential swell, or potential expansion, or the degree of expansion is a favored term used; from this, geotechnical engineers establish how good or bad the expansive soils are.

2.5 Causes of swelling

There are different theories, but the mechanism of swelling is still unclear. No conclusion to the mechanism has been reached. Soil consisting high percentage of clay or colloid, with Montmorillonite mineral present as the chief mineral is one of the most universally accepted reasons for the swelling of soils.

2.6 Swell Pressures

The pressure exerted by expansive soil when they swell, owing to their contact with water, is called swell pressure. The estimation of this swell pressure and likely becomes a very important task for designing a structure on such soils, or building the core of a dam, or constructing a road embankment, or taking a canal through such soils.

2.7 Factors affecting swelling

Initial moisture content, or the molding water in case of a re-molded sample is the most influencing factor.

"The behavior of re-molded clays is much as undisturbed clays", as per Holts' and Gibbs' findings. For a given dry density, the value of initial water content will be a key factor in determining the water affinity of a given sample, as well as its swell pressure. A minimum moisture content (w_n) required by a clay for swelling to begin beneath a prepared sub-grade is given by:

(%)=0.2w_1+g

Where, w_1 = liquid limit

The factors that affect the swelling aspect of a soil largely depend on the soil's environmental conditions. With the intake of water, swelling is more in a soil element which is close to the surface, but if below the surface, the same soil exhibits negligible swelling because the overburden pressure neutralizes the developing swelling pressure of the dry soil. Generally responsible for swelling are the following factors:

- Location of the soil sample from the ground surface
- Thickness, as well as shape of the sample
- Change in volume
- Temperature
- Nature of pore fluid
- Time
- Stress history
- Unit weight of the sample taken, etc.

2.8 Problems associated with the expansive soil

Generation of problems for all kinds of construction over expansive soils is common, leading us to believe that such types of soil are not suitable for these purposes. However, given the placement of these kinds of soil over the country, it leaves engineers no other choice but to develop different

structures on the soil, well aware of the risk. These structures chiefly are a part of irrigation projects. Buildings, and other kinds of structures constructed over these soils are subjected to differential deflections. These deflections cause distressing, and in turn leads to damage of the structure.

Moreover, the reduction in moisture content due to the evaporation of water in soil causes shrinkage, and heaving of soil occurs when there is a disproportionate increase in moisture content. The level of ground water table also has as significant impact on the moisture content of these soils, which in return affect the shrinkage-swelling cycles. In seasons which are dry in nature, the surface of clayey soil shrinks, however, little evaporation is there on the clayey soil on which the building stands. This causes differential settlement at plinth level, posing danger to the structure.

If the construction of a building on such type of soil is done in its dry season, the base of the structure's foundation would experience swelling pressures when the partially saturated soil underneath starts imbibing water in the wet season, developing swelling pressures. When the pressure imposed by the structure on the foundation is less than the swelling pressure developed, upliftment of such a structure occurs, which would lead to formation of cracks. The imposed bearing pressure if the building is constructed in the wet season should be within the permissible limits of bearing pressure for the soil. A better practice is to construct a building during dry season, and completing it before the onset of wet seasons. One of the methods of treatment of expansive soil to make them fit for the construction purposes is called stabilization. According to Petry (2002), assortment of stabilizers can be grouped into:

- By-product stabilizers (Quarry dust, Fly ash, Slag, Phosphor-gypsum, etc.)
- Traditional stabilizers (Cement, Lime, etc.)
- Non-traditional stabilizers (Sulfonated oils, Potassium compounds, Polymer, Enzymes, etc.)
- Lots of geo-environmental problems are a result of industrial by-products whose disposal as fills in disposal sites adjacent to the industries demand large chunks of land, which can otherwise be utilized for construction, growing of vegetation, etc. purposes. Various attempts by different researchers and organizations have been made to utilize these by-products. Stabilization of expansive soil is one of the ways of fulfilling such a thing.

2.9 Stabilization using Fly Ash

- **Sharma et al. (1992),** using mixtures of fly ash, blast furnace slag and gypsum, studied stabilization. He found that when fly ash, gypsum and blast furnace slag are used in proportions of 6:12:18, the swelling pressure decreases from 248 KN/$m2$ to 17 KN/$m2$, whereas an increase by 300% was observed in case of unconfined compressive strength.

- **Srivastava et al. (1997),** studied the microscopic changes in the fabric and micro-structure of the expansive soil due to the addition of lime sludge and fly ash using SEM photography. He found that there were changes in the micro-structure and fabric of the expansive soil when 16% lime sludge and 16% fly ash were both added.
- **Srivastava *et al.* (1999),** have also stated that the best stabilizing effect of the swelling and consolidation behaviors in an expansive soil mixed with fly ash and lime sludge was obtained when 16% lime sludge and 16% fly ash were added.
- **Cokca (2001)** found out that swelling pressure decreased by 75% after 7-day curing, and 79% after 28 day curing when soil specimens were treated with 25% Class C Fly ash (18.98% of Cao).
- **Pandian et al. (2001)**, made an effort towards stabilization of expansive soil by using Class F Fly ash. He found that fly ash can make for an effective additive when he saw that with 20% fly ash content, the CBR value of Black cotton soil improved (about 200%) significantly.
- **Turker et al. (2004)**, employed sand along with Class C & Class F fly ash for stabilization of expansive soil. Without any contradiction of belief, Class C fly ash was more effective in stabilization, and decrease in free swell with curing period was observed. The percentage content of soil, Class C fly ash and sand that gave the best result was 75%, 15% and 10% respectively.
- **Satyanarayana et al. (2004),** aimed to study the mutual effect of addition of lime and fly ash on the engineering properties of the expansive soil. He found out that 70%, 26% and 4% were the optimum percent mixture of the ingredients for the construction of roads and embankments.
- **Phani Kumar *et al.* (2004)** saw that the hydraulic conductivity, swelling properties and plasticity of expansive ash mixture decreased, whereas the strength and dry unit weight increased with the increase of fly ash content in the mix. given water content, the resistance to penetration also increased with the increase in fly ash content.
- **Baytar (2005)** contemplated the stabilization of expansive soils using desulphogypsum and fly ash acquired from a thermal power plant by 0 to 30%. A variable percentage of lime (0 to 8%) was appended into the expansive soil desulphogypsum-fly ash mixture. The samples, thus formed, were cure for a period of 7 days and 28 days. It was observed that swelling percentage decrease, and there was an increase in rate of swell with increasing percentage of the stabilizer in the mixture. The curing process reduced the swelling percentage further; and with the addition of 30% desulphogypsum and 25% fly ash, reduction in swelling percentage were to such levels that stood comparable with the one where lime was only used as stabilizing compound for the expansive soil.

- **Amuetal (2005)** utilized fly ash and cement mixture for the stabilization purposes of expansive soil. Three distinct classes of samples:(i)12%cement, (ii)9%cement+3%flyash, and(iii)natural clay soil, were taken to be tested for Maximum Dry Densities (MDD), Unconfined Compressive Strength (UCS) Optimum Moisture Contents (OMC), California Bearing Ratios (CBR), and the Undrained Triaxial tests. The results of this test indicated that the sample with 9% cement and 3% fly ash showed better results with respect to CBR, OMC, MDD, and shearing resistance, in comparison to the other two samples. This indicated the value of fly ash as a stabilizing agent.
- **Sabatet al. (2005)** studied the stabilization of expansive soil using fly ash-marble powder mixture. He concluded that the optimum proportions of soil, fly ash, and marble powder in the mixture in percentage by weight to give the best result were 65%, 20% and 15%respectively.
- **Rajesh et al. (2006)** talked about experimental investigation of clay beds stabilized with fly ash-lime segments and fly ash segments. An observation of swelling in clay beds of 100 m thickness strengthened with 30 mm diameter fly ash-lime and fly ash segments. There was a considerable decrease in heave in both fly ash-lime and fly ash columns. However, lime-fly ash mixture generated better results.
- **Wagh (2006)** utilized rock flour, lime and fly ash independently, further more in diverse extent to stabilize the black cotton soil from Nagpur Plateau, India. Rock flour or fly ash, or both together, when added to the black cotton soil showed an improved value of CBR to some degree, and there was an increase in angle of shearing resistance with their duction in cohesion value. CBR values increased significantly with the increase of both frictional resistance and cohesion where limes, in addition to both fly ash and rock flour, as added into the mixture.
- **Sharmaetal. (2007)** contemplated the impact on swelling of highly plastic expansive clay, and the compressibility of another non-expansive but highly plastic clay when fly ash was employed. At a given dry unit weight of the mixture, the swelling pressure and swell potential showed a decrease by nearly 50%. A decrease by 40% at 20% fly ash content in coefficient of secondary consolidation and compression index of both the samples was observed.

MATERIALS AND TEST METHODS

3.1 Materials

3.1.1 Expansive soil

As a part of this investigation, the expansive black cotton soil was acquired from **Paschim Medinipur, West Bengal**. The black cotton soil thus obtained was carried to the laboratory in sacks. A small amount of soil was taken, sieved through 4.75 mm sieve, weighed, and air-dried before weighing again to determine the natural moisture content of the same. The various geotechnical properties of the procured soil are as follows:

Sl. No.	Properties	Code Referred	Value
1	Specific Gravity	IS 2720 (Part 3/Sec 1) - 1980	2.44
2	Maximum Dry Density (MDD)	IS 2720 (Part 7) - 1980	1.52 gm/cc
3	Optimum Moisture Content (OMC)	IS 2720 (Part 7) - 1980	22.65%
4	Natural Moisture Content	IS 2720 (Part 2) - 1973	7.28%
5	Free Swell Index	IS 2720 (Part 40) - 1977	105%
6	Liquid Limit	IS 2720 (Part 5) - 1985	65%
7	Plastic Limit	IS 2720 (Part 5) - 1985	37.08%
8	Shrinkage Limit	IS 2720 (Part 6) -: 1972	17.37%

Table 2: Geotechnical properties of Expansive Soil

3.1.2 Flyash

A waste material extracted from the gases emanating from coal fired furnaces, generally of a thermal power plant, is called fly ash. The mineral residue that is left behind after the burning of coal is the fly ash. The Electro Static Precipitator (ESP) of the power plants collect these fly ashes. Essentially consisting of alumina, silica and iron, fly ashes are micro-sized particles. Fly ash particles are generally spherical in size, and this property makes it easy for them to blend and flow, to make a suitable concoction. Both amorphous and crystalline nature of minerals are the content of fly ash generated. Its content varies with the change in nature of the coal used for the burning process, but it basically is a non-plastic silt. For the purpose of investigations in this study, fly ash was obtained from **Kolaghat Thermal Power Plant, West Bengal**. To separate out the vegetation and foreign material, this fly ash was screen through a 2 mm sieve. The samples were dried in the oven for about 24 hours before further usage.

3.2 Methodology Adopted

To evaluate the effect of fly ash as a stabilizing additive in expansive soils, series of tests, where the content of flyash in the expansive soil was varied in values of 10% to 50% (multiples of 10) by weight of the total quantity taken. The Indian Standard codes were followed during the conduction of the following experiments:

- Standard Proctor Test – IS: 2720 (Part 7) –1980
- Unconfined Compressive Strength (UCS) test – IS: 2720 (Part 10) –1991
- California bearing ratio (CBR) test – IS: 2720 (Part 16) -1987
- Free Swell Index Test – IS 2720 (Part 40) – 1977
- Liquid and plastic limit test- IS 2720 part (5)-1985

RESULTS AND DISCUSSION

4.1 Standard Proctor Test Result for soil – fly ash mixture

Mixture	Maximum Dry Density (MDD) (g/cm^3)	Optimum Moisture Content (OMC) (%)
Expansive Soil Only	1.52	22.65
Soil+10% Fly Ash	1.50	22.13
Soil+20% Fly Ash	1.52	22.56
Soil+30% Fly Ash	1.53	21.27
Soil+40% Fly Ash	1.47	23.57
Soil+50% Fly Ash	1.42	21.34

Table 3: Standard Proctor Test

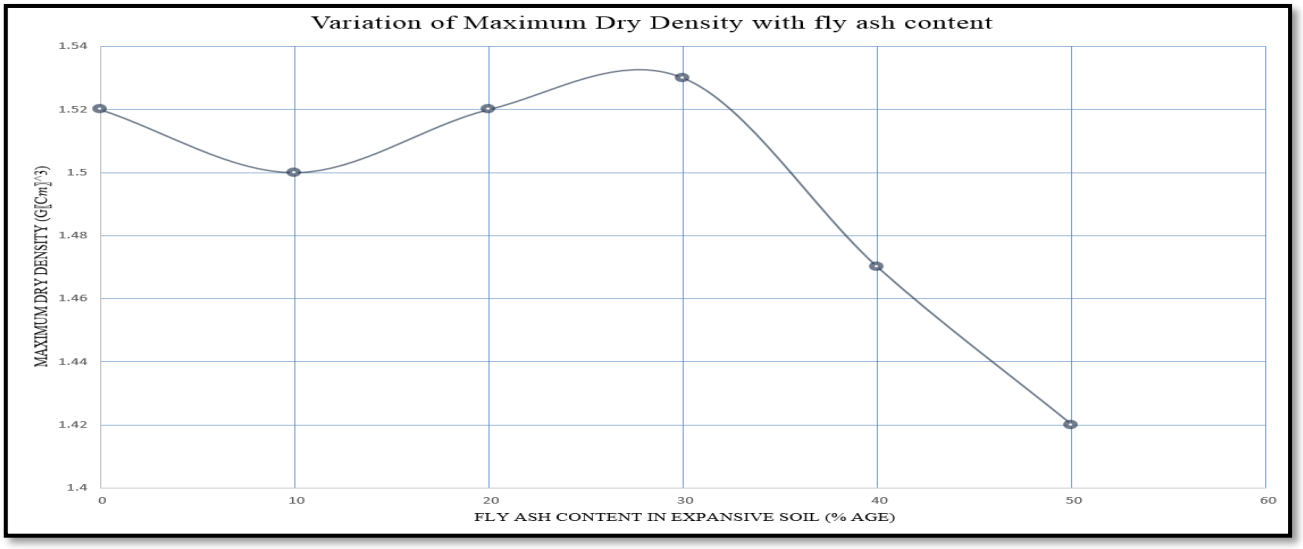

Figure 9: Variation of MDD values with different fly ash content in expansive soil

