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3.3.2 SUMMARY REPORT

3.3.2 Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during last five years

S. No	Name of the Teacher	No. of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during last five years			Total
		Year of Publication			
		2022	2021	2020	
1	Dr.C.Sundar	1	-	-	1
2	T.Chitra	3	1	-	4
3	Dr.P.Gopala krishnan	1	-	-	1
4	Mrs.R.Abiraami	-	1	1	2
5	Dr.P.Boomadevi	-	1	-	1
6	Dr.S.Venkatesh Babu	-	1	-	1
7	Mr.R.Ganesh kumar	-	1	1	2
Total(A):		5	5	2	**12**

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Machine learning is a growing technology which enables computers to learn automatically from past data. Machine learning uses various algorithms for building mathematical models and making predictions using historical data or information. Currently, it is being used for various tasks such as image recognition, speech recognition, email filtering, Facebook auto-tagging, recommender system, and many more.The author assumes basic calculus, linear algebra, probability and statistics but no prior exposure to machine learning. Coverage includes widely used traditional methods such as SVMs, boosted trees, HMMs, and LDAs, plus popular deep learning methods such as convolution neural nets, attention, transformers, and GANs. Organized in a coherent presentation framework that emphasizes the big picture, the text introduces each method clearly and concisely "from scratch" based on the fundamentals. All methods and algorithms are described by a clean and consistent style, with a minimum of unnecessary detail. Numerous case studies and concrete examples demonstrate how the methods can be applied in a variety of contexts.

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Mr. R. Ashok Kumar. M. E. Assist. Prof., Dept. of Electronics and Communication Engineering, VSB Engineering College, India.

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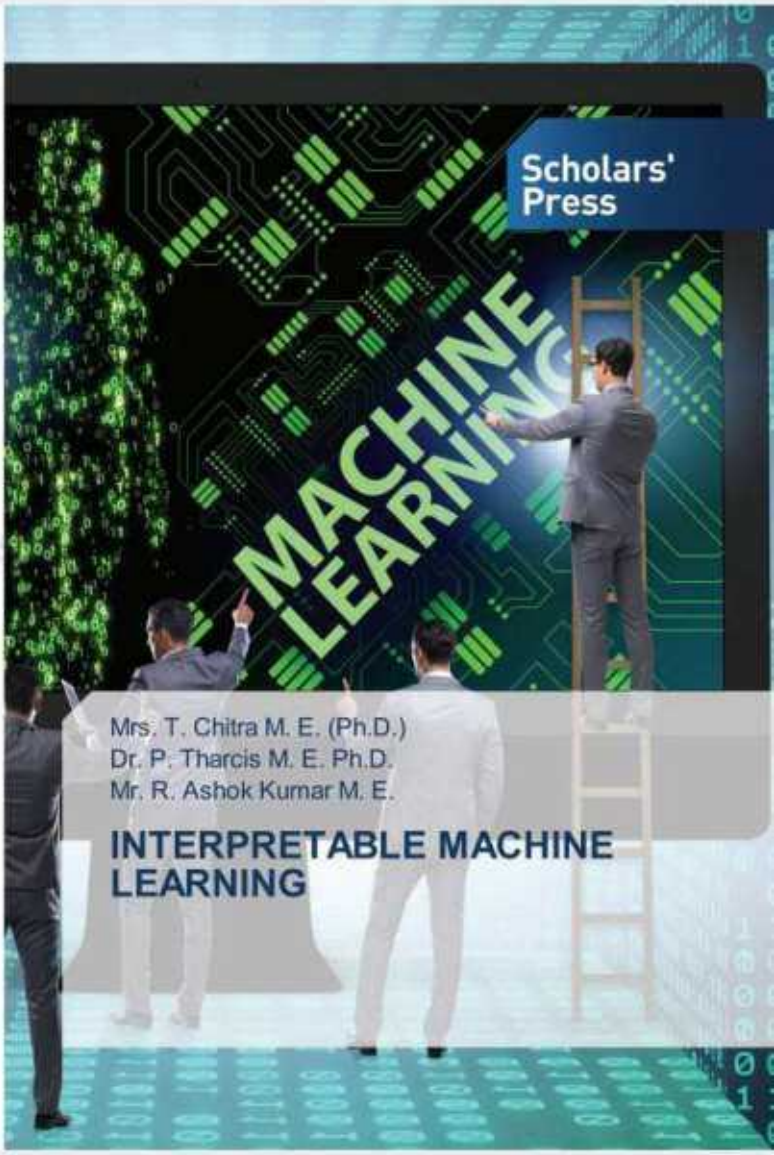