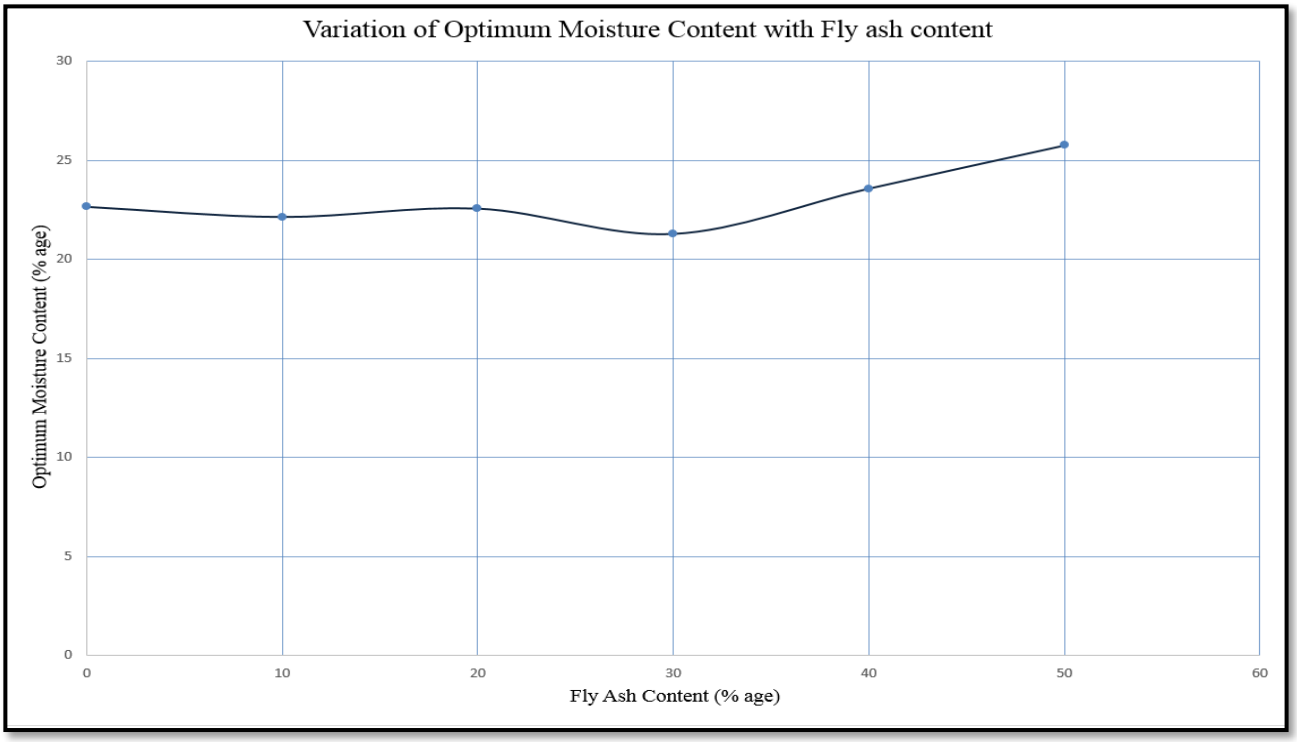

Figure10: Variation of OMC values with different fly ash content in expansive soil

4.2 Unconfined Compressive Strength (UCS) Test Result for soil – fly ash mixture

Mixture	Unconfined Compressive Strength (UCS) (N/mm^2)
Expansive Soil Only	0.197
Soil+10% Fly Ash	0.195
Soil+20% Fly Ash	0.206
Soil+30% Fly Ash	0.176
Soil+40% Fly Ash	0.170
Soil+50% Fly Ash	0.166

Table 4: Unconfined Compressive Strength Test

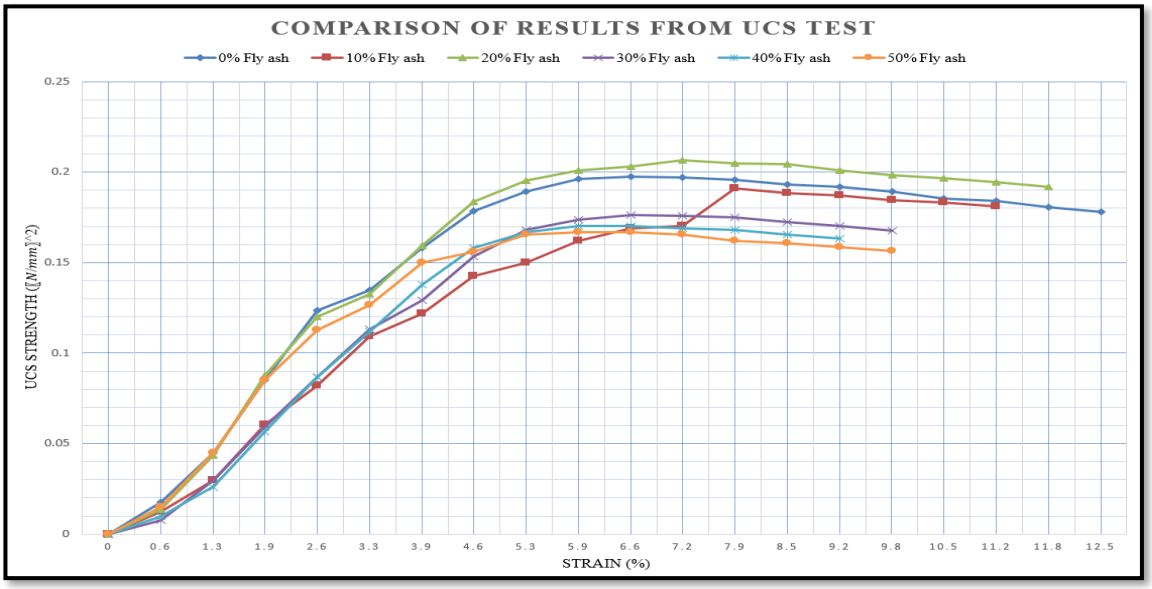

Figure 11: Comparison of UCS test readings in expansive soil, with varying fly ash content

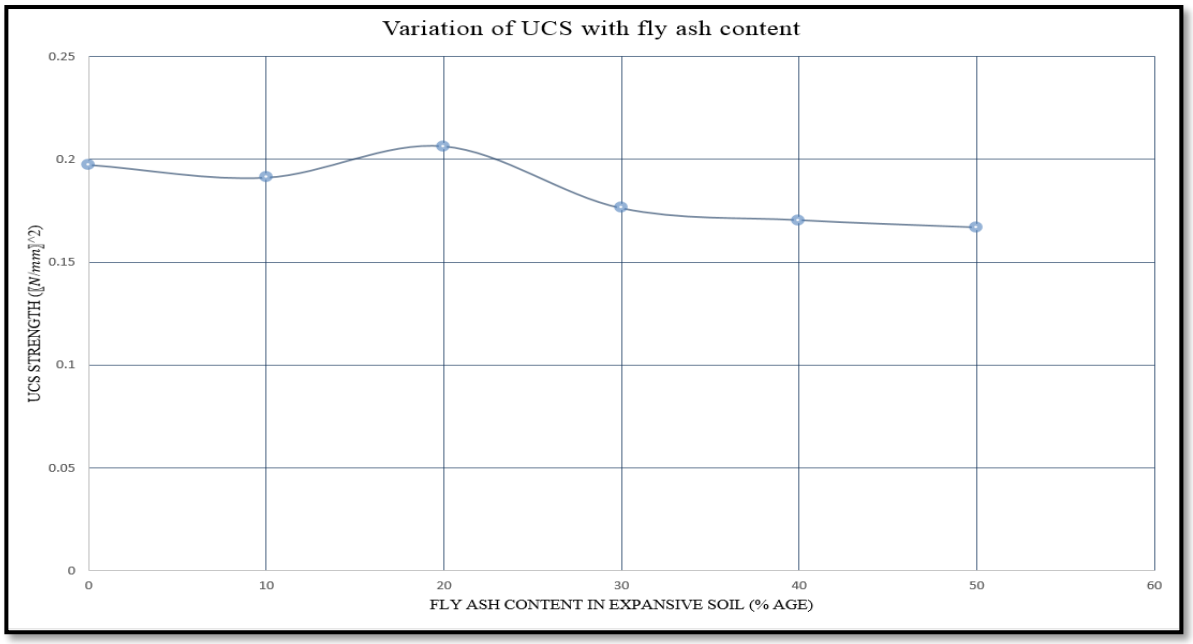

Figure12: Variation of UCS values of expansive soil with different fly ash content

4.3 California Bearing Ratio (CBR) Test Result for soil – fly ash mixture

Mixture	Un-Soaked CBR Intensity (%)	Soaked CBR Intensity (%)
Expansive Soil Only	5.99	4.44
Soil+10% Fly Ash	10.58	4.32
Soil+20% Fly Ash	16.67	5.28
Soil+30% Fly Ash	9.95	5.52
Soil+40% Fly Ash	8.61	4.08
Soil+50% Fly Ash	8.51	3.48

Table 5:CBR Test

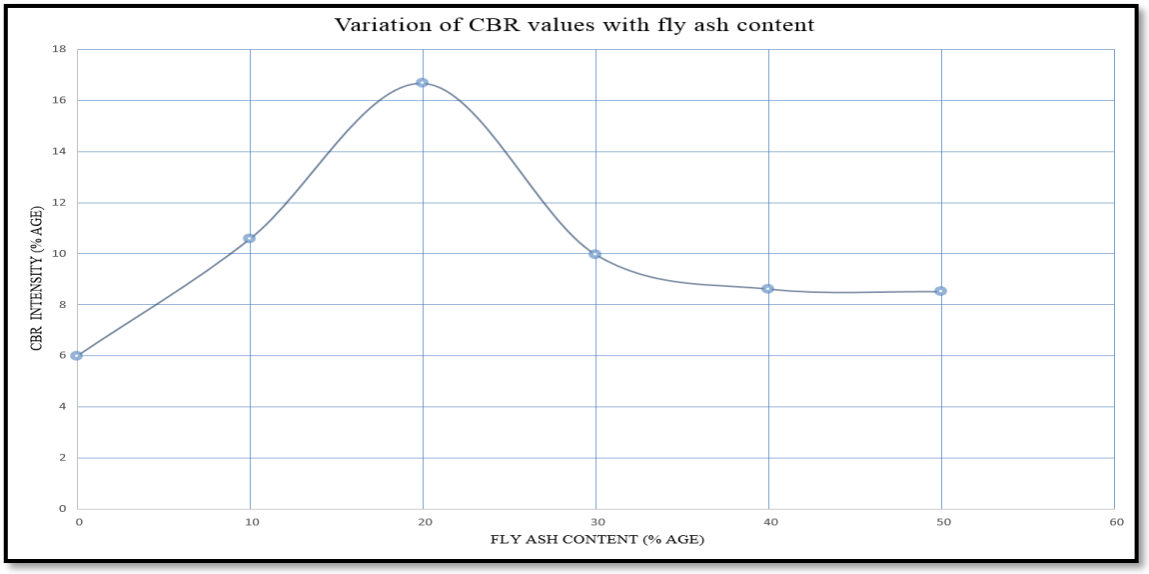

Figure13: Variation of Un-soaked CBR values of expansive soil with varying fly ash content

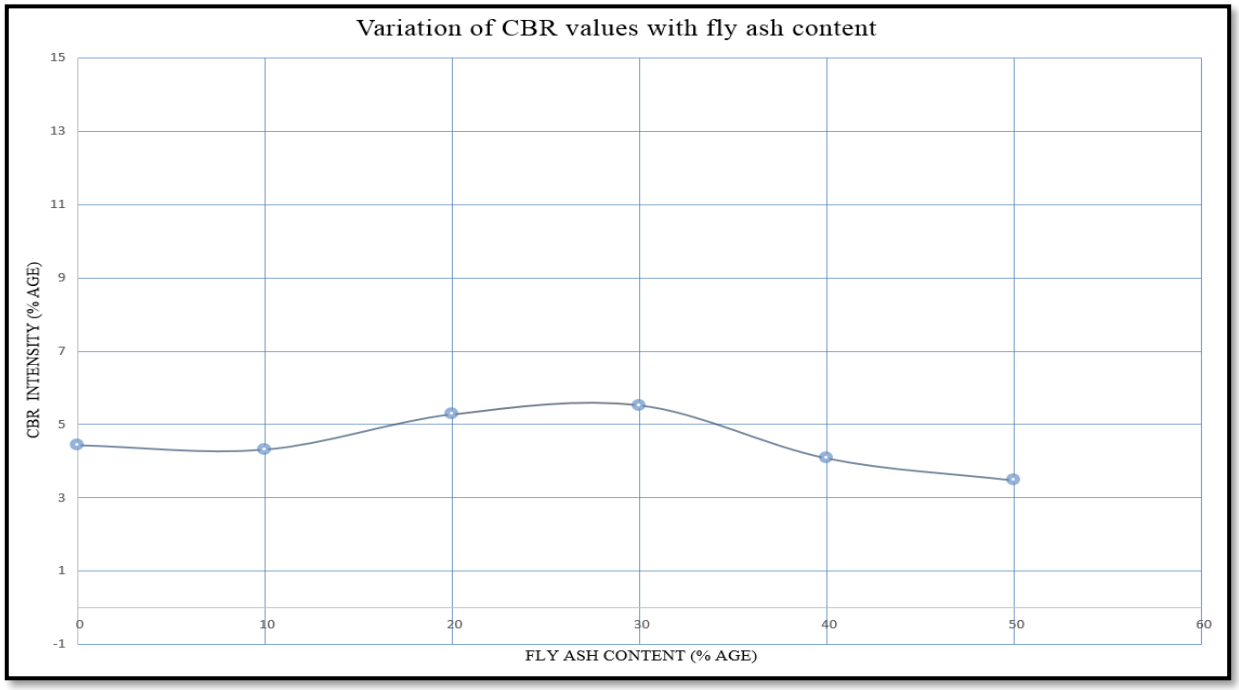

Figure 14: variations of soaked CBR values of expansive soil with varying fly ash content

4.1 Changes in Plasticity Index and Free Swell Ratio for soil – fly ash mixture

Mixture	Liquid limit	Plastic limit	Plasticity index	Free swell ratio
Only soil	65.6	35.8	29.8	2.05
Soil + 10% fly ash	61.2	34.6	26.6	1.92
Soil + 20% fly ash	58.8	33.2	25.6	1.84
Soil + 30% fly ash	56.4	31.5	24.9	1.77
Soil + 40% fly ash	51.8	28.67	23.13	1.63
Soil + 50% fly ash	49.2	26.3	22.9	1.53

Table6: Variation of plasticity index and free swell ratio with fly ash content in expansive soil