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Dr. P. Tharcis M. E. Ph.D.
Mr. R. Ashok Kumar M. E.

INTERPRETABLE MACHINE LEARNING

INTERPRETABLE MACHINE LEARNING

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INTERPRETABLE MACHINE LEARNING

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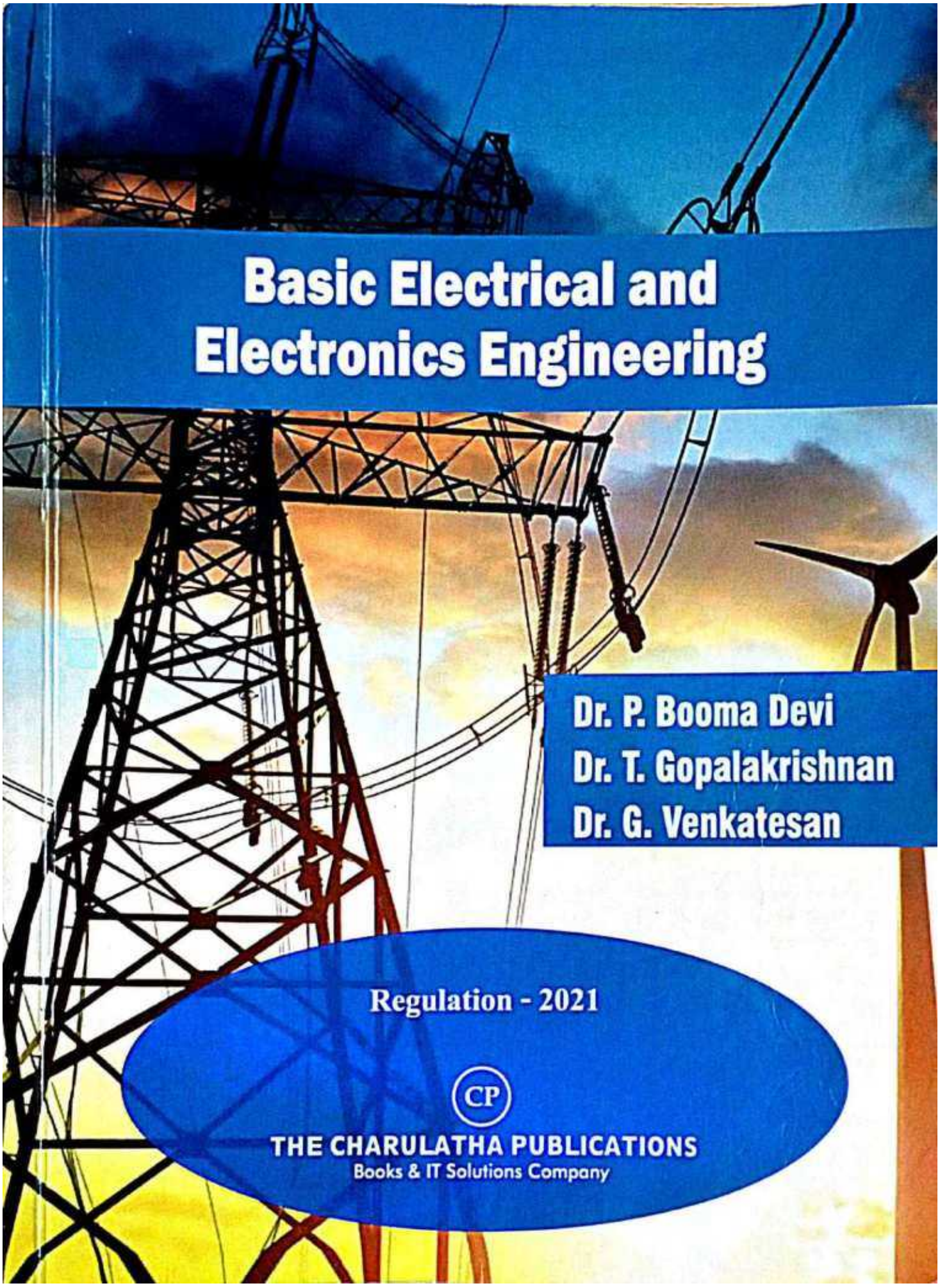