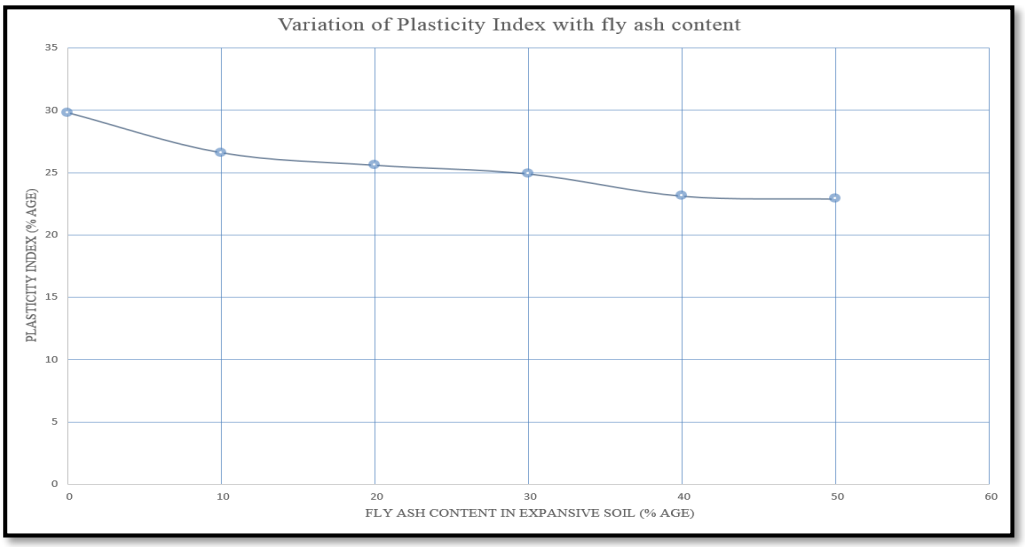

Figure15: Variation of plasticity index values of expansive soil with varying fly ash content

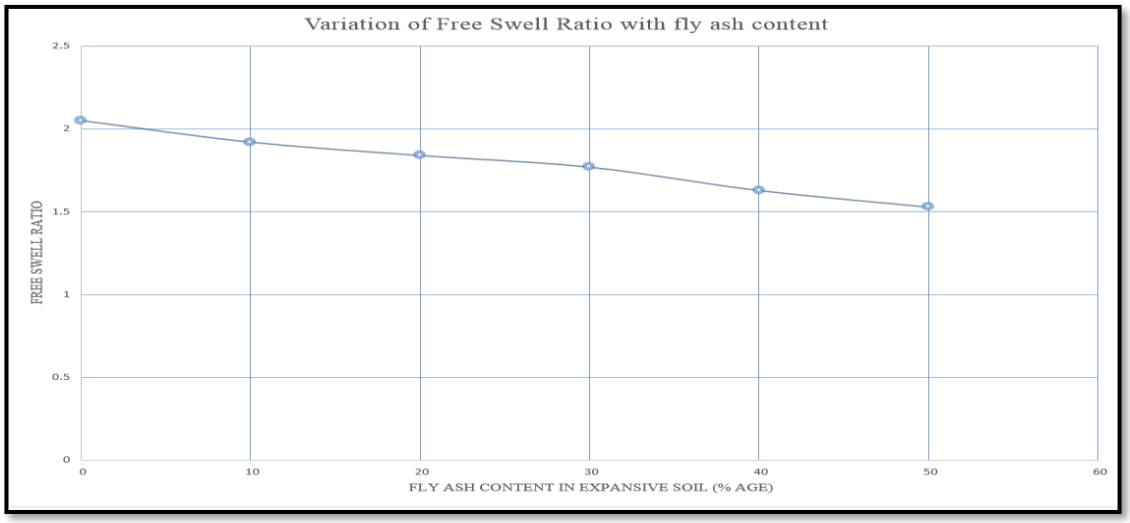

Figure16: Variation of free swell ratio values of expansive soil with varying fly ash content

4.5 Discussions

- Black cotton soil is combined with altering percentage of fly ash (from 0% to 50%, intervals in multiples of 10) by weight to observe its effect as an additive on the expansive soil.
- Maximum Dry Density (MDD) was found to change with varying content of fly. The highest value observed being at fly ash content of 30% by weight.
- The change in Unconfined Compressive Strength (UCS) of the soil with varying content of fly ash is observed. The graph shows the variation of UCS with changing fly ash content. The maximum value of UCS was obtained with the mixture of soil and 20% fly ash content by weight.

- Both un-soaked and soaked California Bearing Ratio (CBR) tests are conducted with varying content of fly ash in the black cotton soil. From the graphical comparison of these values against the varying fly ash content, it can be observed that 20% flyash and 30%flyashcontentgavethemaximumvalueofCBRintensityinun-soakedandsoaked soil-fly ash mixture respectively.
- The liquid limit and plastic limit of the soil-fly ash mixture varied with the changing fly ash content. Plasticity index values were computed from these experiments, which showed a consistent decreasing pattern with the increase of fly ash content.
- From the free swell ratio tests on the soil-fly ash mixture, the value of free swell ratio decreased with the increasing fly ash content.

CONCLUDING REMARKS

5.1 Conclusions

Based on the results obtained and comparisons made in the present study, the following conclusions can be drawn:

- The Maximum Dry Density (MDD) value of the black cotton soil initially decreased with the addition of fly ash. Then, it showed increment with increasing fly ash content in the soil-fly ash mixture. The maximum value of MDD was observed for a mixture of soil and 30% of fly ash content by weight. The MDD values consistently decreased thereafter.
- The Unconfined Compressive Strength (UCS) of the soil with variation of fly ash content showed similar trend as that of the MDD values, except the fact that the peak value was observed for a fly ash content of 20% by weight.
- In un-soaked California Bearing Ratio (CBR) tests of soil conducted with varying fly ash content, the CBR increased gradually with the increase in fly ash content till its valuation was 20% by weight of the total mixture; it decreased thereafter.
- The change in case of soaked California Bearing Ratio (CBR) tests of soil with varying fly ash content was, however, uneven. It decreased with the initial addition of fly ash (10% by weight of total mixture), and then increased till fly ash content reached 30% by weight of total mixture. The values decreased thereafter.
- With the increasing fly ash content in the soil-fly ash mixture, the decrease in value of free swell ratio was remarked. This decrease was also reciprocated by the plasticity index values. Plasticity index values are directly proportional to percent swell in an expansive soil, thus affecting the swelling behavior of the soil-fly ash mixture.
- Thus, fly ash as an additive decreases the swelling, and increases the strength of the black cotton soil. Hence, Coal fly ash can be used for the stabilization of Black Cotton Soil as it has significantly improved the geotechnical properties of Black Cotton Soil.

5.2 Scope for future study

- Fly ash along with another additive like lime, murrum, marbles dust and other such materials can be used together and may be varied in quantity to obtain the best possible stabilizing mixture.
- Utilization of others waste materials to stabilize the geotechnical properties of Black Cotton Soil.

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ASSESSMENT OF RUBBERIZED CONCRETE AS A CONSTRUCTION MATERIAL IN MARINE ENVIRONMENT

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ABSTRACT: - This research aims at solving two major crises which we are facing in recent years; firstly the scarcity of fine aggregate is becoming a major issue nowadays as the extraction causes the morphological changes in river bed, in some cases substrata are being removed and ultimately grain sizes are affected and also recently the government has banned the extraction to a greater limit and secondly waste rubber which forms a substantial part of the world's solid waste as mostly rubber wastes are not being eliminated due to shortage of waste land. The objective would be to replace the fine aggregate in the concrete mix with crumbed rubber in some specific percentage and to study the effects of this concrete in their strength and durability. The project is focused on marine environment as 70% of earth is occupied by oceans and the sea water has some adverse effect on concrete like Corrosion of embedded reinforcement, Loss of strength due to carbonation effect of concrete, Occurrence of sulphate attack on concrete and reinforcement, Erosion and abrasion of concrete surface due to constant high sea winds and waves, Minor cracks due to salt crystallization which led to reduced durability and life of structure also the life time of a concrete structure in normal environment ranges between 50-100 years where as in marine environment it ranges in between 15-40 years.

Keywords: crumbed rubber, corrosion, carbonation, marine environment

INTRODUCTION: -

a) Waste management of rubber:

Waste Rubber contributes to the major part of world's solid waste. Due to increasing number of vehicles, the tyres of the vehicles having a limited life span are soon amounted in world's solid waste. Industries contribute about 9kg of waste rubber per year which are not recyclable and has to be land filled which led to environmental and health threat. Due to their shape, they occupy larger area and thus need to be put in productive use. Rubber wastes are used in the form of crumbed rubber. Crumbed rubber is a material produced by shredding and commutating used tires. The long-term objective is to find a means to dispose the crumbed rubber in Portland cement concrete and still supply a final product with good engineering properties. Crumb rubber, or the powder rubber will replace the fine aggregate i.e., sand in concrete mix. Tests have been carried

out for the percentage of replacements of sand by crumb rubbers. In this research the maximum replacement allowed is 20%.

b) Effect of sea water:

The effects of sea water on concrete may conveniently be examined by considering, first, the factors characteristic of the sea-water exposure that can affect concrete; second, the elements of the specific concrete involved that may be affected by these factors; third, the consequences of the interaction of sea water with the concrete; and, finally, the precautions that should be taken to avoid undesirable performance of the concrete due to its interaction with sea water.

1. **Permeability is the key to durability**.

   Deleterious interactions of serious consequence between constituents of hydrated Portland cement and seawater take place when seawater is not prevented from penetrating into the interior of a concrete. Typical causes of insufficient water tightness are poorly proportioned concrete mixtures, absence of properly entrained air if the structure is located in a cold climate, inadequate consolidation and curing, insufficient concrete cover on embedded steel, badly designed or constructed joints, and micro cracking in hardened concrete attributable to lack of control of loading conditions and other factors, such as thermal shrinkage, drying shrinkage, and alkali aggregate expansion. It is interesting to point out that engineers on the forefront of concrete technology are becoming increasingly conscious of the significance of permeability to durability of concrete exposed to aggressive waters. For example, concrete specifications for offshore structures in Norway now specify the maximum permissible permeability directly.

2. **Type and severity of deterioration may not be uniform throughout the structure**

   For example, with a concrete cylinder the section that always remains above the high-tide line will be more susceptible to frost action and corrosion of embedded steel. The section that is between high- and low-tide lines will be vulnerable to cracking and spalling, not only from frost action and steel corrosion but also from wet-dry cycles. Chemical attacks due to alkali-aggregate reaction and seawater cement paste interaction will also be at work here. Concrete weakened by micro cracking and chemical attacks will eventually disintegrate by action and the impact of sand, gravel, and ice; thus, maximum deterioration occurs in the tidal zone. On the other hand, the fully submerged part of the structure will only be subject to chemical attack by seawater; since it is not exposed to subfreezing temperatures there will be no risk of frost damage, and due to lack of oxygen there will be little corrosion. It appears that progressive chemical deterioration of cement paste by seawater from the surface to the interior of the concrete follows a general pattern. The formation of aragonite and bicarbonate by CO2attack is usually confined to the surface of concrete, the formation of bruise by magnesium ion attack is found below the surface of concrete, and evidence of ettringite formation in the interior shows that sulphate ions are able to penetrate even deeper. Unless concrete is very permeable, no damage results from chemical action of seawater on cement paste because the reaction products (aragonite, brucite, and ettringite), being

insoluble, tend to reduce the permeability and stop further ingress of seawater into the interior of the concrete. This kind of protective action would not be available under conditions of dynamic loading and in the tidal zone, where the reaction products are washed away by wave action as soon as they are formed.

3. **Corrosion of embedded steel is, generally, the major cause of concrete deterioration in reinforced and prestressed concrete structures exposed to seawater, but in low-permeability concrete this does not appear to be the first cause of cracking.** Based on numerous case histories, it appears that cracking corrosion interactions probably follow the route diagrammatically illustrated in Figure3. Since the corrosion rate depends on the cathode/anode area, significant corrosion and expansion accompanying the corrosion should not occur until there is sufficient supply of oxygen at the surface of the reinforcing steel (i.e., an increase in the cathode area).

   This does not happen as long as the permeability of steel-cement paste interfacial zone remains low. Pores and micro cracks already exist in the interfacial zone, but their enlargement through a variety of phenomena other than corrosion seems to be necessary before conditions exist for significant corrosion of the embedded steel in concrete. Once the conditions for significant corrosions are established, a progressively escalating cycle of cracking corrosion– more cracking begins, eventually leading to complete deterioration of concrete.

c) Why maritime environment is taken?

- 70% of earth is occupied by oceans. All the countries as well as off-shore structures are subjected to impact of chemical and physical deterioration due to saline water and wind.
- Reduced durability and life of structure is noted in these areas. Life time of a concrete structure in normal environment ranges between 50-100 years where as in marine environment it ranges in between 15-40 years
- To increase life time special alloy steels and high strength concrete with various admixtures are incorporated in these areas which ultimately leads to increase in cost of the structure.
- Greater depth of cover is provided for reinforcements which increases the size and weight of concrete structures.

d) Major problems with marine environment

- Corrosion of embedded reinforcement
- Loss of strength due to carbonation effect of concrete
- Occurrence of sulphate attack on concrete and reinforcement
- Erosion and abrasion of concrete surface due to constant high sea winds and waves

- Minor cracks due to salt crystallization

OBJECTIVE: -

- Check for compressive strength of rubberized concrete
- Check for sorptivity
- Check for water absorption
- Check for impact strength
- Compare normal concrete cubes with rubberized concrete cube

LITERATURE REVIEW: -

- **Tushar R More, Pradip D Jadhao and SM Dumme** In their study the aim was to study of waste tyre as partial replacement of fine aggregate to produce rubberizes concrete in M25 grade of mix. Different partial replacement of crumb rubber i.e., 0%, 3%, 6%, 9% and 12% by volume of fine aggregate are casted and tested for flexural strength and split tensile strength. The result shows that there is a reduction in all type of strength for crumb rubber mixture, but crumb rubber content concrete become more lean due to increase in partial replacement of crumb rubber as fine aggregate ie.,3%, 6%, 9% and 12%. Flexural strength of concrete decreases with 3% replacement of sand and further decrease in strength with the increase in percentage of crumb rubber. For split tensile strength decreases with 3% replacement of sand and further decrease in strength with the increase in percentage of crumb rubber. This is mainly due to lower bond strength between cement paste and rubber tyre aggregate
- **Prof. M. R. Wakchaura and Mr. Prashant. A. Charan**In this study they did partial replacement of fine aggregate as crumb rubber as 0.5%, 1%, 1.5% and 2% in M25 grade of concrete and its effects on concrete properties like compressive strength, flexural strength were investigated. Addition to this combination of glass fiber at ratio 0.4% and 0.5% addition to the weight of cement are used to regain the reduced strength due to use of waste tyre crumb rubber particle. Results indicate that replacement of waste tyre crumb rubber particle to the fine aggregate in concrete at ratio 0.5% and 1% there is no effect on the concrete properties would occur, but there was a considerable change for 1.5% and 2% replacement ratio.
- **Dr. B. Krishna Rao** in this investigation he did casting and testing of cubes, cylinders, and prisms for M20 grade of concrete and added 5% and 10% of rubber fiber by volume of concrete. There the specimens are tested for compression, split tensile and flexural strength. The test results were done and noted that due to addition of rubber fiber, strength of concrete decreases, but as observing ductility is improving. Hence it is used for medium grade of concrete. The various rubberized concrete mixes were designed in accordance with standard mix design procedure for normal

concrete with grade of M20. As expected, the target strength was not achieved for the mixes incorporating rubber fiber.