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Dr. T. Gopalakrishnan
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Dr. T. Gopalakrishnan is working as an Associate Professor in Department of Electrical and Electronics Engineering at Christian College of Engineering and Technology, Oddanchatram, Dindigul, Tamil Nadu. He received the B.E. degree in Electrical and Electronics Engineering in 1998 from the Bharathiar University, Coimbatore, and the M.E. degree in Applied Electronics in 2003 from the Bharathiar University, Coimbatore. Received his Ph.D degree in Anna University, Chennai during 2018. He has 17 years of Teaching experience in various Engineering Colleges and 5 year Industrial experience. He is a Life Member of ISTE and Member of IACSIT. He has published papers in International and National Conferences proceedings and received "Best Paper Award". He has published 12 papers in international Journals, one book chapter and 10 papers in national and international conferences. He has organized various workshops, seminars, faculty development program and international conferences during his career and received funding from CFD, Anna University, Chennai.

Dr. G. Venkatesan, is working as an Professor in Department of Electrical and Electronics Engineering at Christian College of Engineering and Technology, Oddanchatram, Dindigul, Tamil Nadu. He has completed B.E.(EEE) in 1998 and M.E.(PED) with GATE Score in 2000. He has obtained his Ph.D. in Electrical Engineering from Anna University, Chennai in 2010. He has more than 20 years of teaching experience in various Academic Institutions. He is a Life Member of ISTE and a member in IAENG and SDIWC. He has published 1 patent, 1 book, 16 papers in International Journals and 5 papers in National / International conferences. His area of interest is Electrical Machines, Power electronics and Electric Vehicles. He recently received funding from CFD, Anna University, Chennai for organizing a FDP.

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UNIT V

MEASUREMENTS AND INSTRUMENTATION

Analysis of Artificial Intelligence Enabled Intelligent Sixth Generation (6G) Wireless Communication Networks

Publisher: IEEE

S. Manikandan Annamalai ; [illegible] ; [illegible] ... All Authors

Abstract:
5G devices and ... which have ... improved features compared to ... connectivity, will be ... authoritatively very soon. Between 2027 and 2030, it is anticipated that the sixth generation wireless communication system, utilizing the entirety of artificial intelligence, will be implemented. In addition to 5G, there are a number of fundamental challenges that must be addressed, including increased scheme capability, higher data rates, and improved quality of service (QoS). This ... upcoming 6G wireless technology and ... Emerging technologies such as artificial intelligence and optical wireless technology are discussed. With 6G, ... rates are anticipated to become one hundred times faster. As 6G ... beyond terrestrial networks and into space, it will enable new ... with ... enabling unprecedented human machine interaction. 5G is intended to provide peak data rates of 20 Gigabits per second (Gbps) and average user experience rates of 100 Megabits per second (Mbps); it is anticipated that 6G speeds will be closer to 1,000 Gbps and 1 Gbps respectively. 6G enables ... such as holographic communication, ... and X reality (XR, which integrates AR, VR and Mixed Reality). One of the goals of 6G ... will be to deliver messages with 1 microsecond delays as opposed to 1000 ... delays. ... enhanced by the combination of artificial intelligence and machine learning (AI). Using sub-mm waves, the 6G significantly influences the ... communication capability for location determination. Using a ... wave (e.g., wavelengths less than one millimeter) in conjunction with frequency ... to determine ... electromagnetic ... change will lead to significant advancements in wireless sensing technology. In terms of 6G, the calculation of mobile edge computing (MEC) is merely the tip of the iceberg. By the time 6G hits ...