- **Er. Yogender Antil** The primary objective of their investigation is to study the strength behaviors i.e., compressive strength and flexural strength of rubberized concrete with different volume of crumb rubber. Parameter to be varied in Investigation is volume variation of crumb rubber. The proposed work is aimed to study the effect of volume variation of crumb rubber on the compressive strength, flexural strength and slump test. So, they founded that strength of modified concrete is reduced with an increase in rubber content. The Flexural strength of the concrete decreases about 69% when 20% of sand is replaced by crumb rubber. The compressive strength of the concrete decreases about 37%when 20% of sand is replaced by crumb rubber. So overall large percentage of crumb rubber the lower the compressive strength and flexural strength as compared to conventional concrete.
- **Sulagno Banerjee, Aritra Mandal, Dr. Jessy Robby** the aim of their investigation was studies on mechanical properties of tyre rubber concrete. In their study they made a concrete of M25 grade by replacing 5%, 10%, 15%, 20% and 25% of tyre concrete with coarse aggregate and compared with regular M25 grade concrete. The properties of fresh concrete and flexural strength of hardened concrete were identified. So, they concluded that flexural strength decreases in concrete. In 7 days', flexure strength, there is not much variation seen between conventional and rubberized concrete. So, there was not much difference in strength of rubberized and conventional concrete.
- **Nithiya P and Portchejian G** It this research paper the mix design was done as per IS:10262-2009 to achieve the target strength. The concrete mixes were made by replacing fine aggregate with 5%, 10%, 15% and 20% for M20 grade concrete. So, they founded that compressive strength decreases with the replacement of crumb rubber increased and 5% replacement of crumb rubber proves exceptionally well in compressive strength and tensile strength. It also gives more strength at 28th days for 5% replacement for M20 grade of cement and split tensile strength decreases at the maximum at the maximum of 25% when crumb rubber is replaced up to 10% of fine aggregate. Thus, by replacing fine aggregate by crumb rubber safeguards the environment.

METHODOLOGY:

1. Artificial marine environment

Artificial sea water is used for laboratory testing such as evaluating the deleterious effects on concrete surfaces and structures, electronic components, test for oil contamination and detergency evaluation and for oceanographic, biochemical and forensic purposes, etc., where a reproducible solution simulating sea water is required. The effect of marine flora and fauna are excluded. In this experiment artificial sea water is required as the rubberized as well as the normal concrete cubes will be cured in water for particular day's gaps.

1.1. Quantity of chemical proportions

The proportions are as per IS: 8770 – 1978.

COMPOUND	CONCENTRATTION (G/L)
Sodium Chloride (NaCl)	23.5
Magnesium Chloride (MgCl)	5.0
Sodium Sulphate (Na_2SO_4)	3.9
Calcium Chloride ($CaCl_2$)	1.1
Potassium Chloride (KCl)	0.66
Sodium Bicarbonate ($NaHCO_3$)	0.20
Potassium Bromide (KBr)	0.10
Boric Acid (H_3BO_3)	0.026
Strontium Chloride ($SrCl_2$)	0.024
Sodium Fluoride (NaF)	0.003

2.3. Solutions

Amount of sea water required for the completion of this test is 90 liters. The compounds are mixed with 90 liters of normal water as per the proportions written in IS:8770 – 1978 as mentioned above.

2.4. Preparation of solution

Stock Solution A - Dissolve the indicated amounts of the following salts in water and dilute to a total volume of 10 liters. Store in well- stoppered glass container:

- Magnesium chloride ($MgCl_2.6H_2O$) 5335 g
- Calcium chloride ($CaCl_2$) Anhydrous 550 g
- Strontium chloride ($SrCl_2.6H_2O$) 21 g

Stock Solution B - Dissolve the indicated amounts of the following salts in water and dilute to a total volume of 10 litres. Store in well- stoppered glass container:

- Potassium Chloride (KCl) 660 g
- Sodium bicarbonate ($NaHCO_3$) 200 g
- Potassium bromide (KBr) 100 g
- Boric acid (H_3BO_3) 26 g
- Sodium Fluoride (NaF) 3 g

2.5. Preparation of sea water

Amount of compounds in solutions required for 90 litres of sea water are described as follows

Solution A		**Solution B**	
Magnesium chloride	48015 gm	Potassium chloride	5940 gm
Calcium chloride	4950 gm	Sodium bicarbonate	1800 gm
Strontium chloride	189 gm	Potassium bromide	900 gm
		Boric acid	234 gm
		Sodium fluoride	27 gm

1. **Concrete mix**

A-1 STIPULATIONS FOR PROPORTIONING:

a) Grade designation: M30
b) Type of cement: OPC-43 grade conforming to IS 8112
c) Max nominal size of aggregates: 20 mm
d) Min cement content: 260 kg/m^3
e) Max water cement ratio: 0.42
f) Workability: 100 mm (slump)
g) Exposure condition: very severe (for RC)
h) Method of concrete placing: pumping
i) Degree of supervision: good
j) Type of aggregate: crushed angular aggregate

k) Max cement content: 450 kg/m^3

A-2 TEST DATA FOR MATERIALS:

a) Specific gravity of cement: 3.15
b) Specific gravity of1. Fine aggregate 2. Coarse aggregate: 2.74
c) Water absorption 1. Fine aggregate: 1.0 2. Coarse aggregate: 0.5%
d) Free surface moisture: Nil (for coarse and fine aggregates)
e) Sieve analysis:

1. Coarse aggregate:

IS sieve size (mm)	**Analysis of coarse aggregates fraction**		**% of different fractions**		
	I	II	I 60%	II 40%	Combined 100%
20	100	100	60	40	100
10	0	71.20	0	28.5	28.5
4.75	-	9.40	-	3.7	3.7
2.36	-	0	-	-	-

2. Fine aggregate:
   Conforming to grading zone II of Table-4 of IS 383.

A-3 Target strength for mix design:

$F_{ck}' = f_{ck} + 1.65S$

Where, f_{ck}'= Target avg compressive strength at 28 days

F_{ck}= Characteristic compressive strength at 28 days

S= Standard deviation

From Table I, standard deviation, S= 5N/mm^2

Therefore, f_{ck}'= 30+1.65x5 = 38.25 N/mm^2

A-4 Selection of water cement ratio:

Max w/c ratio = 0.42

Adopted w/c ratio = 0.42, 0.42 <= 0.42, hence ok

A-5 Selection of water content:

From table 2, max water content for 20 mm agg = 186 litres (for 25-50 mm slump range)

Water content for 100 mm slump = 186 + 6/100 x 186 = 196 litres

A-6 Calculation of cement content:

w/c ratio = 0.42; cement content = 197/0.42 = 469 kg/m^3; For very severe exposure conditions min. cement content is 260 kg/m^3;469 kg/m^3> 260 kg/m^3, hence ok

A-7 Proportion of volume of coarse and fine aggregates content:

From table 3, volume of coarse aggregate corresponding to 20 mm size and fine aggregate (zone II) for w/c ratio of 0.5 = 0.62

Present w/c ratio = 0.42

Corrected volume of coarse aggregate for the w/c ratio of 0.42 = 0.635

For pump able concrete these values should be reduced by 10%

Therefore, vol of coarse agg = 0.635 x 0.9 = 0.5

Vol of fine agg = (1-0.57) = 0.43

A-8 Mix calculation:

The mix calculation/ unit volume of concrete

a) Vol of concrete = 1 m^3

b) Vol of cement = (mass of cement)/ (specific gravity of cement) x 1/1000

= 469/3.15 x 1/1000

= 0.148 m^3

c) Vol of water = (mass of water)/(specific gravity of water) x 1/1000

= 197/1 x 1/1000

= 0.197 m^3

d) Vol of all in aggregate = [a-(b+c)]

= [1-(0.148+0.197)]

= 0.655 m^3

e) Mass of coarse aggregate = ex vol of coarseagg x spc gravity of coarse aggregate x 1000

= 0.655 x 0.57 x 2.74 x 1000

= 1023 kg

f) Mass of fine aggregate = ex vol of fine aggregate x spc gravity of fine aggregates x 1000

= 0.655 x 0.43 x 2.74 x 1000

= 772 kg

A-9 Mix proportions:

- Cement = 469 kg/m^3
- Water = 197 litres
- Fine aggregates = 772 kg/m^3
- Coarse aggregates = 1023 kg/m^3
- Water cement ratio = 0.4

RESULT

COMPRESSIVE STRENGTH TEST:

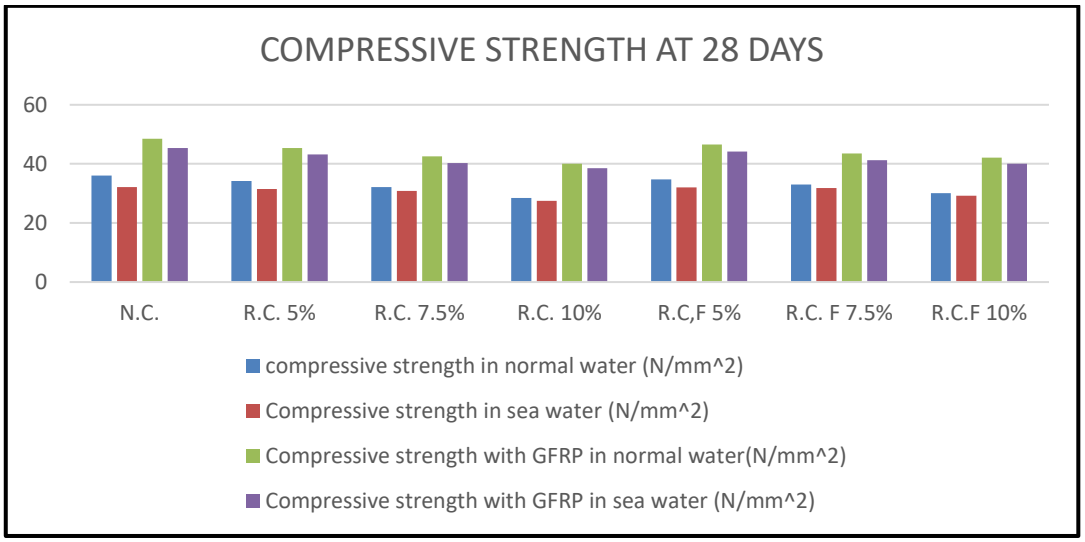

Figure17: Graph for type of concrete versus compressive strength

CONCLUSION: - Rubberized concrete is found to be slightly weak than the normal concrete which can be concluded. With addition of fly ash its strength increases slightly. Thus, we can say the long-term strength of both normal concrete and rubberized concrete is same under marine environment. GFRP sheets help in increasing the resistance and thus can be used as long-term materials for joints in beams and columns.

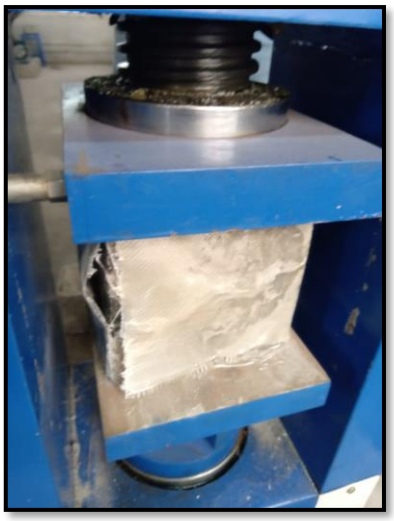

Figure 18: specimen under compressive testing machine Fig19: specimen for strength test

SORPTIVITY TEST

Sorptivity = $[I \div \sqrt{t}]$

Where,

$I = [\Delta W \div \sqrt{\beta}]$

t = time in minutes (30 min)

$\beta = 1000\ kg/m^3$

$A = 150 \times 150\ mm^2$

$\Delta W = (W_2 - W_1)$

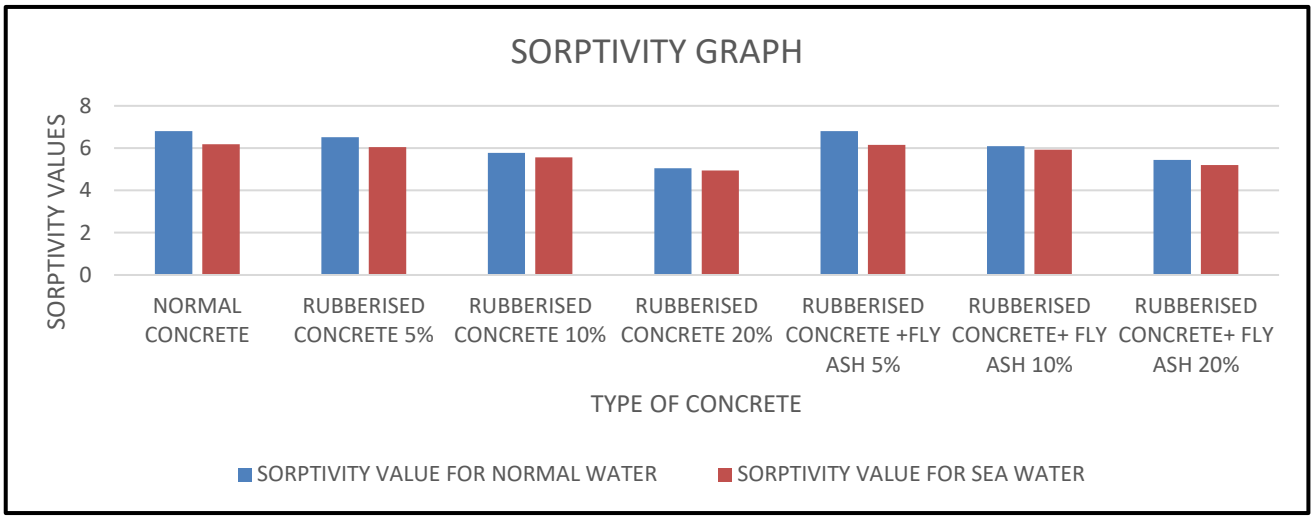

Figure 20: Graph for type of concrete versus sorptivity values

CONCLUSION: - Sorptivity of rubberized concrete shows lower value at the replacement of 7.5% of each fly ash and crumb rubber. The fly ash here can be an innovative supplementary cementitious construction material but judicious decision has to be taken by engineers. Thus, fly ash increases sorptivity.

WATER ABSORPTION TEST:

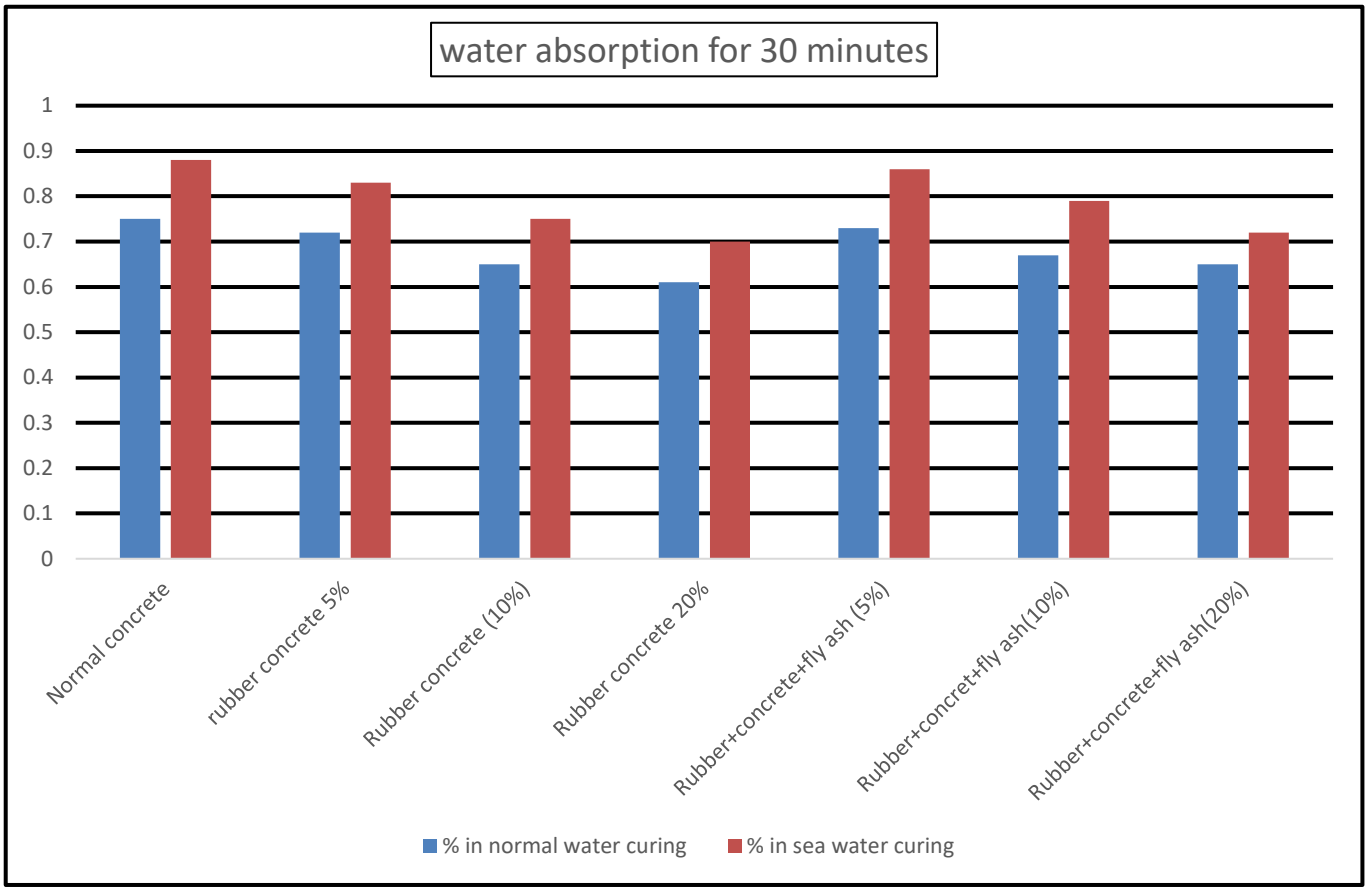

Figure 21: Graph showing type of concrete versus water absorption

CONCLUSION: - Water absorption by rubberized concrete is low compared to normal concrete in both normal as well as sea water, which can prove to be an advantageous factor because lower water absorption is beneficial for construction in marine environment.

Figure 22: specimens kept for water absorption

IMPACT TEST

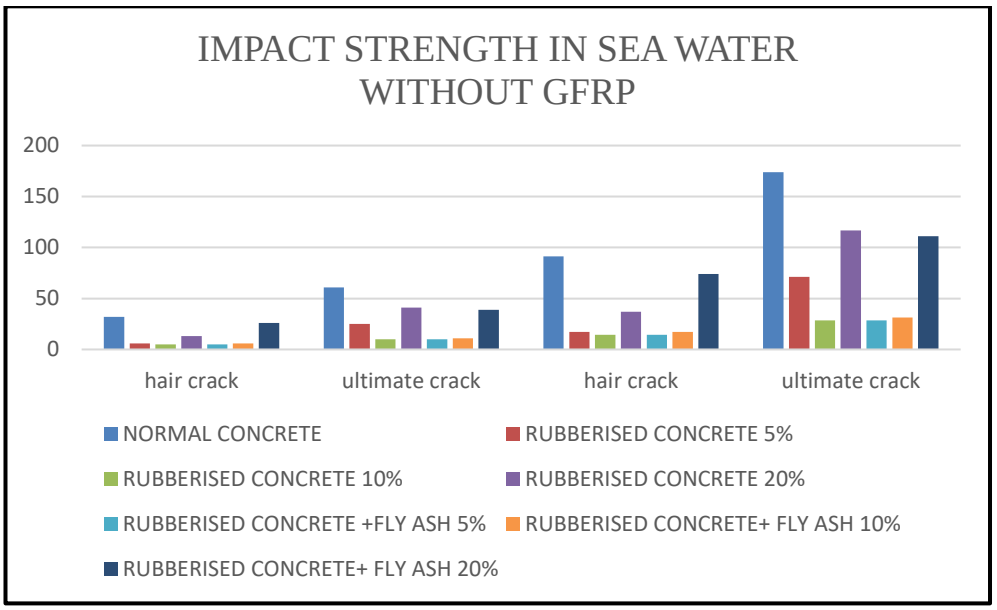

Figure 23: Graph for impact strength in sea water without GFRP

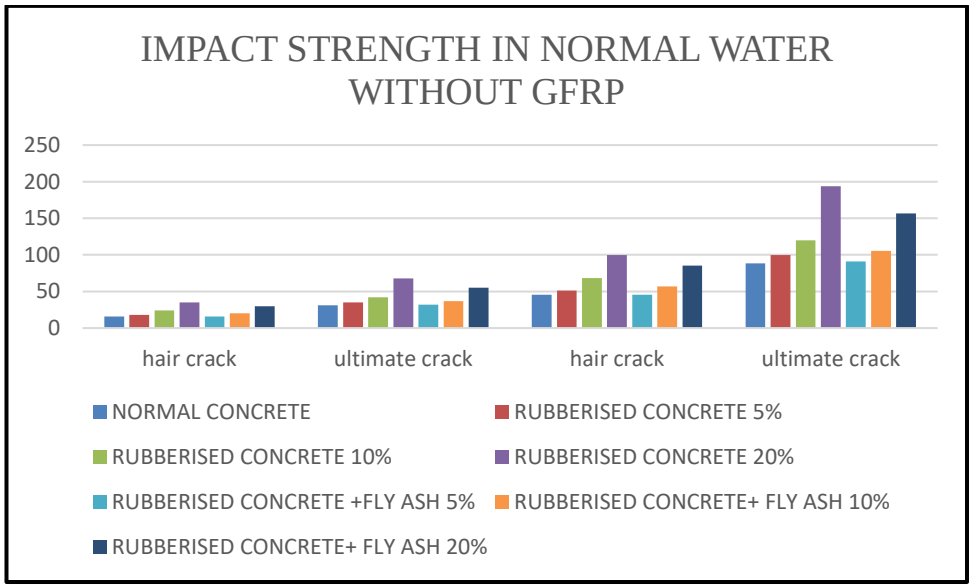

Figure 24: Graph for impact strength in normal water without GFRP.

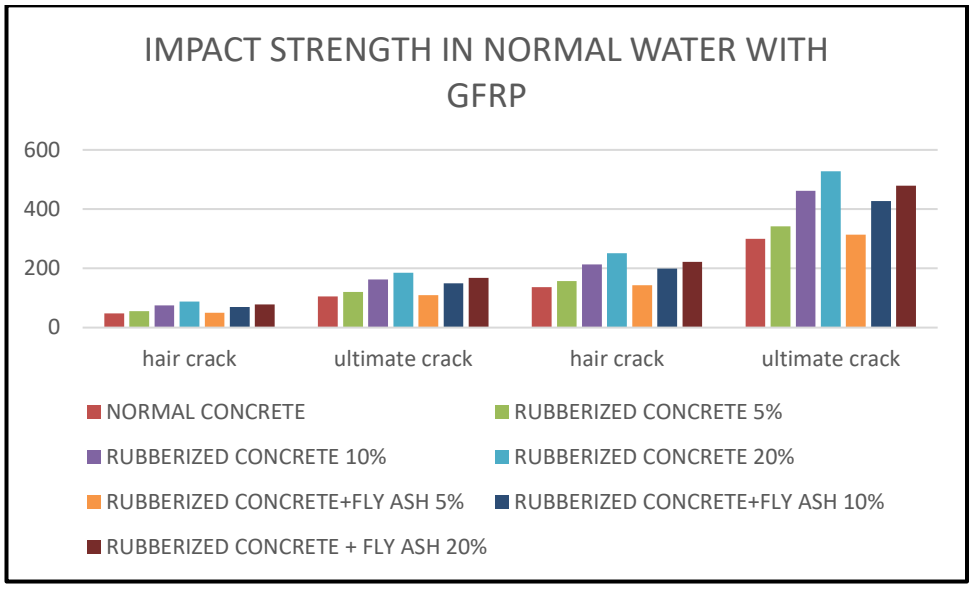

Figure 25: Graph showing impact strength in normal water with GFRP.

CONCLUSION:

Rubberized concrete can resist greater impact when immersed in sea water for 28days than in normal water thus it can be concluded that the rubberized concrete with greater percentage of rubber and fly ash can be used in marine environment as it can take greater impact. Adding GFRP confinement to the moulds can take greater impact in normal than without GFRP sheets.

Figure 26: specimens with GFRP sheets after impact test

CONCLUSION: - From the above tests on rubberized concrete in normal as well as sea water and its correlating with the normal concrete we can say that rubberized can be used in construction as the compressive strength of rubberized after 150 days in marine condition is same as that of normal concrete. the water absorption of rubberized concrete is also low which will be a beneficial factor for construction in marine environment. The test results of this study indicate that there is great potential for the utilization of waste tyres in concrete mixes in several percentages, ranging from 5% to 20%. Based on present study, the following can be concluded: The strength of modified concrete is reduced with an increase in the

rubber content; however lower unit weight meets the criteria of light weight concrete that fulfill the strength requirements as per given in table 5.9 by Neville in 1995. Concrete with higher percentage of crumb rubber possess high toughness The slump of the modified concrete increases about 1.08%, with the use of 1 to 10% of crumb rubber. Stress strain shows that concrete with a higher percentage of crumb rubber possess high toughness, since the generated energy is mainly plastic. Failure of plain and rubberized concrete in compression and split tension shows that rubberized concrete has higher toughness. The split tensile strength of the concrete decreases about 30% when 20% sand is replaced by crumb rubber. The flexural strength of the concrete decreases about 69% when 20% sand is replaced by crumb rubber. The compressive strength of the concrete decreases about 37% when 20% sand is replaced by crumb rubber. For large percentage of crumb rubber, the compressive strength gain rate is lower than that of plain concrete.

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SOIL STABILIZATION USING GEOSYNTHETIC MATERIAL (BAMBOO FIBRES)

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ABSTRACT: - Soil stabilization is the process which involves enhancing the physical properties of the soil in order to improve its strength, durability etc. by blending or mixing with additives. The different types of method used for soil stabilization are: Soil stabilization with cement, Soil stabilization with lime, Soil stabilization using bitumen, Chemical stabilization, and a new emerging technology of stabilization by Geo textiles and Geo synthetic fibers. In this study, we are making use of bamboo fibers as geo synthetic material for stabilization of soil. With the use of bamboo fibers to the soil the CBR values will improve, and thickness of pavement layer also gets reduced. Bamboo fibers are such a geosynthetic material which is easily available, and ecofriendly, and also cost effective. Bamboo fiber can substantially improve the properties of Black cotton soil. The advantages of this project are that to add bamboo fiber in soil stabilization is economically cheap as well as a superior concrete can be made.

INTRODUCTION: - A developing country with such a huge geographical area and population, such as India, requires extensive infrastructure. In India, land is being used for a variety of structures like houses, bridges, trains, and airports. Encountering land having soft soil for construction leads to an attention towards adopting ground improvement techniques such as soil stabilization. Soil stabilization is the process which involves enhancing the physical properties of the soil in order to improve its strength, durability etc. By blending or mixing it with additives. The different types of methods used for soil stabilization are: Soil stabilization using cement, Soil stabilization using lime, Soil stabilization using bitumen, Chemical stabilization and a new emerging technology of stabilization that is stabilization of soil by using Geo textiles and Geosynthetic fibers. Geosynthetic are synthetic products made from various types of polymers which may be either Woven or Non-Woven. These are used to enhance the characteristics of soil and have provided a practical way of constructing civil engineering structures economically. In this study, we are making use of bamboo fibers as geo synthetic material for stabilization of soil. With the introduction of bamboo fibers to the soil the CBR values may improve, and thickness of pavement layer also may get reduced. It may also reduce the intensity of stress on sub grade. Bamboo fibers is such a geosynthetic material which is easily available, eco- friendly, and also cost effective. With the application of soil stabilization technique in construction process the overall cost may get reduced when compared to the ordinary method of construction.

1.2 Needs and Advantages of soil stabilization

Soil properties vary a great deal and construction of structures depends a lot on the bearing capacity of the soil, hence, we need to stabilize the soil to improve the load bearing capacity. The gradation of the soil is also a very important property to keep in mind while working with soils. The soils may be well-graded which is desirable as it has a smaller number of voids or uniformly graded which though sounds stable but has more voids.