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Published in: 2022 IEEE International Conference on Data Science and Information System (ICDSIS)

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Date Added to IEEE Xplore: 14 October 2022

Publisher: IEEE

Conference Location: Hassan, India

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Abstract

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Abstract: 5G Generation connections, which have many novel features compared to Four-G connections, will be dispatched authoritatively very soon. Between 2027 and 2030, it is antic... View more

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Abstract:
5G Generation connections, which have many novel features compared to Four-G connections, will be dispatched authoritatively very soon. Between 2027 and 2030, it is anticipated that the sixth-generation wireless communication system, utilising the entirety of artificial intelligence, will be implemented. In addition to 5G, there are a number of fundamental challenges that must be addressed, including increased scheme capability, higher data rates, and improved quality of service (QoS). This accessible manuscript discusses upcoming 6G wireless technology and its situation. Emerging technologies such as artificial intelligence and optical wireless technology are discussed. With 6G, mobile networks are anticipated to become one hundred times faster. As 6G expands beyond terrestrial networks and into space, it will enable new scenarios and services with terabytes of data traffic, enabling unprecedented human-machine interaction. 5G is intended to provide peak data rates of 20 Gigabits per second (Gbps) and average user experience rates of 120 Megabits per second (Mbps). It is anticipated that 6G speeds will be closer to 1,000 Gbps and 1 Gbps, respectively. 6G enables options such as holographic communication à la Star Trek and X reality (XR, which integrates AR, VR, and Mixed Reality). One of the goals of 6G cyberspace will be to deliver messages [illegible] technology is enhanced by the combination of artificial intelligence and machine learning (AI). Using sub-mm waves, the 6G significantly influences the calculated communication capability for location determination. Using sub-mm

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Wave (e.g., wavelengths less than one millimetre) in conjunction with frequency selectivity to determine comparative electromagnetic incorporation charge will lead to significant advancements in wireless sensing technology. In terms of 5G, the calculation of mobile edge computing (MEC) is merely the tip of the iceberg. By the time 6G net...

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Analysis of Artificial Intelligence Enabled Intelligent Sixth Generation (6G) Wireless Communication Networks

in the IEEE International Conference on Data Science and Information System (ICDSIS-2022), organized by the Malnad College of Engineering, Hassan, India in association with IEEE Bangalore Section and IEEE Mysore Subsection on 29th-30th July, 2022.

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Water Quality Analysis of Water Bodies in Dindigul and Trichy

Abiraami R [1]*, Ganesh kumar R [1]

[1] Department of Civil Engineering, Christian College of Engineering and Technology, Tamilnadu, India.

* Corresponding Author Email: abiraaminithya@gmail.com

Abstract

Water is a vital resource for human survival. The presence of heavy metals in drinking water higher than a certain concentration can cause detrimental impacts on human health. The availability of good quality is an indispensable feature for preventing diseases and improving quality of life. In this work, samples of water were collected from two different rivers at two different times of the year. The first set of samples was collected in the month of December, 2019 & the second set was collected in February 2020. It is important to know details about different physio-chemicals such as pH, sulphate, chloride, BOD, TDS, TSS, conductivity, Iron content, Turbidity alkalinity used for testing of water quality. An assessment of the aquatic macro invertebrates an also provide an indication of water quality. Over the due course of time various parameters regarding the water quality were analyzed & the Indian Standard: 10500- 1991(drinking water specification) was referred to in order to check the acceptability of water.