Advantages of soil stabilizations are as follows

- If weak soil strata are discovered during the construction phase, it is common practice to replace the weak soil with another excellent quality soil. With the use of soil stabilization techniques, the qualities of locally accessible soil (soil on site) may be improved and it can be utilized successfully as a sub grade material without having to be replaced. The cost of preparing the sub grade by replacing the weak soil with a good quality soil is higher than that of preparing the sub grade by stabilizing the locally available soil using different stabilization techniques.
- Stabilization can efficiently enhance the soil's strength-giving properties to the adequate point. It improves the strength of the soil, thus, increasing the soil bearing capacity.
- Increasing the bearing capacity of the soil, instead of using a deep foundation or raft foundation, is more cost and energy efficient. It is also used to provide more stability to the soil in slopes or other such places.
- Soil stabilization is sometimes used to reduce soil erosion or dust generation, which is especially useful in dry and arid conditions.
- Stabilization is also done for soil water-proofing; this prevents water from entering into the soil and hence helps the soil from losing its strength.
- It helps in reducing the soil volume change due to change in temperature or moisture content. However, the soil stabilization has disadvantage like increase in cost of construction and difficulty in mixing the fibers with soil.

Objective:

- To find an alternative solution for Soil Stabilization.
- To reduce Artificial Fiber and produce eco- friendly Natural Fiber.
- To provide high strength Soil than ordinary Black Cotton Soil.
- To develop an eco-friendly product at low cost.
- Optimization of Bamboo Fiber in valuable product.

LITERATURE REVIEW:

- **Sujitkawade** et al., were studied the effect of geogrid and lime on the properties of the soil. Their key objectives are to evaluate the properties of the soil prior and later the mixing up of lime and geogrid to it. The various tests they have conducted and were natural water content determination, Compaction test, Atterberg's limits, specific gravity, Compaction test, and Compressive Strength test. After the study and executing the entire above tests, they concluded that and they concluded that there was a significant increase in the compressive strength of the soil for optimum lime content of 15% which was found.
- **AyushMithal and Dr.Shalinu Shukla** were examined the effectuality of use of geotextiles as a reinforcement material (such as Mechanical property, Physical property, Hydraulic property, Durability property and Endurance property), Fibers of Geotextiles, (both natural and synthetic fibers), functions of Geotextiles, application of geotextiles Types of Geotextiles and impact of geotextiles on environment. They have finalized that, because of the versatile functions of geotextiles they should be used in many strategic civil engineering works. The usage of geotextiles not only reduces the cost of construction but also reduces maintenance cost.
- **Vegulla,Raghudeep** et al. were examined that the outcome of vitrified polish waste on the properties of the soil. Their subjective was to sums out the decrease in pavement thickness due to an increase in CBR after adding of polish waste. They have carried out the various tests like Atterberg's limits, Grain size distribution, Compaction tests and CBR tests on soil solely and with addition of vitrified polish waste. They summarized that with 10% add on of vitrified polish
- **E.A. Subaida, S. Chandrakaran, N. Sankar** et al presents the results of an experimental study conducted to investigate the beneficial use of woven coir Geotextiles as reinforcing material in a two-layer pavement section, are presented. Monotonic and frequent loads were practical on reinforced and unreinforced laboratory roadway segment through a rigid rounded plate. The effects of placement location and stiffness of geotextile on the presentation of reinforced sections were investigated using two base course thicknesses and two types of woven coir Geotextiles. The investigation consequences designate that the inclusion of coir Geotextiles improved the bearing capacity of thin sections. Placement of geotextile at the interface of the sub grade and base course increased the load carrying capacity significantly at large deformations. Considerable development in bearing capacity was experimental when coir geotextile was located within the base route at all stage of deformations. The best possible placement position of coir geotextile was originated to be within the base course at a depth of one-third of the plate diameter below the surface.
- **Akolade, A.S And Olaniyan** et al presents Highway construction is one of the main engineering design and construction in civil engineering in many countries all over the world. Existing revise have exposed that civil engineer attractive in highway construction have quite a little challenge

during road construction especially as it is related to the topography of the site, inadequate sub grade soil and high-water table, in spite of this challenges, the application of geogrids as a geotechnical property is imperative to improve the sub grade of soils with soaked condition. Soil samples were label (A, B& C) at haphazard. These samples were taken to the Laboratory for experiments to recognize and establish the Grain size analysis, Atterberg, compaction and California bearing ratio by introduction the geo-grids at unreliable depths and in single layer under soaked circumstances (48hrs) to determine the strength of the soil samples.

- **Charles Anum Adams, Nana Yaw Amofa, Richter Opoku –Boahen** et al presents Geogrid reinforcement is gaining acceptance as an effective way of improving on the properties of naturally occurring soils for road pavement construction. In lots of steamy countries, weak lateritic sub grades are common and often discarded after proof rolling during construction due to deprived strength. The precise objectives of this research were to 1) Determine the effect of strength of geogrid reinforcement material on the California Bearing Ratio of a sample of relatively poor lateritic sub grade material under soaked and unsoaked condition and 2) Establish the effect of geogrid reinforced sub grade on the design thickness of low volume paved roads. This was undertaking for two strengths of geogrid in both soaked and unsoaked circumstances. The California Bearing Ratios of the soil–geogrid sub grade was used to determine the pavement layer thicknesses for a low volume paved road using the Transport Research Laboratory Road Note 31 method of pavement design.
- **Charles A.Adams, YawAdubofourTuffour , Samuel Kwofie** et al presents The mechanism for strength development when unbound soils are reinforced with geogrid is not well understood. Research on geogrid reinforcement has tended to center mostly on humanizing the property of the geogrid with little attention to the pressure of soil properties on geogrid performance. This learning investigated the effects of plasticity index and gradation properties of lateritic soils on strength enhancement within a soil-geogrid-reinforced compound for a pavement. Three samples of soil with dissimilar plasticity and gradation were compacted and hardened in strength with and without geogrid reinforcement. Reinforcement involved incorporating one and two layers of geogrid into the sample at diverse depths within the compacted sample height. The consequences indicated that as soil plasticity increased, the CBR decreased.
- **Abhijith R.P** et al presents an experimental study on the utilization of natural coir fibers on unpaved roads. Coir fibers provide a reinforcement action to the sub grade soil. Coir fiber is a natural material obtained from coconut husk which is commonly seen in India. Use of coir fibers improves the sub grade soil strength. Coir fibers of varying length from 0.5 to 3cm and varying percentage from 2 to 8 of total weight of soil were added with the soil and CBR test was conducted. The consequences completed that introduction Geotextiles at two third deepness from bottom position was seems to be more effective. The reinforcement action is necessary during initial stage and later reinforcement action is obtained by the consolidation of sub grade soil.

Methodology:

Materials Used: In this study we are using varies materials such as Bamboo fiber and Black Cotton Soil for stabilizing the soil.

Table 1 Physical properties of bamboo fiber

Serial number	Bamboo fiber properties	Values
1.	Density	0.6–1.1
2.	Young's modulus (GPa)	11–17
3.	Tensile strength (MPa)	140–230
4.	Elongation (%)	16
5.	Uniformity index (%)	92.7
6.	Moisture (%)	6.5

Table7: The physical properties of Bamboo Fiber

Conclusion: After studying a number of journal papers and previous study reports, I came to the conclusion that Bamboo Fibers are widely used for stabilizing black cotton soil. The goal of my study is to find an alternative source of stabilizing materials that is also eco-friendly, and by using this material, the properties of black cotton soil are improved.

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FORECASTING OF RENEWABLE ENERGY RESOURCE IN INDIAUSING SPSS

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ABSTRACT: - Energy consumption is promptly increasing in most developing countries Since they foster their economic growth. Modern technological electrical devices in day-to-day activities require high consumption of energy. People's requirement for higher living standard and rapid population growth are among the determinants in the demand of energy generation. There is increasing demand for the use of alternate or renewable energy sources to achieve clean and low-cost electricity to meet requirements. The potential for onsite power generation also remains enormous in India with increasing in-vestment in small-scale solar, wind power, biomass and other renewable resources. Pro-motion of energy production from the combination of sources of energy known as hybrid system is represented by an important objective of meeting the energy demand and justified by environmental protection and increase of energy independence. This paper portrays the forecast of renewable hybrid energy generation of India by using statistical package for social sciences (SPSS) as dependent variable and independent variables are mini hydro, solar, wind, biomass and other sources (Power generation from waste). The findings are similar and correspond with the assumptions in the relationship between variables.

Keywords: Renewable energy generation forecasting, standby power system (SPS) statistical package for social sciences (SPSS), auto regressive integrated moving average (ARIMA), hybrid energy, energy scenario in India.

1. **INTRODUCTION: -** One-third of global greenhouse gases are emitting from fossils fuels such as coal, oil, and natural gas. It is important to make people's lives better, safer and there must be plentiful energy implemented programs in India. Energy also needs for implementing economic growth goals. As for the economic development of a country, demand of electric power is increased. Across the country with a ten-year timetable for the Ministry of Power (MoP) established an extensive long-term plan with the purpose of offering electricity to all at an affordable price and a specific goal of minimizing power wastage and expense. India contributes approximately 6.65% of total global greenhouse gases emissions-stands fourth, after China (14.36%), The EU (9.63%) and The United

States (6.85%), to an estimated 6.8% of total CO2 emissions (9.66 percent). With respect to global warming, the ecological equilibrium may also be altered. For the past twenty years, John Schellenauer has sought to restrict global warming to under two degrees Celsius. The World Energy Council predicts that global demand for electricity will top out in the year 2030. At the same time, it is one of the biggest users of energy and imports expensive fossil fuel just about a quarter of energy demand pro- vided by the combination of coal and oil, close to 74% of which is supplied by either of these. The process of adopting renewable energy would enable the country with rapidly transition to sustainable growth while protecting against potential climate disaster as well as sustainable energy sources of renewable energy. Renewable energy already meets the electricity needs and reduces greenhouse gas emissions, as described in. India has established a sustainable energy supply choice for its long-term goal. At present date awareness of renewable energy has increased resulting in an increase in citizens' usage of solar, wind and waste-powered. It's clear that renewable energy is both safer and cheaper than other options. An ambition of the Indian Government to-generate 175 GW of renewable energy, that includes 100 GW from solar, 60 GW from bioenergy, and 10 GW from hydro power plants by that year. The global investors have set out to meet the promises of over 270 GW of renewable energy capacity to be installed in 2020, which was a substantial increase from the projections. As it has been observed from these assurances, that guarantees are: 58 GW by international corporations and 131 GW by the private sector with a further 13 GW by Indian Railways. The Latest projections show that solar power will exceed 700 GW and renewable energy will account for over 400 GW in 2050. India will have to set ambitious renewable energy goals of 175 GW by the end of 2022, in order to achieve them, it will need to generate 175,000 new jobs and give rise to 15 million new energy-poor people. There needs to be an aggressive combination of push and pull policies alongside clear approaches to grow renewable energy sources. With the advancement in technology and proper environmental policy along with proper research and development will make the renewable resources more cost-effective and efficient manner. To assist with investment, opportunities for unskilled employees and vendors in the renewable sector are being explored. This study also expresses the technical and financial strategies, as well as government policies that support growth in renewable energy. There is a pressing need to learn more about all the challenges that renewable energy production has faced. Also, it is important to discover ways to resolve these obstacles for the growing renewable power sector. Under normal circumstances, renewable and green energy has such an enormous advantage as compared with fossil fuel.

2. **Methodology:** The forecasting of energy generation is critical with misjudging abilities; one will underserve their customers and deficiencies that could not be justified for many years. It would be a difficult to find such an investment from government funds in a developing country like India, since the costs will greatly exceed government revenues. Since there is so much change in energy needs over time, it is absolutely essential to predict future energy use. Predictions say

the government would prepare and build infrastructure to meet potential needs. Businesses also use projections on energy usage to assess the effect a new technology. The new information technology will enable them to understand and account for various approaches exist for projecting a variety of them, including simple extrapolation, simple time series analysis and complex models that employ a combination of these. Some of the notable works in connection with the present study includes ten models of FIS (Totally Integrated System Predictions) were developed to study the effects of two variables such as population and income (parameters: socioeconomic or demographic) on the Municipal Solid Waste (MSW) generation for Kolhapur City, India. A study demonstrates, the grey theory uses of single and multi-hybrid load fore- casting techniques to estimate the increase in China and India's energy demand. Three quality-measurement standards (trend map, error measure and fit model) are applied to test the usefulness of these proposed methodologies. The results demonstrated that these proposed models can generate dependable energy demand, which forecasts in India and China, could be applied elsewhere. Metabolic Grey Model (MGM), Auto- regressive Moving Average (ARMA) and back propagation neural network (BP) have been reported to predict the energy demand in India that is the third-largest consumer in the world after China and The United States. To determine the Total Electricity Consumption (TEC) in industrial sectors, agricultural, commercial, traction and domes- tic electricity consumption of India by 2030, suitable approaches for forecasting the energy demand are used. Such as multiple linear regression (MLR), simple regression, exponential smoothing and the software's are used with the input data of Holt's and GDP are IBM's SPSS Statistics and Microsoft Excel, while output data is using GDP per capita. GDP, population of the country, and GDP-per-per-capita are considered in formulating the prediction. Energy pattern analysis was also conducted to find out the significant influencing variables.

2.1 Forecasting method: The time series is a sequence of one variable's data value over given period of time. Econometric models are time series models with a little more imagination. Using historical data to predict the future semi pertaining the prospective actions with anticipated misperceptions taken into account. Prerequisite data for a forecasting technique, there is a difference between econometric models and time series dependent models' dynamic memory (over a very limited periods of time). Therefore, in addition to the timeseries analysis models, time series are completely simple. Since several variables are not required, the data is not likely to be useful and they don't define any cause -and-effective relationships. Even if changes to the variables are observed, it does not offer insights as to how and why they occurred. What typically happens when someone use econometric techniques or models on time series data, several variables are strongly correlated. To sum it up, this concept is called multi-linearity

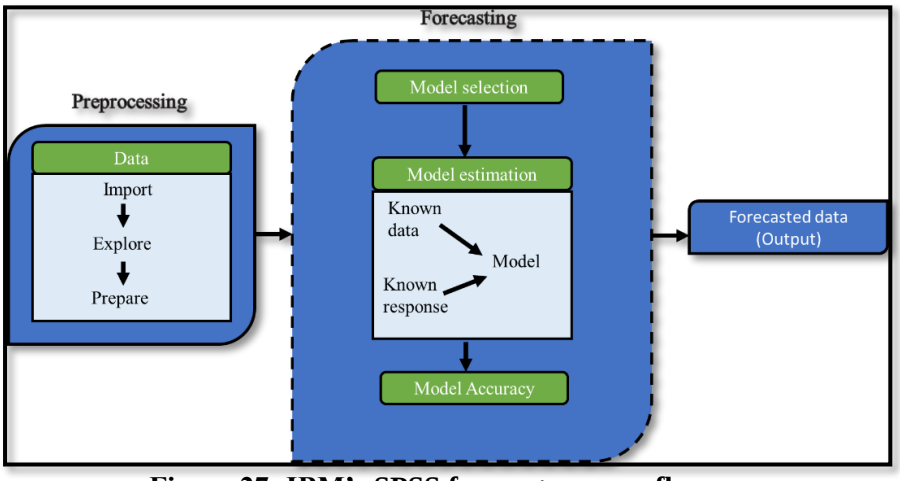

Figure 27: IBM's SPSS forecast process flow

Forecasting tool: Time series modeling is used by IBM Business Rules Forecasting. The time series is the same as a data series measured on a regular basis. With time series forecasting, future events are predicted based on what has already occurred and are tied to each other, as they share the same behavior over time. With this, time element, a forecaster is inherent in the process. It can be said to be described as, the time-line serves as a metaphor for the future to improve forecast accuracy of the time series analysis and additional factors are needed. For instance, energy required, population growth and energy demand that are called variables on their own. These have been properly utilized as predictions for future energy use. In the section energy required, supplied and the population of India is described below Instead of hardcoding the values like inputs and settings. The study employed the expert Mode here, so forecasting is an essential to the, standby power system (SPS). With the support of an auto regressive integrated moving average (ARIMA) or exponential smoothing model, it was able to find and use the best fitting set of ARIMA parameters.

3. Results and Discussions:

A country's population size has a huge impact on energy demand. India ranks as the second most populous country in the world for the month of January 2019 (second in terms of population), nearly 17.7% of the world's population. growth projections show that, the nation would have over 1.383 billion, 1.610 billion, 1.658 billion, and 1.704billion residents by the year 2020, respectively. Each year, India's population grows at a faster rate than any other country, as well as the states' populations of all over 30million. By the year 2040, India will be the world's most energy-hungry country. Renewables would become the second- or will soon overtake gas as-domestic power output by that year. The demand for renewable energy will rise by a total of 256 MW by theyear2016and increase by approximately 12% per year.

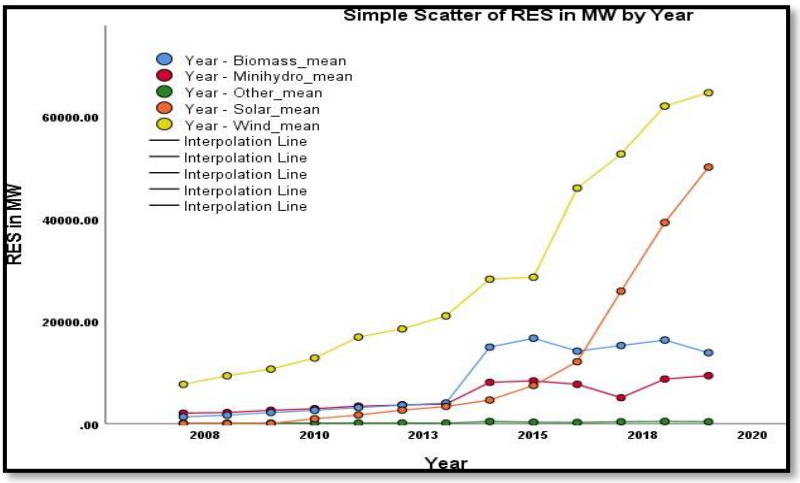

Figure 28: Sources of renewable energy generation in India between 2008-2020

*Source: Annua lCEA report of India 2019-2020

The primary sources energy consumption for the BRICS nations (Brazil, Russia, India, China and South Africa) over the next 20 years is around 17 million tonnes of renewable energy was consumed in 2016, and this will be approximately equal to that by 2040.It is believed that India's energy use will expand at the highest rate of all major economies by the year 2040, with a coal dependency occurring to the most and then declining to a near-complete extent, with respect to natural gas, renewables, and nuclear power at the tail end of the scale. In the year 2020, and to rise to 13 percent by 2040 Even with India's rapid economic growth, energy is still in short supply. The need for economic growth in India is increasing the supply of energy. Sustainable development faces increased population growth at the same time as population growth can no longer be maintained, and at the same time, the country is confronted with a looming problem of sustainability. It is projected that demand and supply will increase in the coming decades. The power supply forecast for the country is in the table from 2009–2018 to 2018–19 (or till). In 2018, the energy demand was1,212,000 megajoules of 134 gigawatt per hour energy and the supply was 1,167 giga-joules of 567 megajoules, which is 0.7% deficient (correction). This study anticipates that by 2021–22, the overall electricity demand would be around 1925 Terawatt hours (TWh), with a peak demand of 297 GW. Possible causes an increase in electrical appliances, i.e., a rise in the residential sector with growing demand for construction materials, transportation services, increased demand for capital goods, and increased investment in infrastructure, the industrial sector is using more electricity. India's 25% of energy needs could be fulfilled with renewable sources of energy, will provide 33% of its electricity from renewable sources by that year. 175 GW of installed capacity, along with a rising percentage of renewable power, by 20.3% of the energy needs are met by renewable resources in 2022. MoP, aims to increase the contribution of renew-ableenergyinIndia'stotalenergyconsumption.2018oftheorderofrevisedRPO (the legislation of June 2018 specifies a target of 21% renewable energy by the year), that goal will be attained, the overall target was set at fifteen percent in 2014, and raised to twenty one percent in 2018.With a stated target of having 40% of the country's energy supplied by renewable sources in place by the year 2030, India intends to go as far as possible in that direction.

3.1 Mini Hydro Energy: Big hydropower developments are small hydropower, and micro-hydro (2 to 25 MW) and mini-hydro While it is expected that SHP will produce 20 GW of electricity, the actuality will be only 5 GW. As of December 31st, 2018 the country has reached an installed capacity of 4.5 GW and is capable of increasing by that number. The long- term target, which was designed by the new NITI Ayog (started on August 1, 2017 and finished in 2019–2020), was compiled into the 2017–2020 NITI Ayog's 3-year plan. MNREU is supplying funds to support for the installation of small/beginner-size micro- hydro projects in both public and private sectors. A number of surveys and financial studies are performed, accompanied by the identification of new possible sites, along with the preliminary preparation of new and/funding studies an integrated supervisory control and data acquisition (SCAD) system has been installed). As part of a joint venture, the cost was 400 million INR, or 95.62 million USD, for the facility was INR 40 crore. Standards that conform to laws and regulations applicable to hydro-mechanical devices are researched. Holt's forecasting model were analyzed for the years be- tween 2014-2040 and were forecasted to be 15761 MW, 18921 MW and 22081 MW respectively for the years 2030, 2035 and 2040. When compared with independent variables as Population, required and supplied data, it is concluded that Population foresees RES better

3.2 Solar Energy: Under the solar mission, the target of 20,000 MW to 100,000 MW of solar energy bytheyear2021-22. In2008 2009, only six megawatts were required. An initiative of the "Made in India" campaign is to increase the country's solar capacity to help the progress of the country. Currently, India stands fifth in the world in terms of solar power generation. Tenders have been issued for 25,212MW of installed solar energy, and 22.8GW of tendered out or active solar power are in process by the end of the year 31st of December 2018. The Ministry of New and Renewable Energy has earmarked 100GW of new solar power generation for the three years (2018–2019 and 2019–2020) which is expected to be supplied from next year. As a result, these programs will remain at least two years from fruition. Tar taxes will be handled by reverse e-auction to slash tariffs. In July 2018 that the lowest solar tariff was 2.44 Indian Rupees per kWh. Solar energy tariffs were INR 18 Indian Rupees per kWh in 2010. Of the over 10 million acres of available land, over 100,000,000 have been allocated to the solar power initiative, of which 75,000 has been secured. in total, solar parks have produced a 26,694MW of energy. A total of forty-one megawatts of solar projects have been put into service in the various solar parks (floating solar power). Brown's forecasting model were analyzed for the years between 2014-2040 and were forecasted to be1,69,295 MW, 2,23,473 MW and 2,77651 MW respectively for the years 2030, 2035and 2040. When compared with independent variables as Population, required and supplied data, it is concluded that Population foresees RES better.

3.3 Wind Energy: The installed capacity target of India as of was just over 40 GW as of December 31st,2018, but it expects to cross 60 GW by 2022. Following China, India stands in fourth place in the world when it comes to the total capacity of wind turbines built. Additionally, almost 9.4 GW capacity has been or is being added. MNRE will be offering a 10 GW of new wind power per year for 2018-2019

and 2019-2020. Overall, the country's total wind energy potential exceeds 302 megawatts at a height of 100meter above ground level. The previous tariff administration has been replaced with the feeding capacity system. On December 8, 2017, the Ministry of Energy announced guidelines for an energy procurement through tariff-based competitive bidding for wind power installations. The open method of bidding has achieved the lowest construction costs for wind power. Since the industrial revolution, the growth of the wind industry has continued through a vigorous, long-term ecosystem, resulting in robust projects as well as stable manufacturing capability. Winding turbines can now be generated with state-of-the-art technologies General Electric, Siemens, ABB, Mitsubishi, Vestas, Suzlon, GE Windstream, Vestas, the first is very strong in India. Firms generate more than 12 different types of wind turbines in India. To countries in addition to exporting them to the USA, Europe, Australia, and Brazil, the nation is a manufacturer of wind turbines and components approximately 70-80% of the domestic output was done with strong domestic. Brown's forecasting model were analyzed for the years between 2014-2040 and were forecasted to 1,39,098 MW, 1,72,488 MW and 2,05,878 MW for the years 2030, 2035 and 2040 respectively. When compared with independent variables as Population, required and supplied data, it is concluded that Population foresees RES better

Model Statistics					Pearson's Correlations
Source Variables	R-squared	RMSE	MAPE	MAE	p-value
Minihydro	0.776	1374.438	19.689	972.194	6.3637E-7
Wind	0.944	4800.206	10.384	2854.807	6.3637E-7
Biomass	0.731	3378.208	21.724	1776.832	6.3637E-7
Other	0.672	81.45	33.17	55.052	6.3637E-7
Solar	0.97	2848.366	21.289	1347.071	0.001

Table 8: Summary of forecasted results of time series modeler statistics(dataupto2040)

3.4 Biomass Energy: In today's world, modern technology has created a new way of doing business for bio- energy use in India. Following the vote in May 2018, the existing policies for biomass were modified. The policy shows industrial residues such as fossil fuels, wood created through energy plantations, wood obtained from crop-residue, agricultural waste, and industrial waste wood, along with bagasse, wood produced through energy plantations, and weed-generated. At 2.5 million (USD 35,477.7) per bagasse per year energy from products such as bio-waste, agricultural, forestry, poultry, agro-industrial, industrial, and municipal waste. The federal government declared the national biofuel policy in August 2018. The MNRE pursued expressions of interest in biomass energy and biogas potential. established in 2018, including the distribution of a biomass subsidy and the incentivization of co-generation in sugar mills and other industries to follow the new method. ARIMA forecasting model were analyzed for the years between 2014-2040 and were forecasted to be 25,317 MW, 30,532 MW and 35,748 MW respectively for the years 2030, 2035 and 2040. When compared with independent variables as Population, required and supplied data, it is concluded that Population fore- sees RES better

3.5 Other energy: Often known as waste-to-energy (WtE) or energy-from-waste (EfW), this method converts primary energy or process energy into waste through use of a waste reduction system. The term WtE is a form of energy reclamation. The majority of WT processes generate electricity or create a combustible fuel, such as methane or ethanol.

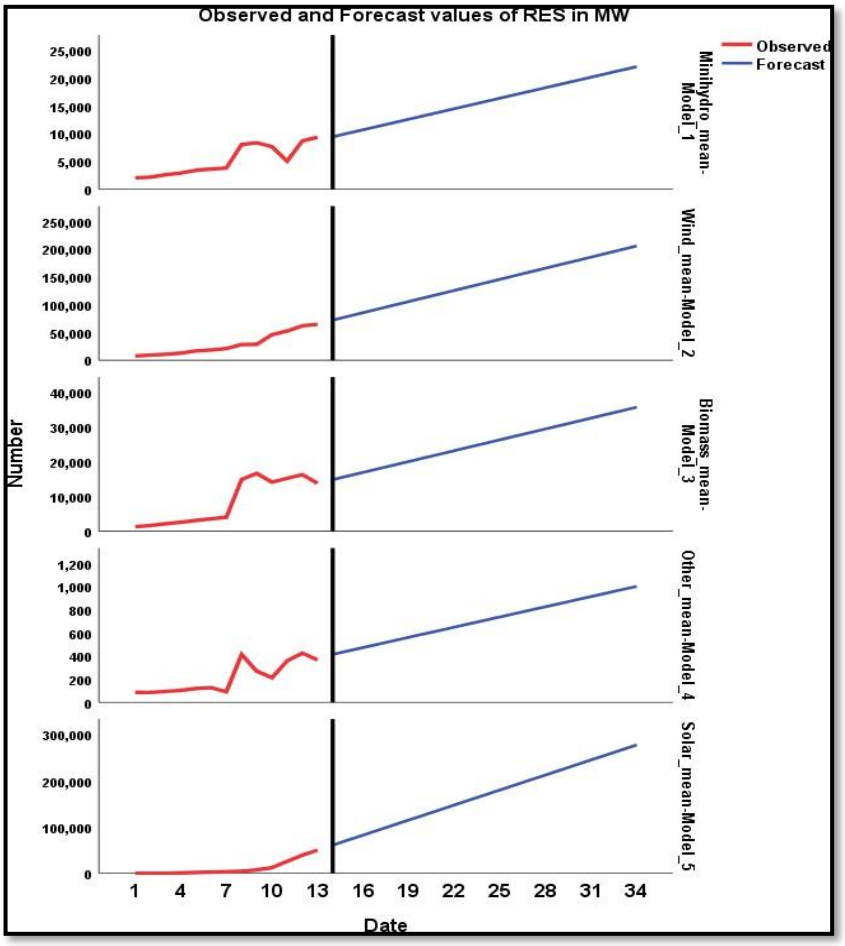

Figure 29: Forecasted sources of renewable energy generation

A capacity for turning waste into energy grew by about four million metric tonnes per year during the 2001-2007 period. Several waste-to-to-energy plants were installed in Japan and China, that used direct smelting or fluidized bed incineration instead. There are several modern breeders who have incorporated the new stoker technology, and others who have taken advantage of the oxygen enrichment. A variety of innovative treatment methods such as direct smelting, the Ebara fluidization and fluidization procedure, and the Thermos select Fluidization method exist worldwide. As of June 2014, India has 93.5 MW total waste-to-to-energy power, of which 373 MW is ready to be utilized. 2011 and 2012 data are shown, followed by projections for 2011 and 2012. Holt's forecasting model were analyzed for the years between 2014-2040 and were forecasted to be 708 MW, 855 MW and 1002 MW respectively for the years 2030, 2035 and 2040. When compared with independent variables as Population, required and supplied data. It is concluded that Population foresees RES better as given in Table 8.

4. **CONCLUSION:** The role of predicting power plant usage requires sophisticated long-term forecasting because it is associated with the economy, population and usage of Exponential smoothing. Every year since 2014 to 2040 was accurately predicted by the method given. As it can be observed from the information provided in this project, renewable power production will increase rapidly in India. Indications for an articulate rise in re- new able power generation coupled with modest potential growth in Indian economy. In addition, increasing contribution of renewable energy in the faster pace of economic growth can be attributed to the shift in the overall Indian economy, as some industries with energy use are expected to expand. Power generation from renewable energy sources, especially mini hydro, wind, solar, and biomass, is expected to become increasingly important in light of the Government's goal to use more cleaner energy. Therefore, energy planning of a country depends heavily upon precise and proper demand forecasting. Precise forecasting is one of the major challenges to manage in the energy sector of any nation. Moreover, forecasts are important for the effective formulation of energy laws and policies in order to conserve the natural resources. It also protects the ecosystem, promote the nation’s economy as well as protect the health and safety of the society.

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REVIEW OF MAXIMUM POWER POINT TRACKING APPROACHES SUITABLE FOR PHOTOVOLTAIC SYSTEM

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ABSTRACT: In solar photovoltaic (PV) generation, maximum power point tracking (MPPT) techniques are fundamental especially as they grow in size and are subjected to varying climatic conditions. In photovoltaic (PV) systems, maximum power point tracking (MPPT) approaches are used to maximise the PV array output power by continually tracking the maximum power point (MPP), which is dependent on panel temperature and irradiance conditions. A significant amount of research has been conducted in attempt to develop more efficient MPPT. On the basis of development, this study explores maximum power point tracking strategies.

INTRODUCTION: Under uniform irradiance, a photovoltaic (PV) array's current-voltage characteristic has a single point, known as the maximum power point (MPP), where the array provides the most output power. In order to maximize the power production from a PV system under a particular set of operational parameters, the MPP must be tracked continuously.

Precisely for low-cost implementations, perturb and observe (P&O) and incremental conductance (INC) approaches are extensively used though there are many approaches available.

The P&O MPPT algorithm is widely implemented because of its simplicity. The disadvantage of the P&O MPPT technique is the operating point oscillates about the MPP at steady state, resulting in the loss of some available energy. Many P&O algorithm enhancements have been developed to lower the number of fluctuations around the MPP while stable condition, however they slow down the algorithm's response time to fluctuating environmental parameters and lessen the method's efficiency on overcast days. The INC algorithm aims to address these issues. It is a simple procedure with better transient performance. There are many methods of MPPT shown in table 9. A block diagram of a single-stage solar energy conversion system (SECS) is shown in Figure No. 31, and a dual-stage energy conversion system (SECS) is shown in Figure No. 32. The MPPT is used extensively in SECS to track the maximum power point to get maximum output.

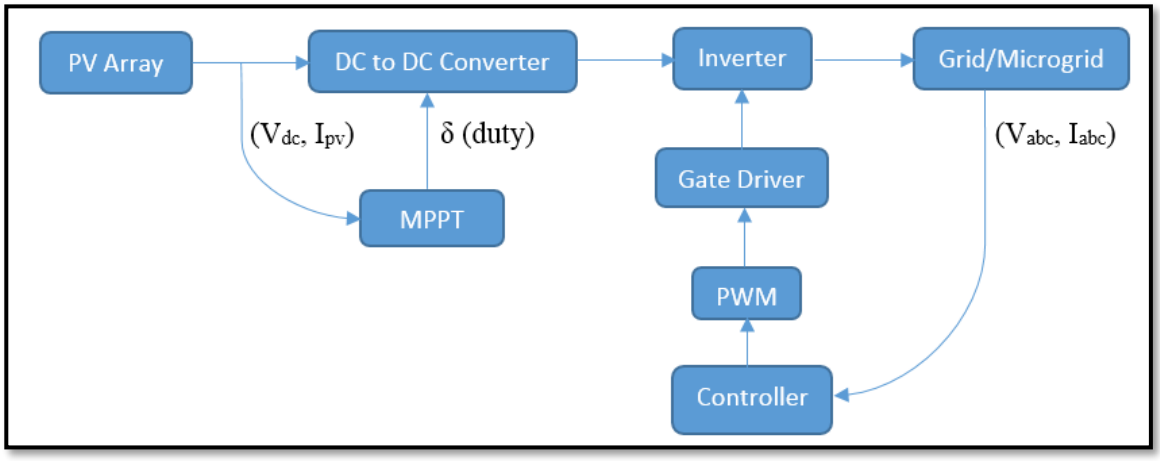

Figure 30: Dual stage solar energy conversion system.

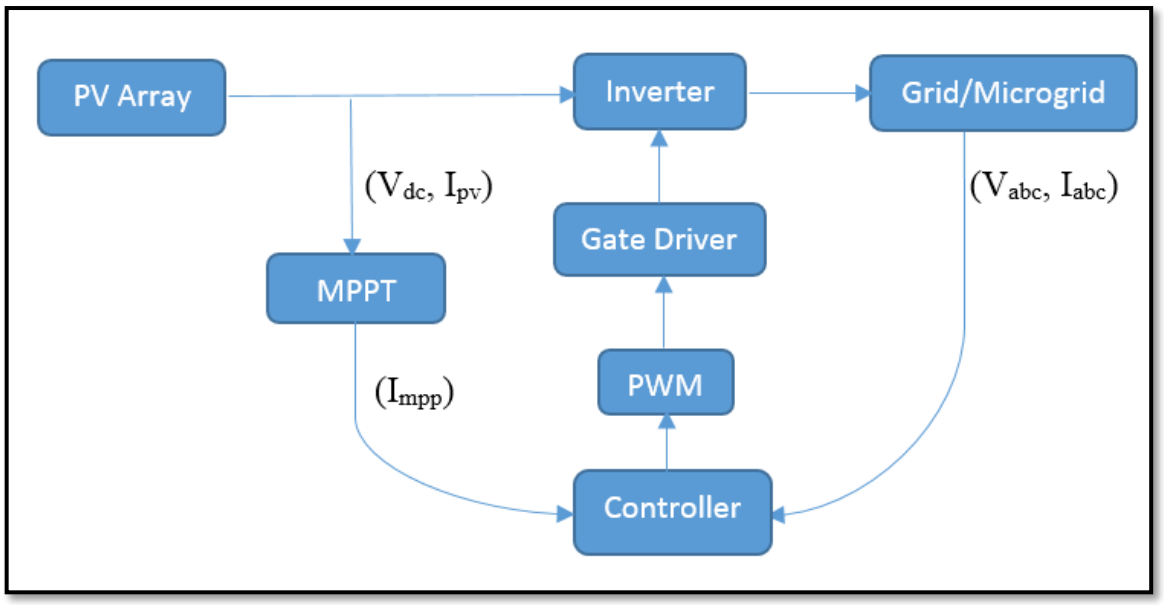

Figure 31: Single stage solar energy conversion system.

OBJECTIVE: The main aim of this study to explores maximum power point tracking strategies and classification of different MPPT algorithms depending upon their working principle

LITERATURE REVIEW: When insolation and temperature change, photovoltaic systems often use a maximum power point tracking (MPPT) technique to continually send the highest feasible power to the load. It solves the problem of solar arrays that aren't matched to the load. Solar radiation, ambient temperature, and solar cell temperature all affect maximum power. (Enslin, 1990) [5] has described an industrialized MPPT regulator, along with some evaluation findings and a simple cost analysis. Finally, it can be argued that MPPT procedures, especially for smaller Remote Area Power Supply (RAPS), are cost-effective and, in some situations, necessary for precisely sizing RAPS. (Enslin& Snyman, 1991) [6] have given a new approach for increasing the efficiency of a maximum power-point-tracker. They have introduced described, and evaluated compound power converter for photovoltaic systems as a

high frequency dc-ac inverter, an MPPT, and a battery charger. Then (Siri et. al., 1993) [7] have developed Maximum power point control scheme which is capable always look for peak power flow without needing to know the non-ideal source's characteristics. (Enslin et. al., 1997) [8] proposed Maximum Power Point Tracker (MPPT) which has increased in efficiency and cost effective than previous MPPT. (Hua et. al., 1998) [9] have suggested a control algorithm that only requires two sensors and uses power as the control variable based on the perturbation and observation approach. Increase the execution speed to get a better reaction for the system amid quick atmospheric condition changes. A low-cost, low-power consumption MPPT system for battery charging has been developed and evaluated by (Koutroulis et. al., 2001) [10] in their article. A Buck-type dc/dc converter with great efficiency and a microcontroller-based unit that controls the dc/dc converter directly from PV array output power measurements make up the system. Traditional two-stage PV energy conversion systems are bulky, expensive, and inefficient, making them unsuitable for use in small-scale PV energy conversion. To address this issue, (Kuo et. al., 2001) [11] have proposed a PV energy conversion system with a single-stage architecture. Advanced features of the suggested single-stage system include a small physical volume, low weight, and great efficiency. For quick tracking of the PV array's maximum power point, a unique single-stage MPPT controller is implemented. The suggested technique considerably improves tracking by reducing oscillation. When insolation is adequate, the proposed PV energy conversion system provides solar generation, and when insolation is insufficient, it provides active power line conditioning. The transition between the two modes is smooth and consistent. (Veerachary et. al., 2002) [12] developed a current sensor less (Solar Cell Array) SCA voltage based on an MP point tracking method for a (Interleaved Dual Boost) IDB converter supplied PV system. A short-current pulse-based adaptive MPPT approach for PV power generation systems has been described by (Noguchi et al., 2002) [13]. The approach makes use of a proportional relationship between the short current and the PV's optimum operating current. Furthermore, the suggested system incorporates a proportional parameter identification technique to make the MPPT algorithm resistant to disturbances like as shading and surface pollution on the PV panels. The short-current pulse-based MPPT algorithm is adaptable to many environmental scenarios because the relationship between the short current and the optimum operating current may be considered linear even though both temperature and irradiance simultaneously vary substantially. For the interleaved dual boost (IDB) converter supplied PV system, (Veera chary et. al., 2002) [14] established a fuzzy feed forward voltage-based MP point tracking approach. The PV source and converters are given analytical expressions. For on-line estimate of reference voltage for the feed forward loop, an off-line ANN trained using the back-propagation approach is used. (Tse et. al., 2002) [15] proposed a method for determining the maximum power point (MPP) that involves injecting a small-signal sinusoidal disturbance into the switching frequency and comparing the ac component with the average value of the panel terminal voltage. Apart from not requiring any complex digital panel power computations, the suggested technique does not approximate panel characteristics and can locate the MPP globally under a wide range of insolation

conditions. (Veera chary et al., 2003) [16] proposed a fuzzy controller-based feedforward MP-point tracking technique for the coupled-inductor interleaved-boost-converter-fed PV system. In comparison to the non-coupled converter system, the suggested converter has reduced switch current stress and higher efficiency. The tracking algorithm alters the duty ratio of the converter for a given solar insolation so that the solar cell array voltage equals the voltage corresponding to the MP point. The feedforward loop does this by comparing the instantaneous array voltage and the reference voltage corresponding to the MP point to generate an error signal. The fuzzy controller creates a control signal for the pulse width-modulation generator, which modifies the duty ratio of the converter, based on the error and change of error signals. The reference voltage corresponding to the MP point for the feedforward loop is obtained by an offline trained neural network. Experimental data are used for offline training of the neural network, which employs a backpropagation algorithm.

MPPT Methods	Advantage	Disadvantage	Improvement methods	References
Perturb and Observe and Incremental conductance	simple approaches, cost effective	oscillation in steady state, simultaneous optimization (optimising multiple variables at the same time), MPPT drift	zero-oscillations methods, variable-step size methods, drift-free methods	[17]-[19]
Fuzzy logic control	excellent performance in a variety of climatic changes	need designer's depth understanding of the system	design simplification by reducing the number of fuzzy rules. parameter optimization	[17], [20]-[23]
Curve-fitting	good precision	particular measurements are required	parabolic prediction, parameter estimation	[17], [24]
MPP-locus method	an excellent result in the	the tracking technique is still	employed additional	[17], [24]-[26]

	context of a changing weather	not comprehensive enough	voltage line and maintain at voltage line	
Beta method	characterized by step size	parameter optimizations	validation of bounding rang optimization of corresponding parameters	[17], [24]

Table-9. **PV MPPT algorithms are classified depending on their working concepts.**

(Konstantopoulos, C., & Koutroulis, E. 2014) [27] proposed a new way for tracking the global MPP of adaptable PV modules. With fewer search steps, the technique suggested in this paper can determine the global MPP of an adaptable PV module. As a result, the power generation of the adaptable PV module is maximized while the energy dissipation during in the global MPPT method is minimized.

For photovoltaic generation systems (PGS) operating under complex partial shadowing situations, a new global maximum power point tracking (GMPPT) technique is suggested by (Ye et. al., 2022) [28]. The current GMPPT technique is based on the Nelder-Mead (NM) simple technique, which is widely used to tackle complex optimization problems and has features such as ease of implementation, derivative-free nature, rapid convergence, and high accuracy. (Tafti et. al., 2022) [29] proposes a global flexible power point tracking (GFPPT) technique for Photovoltaic system under partial shadowing conditions. (Constant power control) CPC and (power reserve control) PRC are two capabilities of the algorithm that are necessary for frequency assist in Photovoltaic system. In table no-1 PV MPPT algorithms are classified depending on their working concepts.

DISCUSSION: Numerous MPPT methodologies for extracting the maximum power provided by PV modules in various PV systems have been outlined. Perturb and Observe (P & O), Fractional Short Circuit Current (FSCC), Incremental Conductance (INC), and other MPPT techniques are frequently utilised. Artificial Neural Networks (ANN), Fuzzy Logic Method, and Particle Swarm Optimization are some of the more advanced soft computing-based MPPT methodologies (PSO). Though there are many advanced methods developed to track the maximum power point, they still suffer from different drawbacks such as low accuracy, complexity, etc.

CONCLUSION: Many MPPT approaches are studied and classified in this study. MPPT approaches are thoroughly investigated. There has been a lot of effort put into improving the traditional MPPT procedures. There's also an outline of the importance and development of these MPPT approaches. It is clear that the research on MPPT approaches is ongoing. As a result, it is advised that future work be done to adapt soft computing based MPPT, preferably work under partial shading and load variance.

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