Keywords: Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Potential of Hydrogen (pH), Biochemical Oxygen Demand (BOD)

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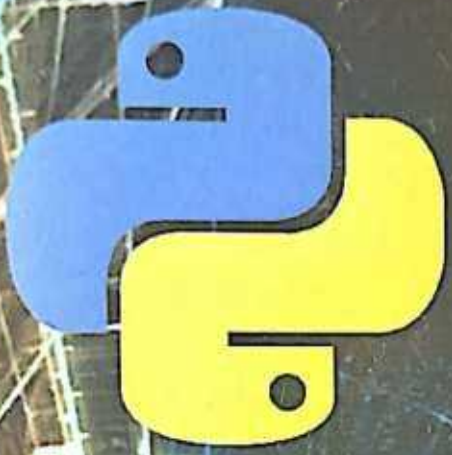
Problem Solving and Python Programming



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UNIT-I

COMPUTATIONAL THINKING AND PROBLEM SOLVING

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ICMSCE2021, SIET

Coimbatore, India ▪ 26 – 27, October 2021

Editors ▪ Dr. R. Anuradha, Mr. V. Sre Adethya

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Ground Water Treatment Using Agro-Based Absorbent Materials

Abiraami R[1,a)], Johnpaul V[2,b)], Ganesh Kumar R[2,c)], Mahmoud Al Khazaleh[3,d)]

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Abstract. In most rural and urban places, people are utilizing groundwater for their domestic purposes. The rural area population is mainly exposed to groundwater through dug wells since its hard-to-get purified drinking water is feasible. The people were not aware of the adverse effects of water-borne diseases on their well-being caused by the abnormal levels of chemicals present in the untreated groundwater. In this study, the groundwater was treated using activated carbon as an adsorbent, and the mineral content was analyzed to assess the groundwater quality to incorporate as drinking water. The sample was collected in the Dharmapuri district located in Tamil Nadu, India. The bamboo and pomegranate peel were used as the adsorbents to remove pollutants from the groundwater. The Physical, chemical, and biological characterization for the sample were determined. The results showed that the agro-based water holds good in minimizing the acceptable limit of chloride, calcium, and manganese. The treated water determined to have a permissible limit of fluoride content (less than 1.2 mg/l), thereby chosen activated carbon, is an effective adsorbent in purifying the groundwater.
Keywords: Chlorides, Conductivity, Groundwater, Hardness, Quality, TDS and Turbidity.

INTRODUCTION

Nature's most significant resource is water, and all living beings survive because of its vital role (R. M. Ali et al., 2016). Drinking safe and pure water is a critical requirement for every human being. However, because of the pollution of water and overexploitation, freshwater becomes a scarce commodity. Groundwater usages now rectify the primary demand for water (N & Poongothai, 2008). Hence the need to protect the quality of groundwater became a considerable responsibility for the welfare of the human community. Even water budget planning became mandatory for policy planners because of the usage of groundwater for drinking purposes, irrigation for crops, and other purposes (F. Ahmed et al., 2014). The domestic water collected at three different locations in the Dharmapuri district is contributed by the fluoride-bearing rocks, which are the primary resource of fluoride in groundwater, that possess rock-producing minerals (Alvarez-Bastida et al., 2018). The calcium level decreases with a higher level of fluoride because of the carbonate precipitation in an aquifer; the substitution of Na by Ca (Shanmugasundharam et al., 2017) decreases the amplitude of the endplate potential and produces a slight decrease in quantal content neuromuscular junction study. However, the fluorites of these ions have low solubility (Nethaji Mariappan, 2015).

Acknowledging the filtration through a medium concentrated with Ca of underground water, the positive correlation of Ca2+ with fluoride indicates that the hardness of water rises with depth. Therefore, high fluoride content is reported in many geographical areas, and the allowable fluoride levels can be calculated based on climatic conditions (Adekola et al., 2016).

The air temperature influences the consumption level of water and subsequently the ingested quantity of fluoride. If groundwater quality gets affected, it is not easy to revive its originality (Florence et al., 2012). The nature of groundwater quality might get affected by the temporal changes in the different layers of soil mass, hydrologic and human activities. There is a rapid development occurring in the industries, and simultaneously, it creates a massive demand for fresh water supplies. Removal of heavy metal content in water before it reaches aquatic environment makes desirable for drinking purpose.

1st International Conference on Material Science and Civil Engineering

ICMSCE2021, SIET

Coimbatore, India ▪ 26 – 27, October 2021

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The Institute collaborated with worldwide Universities and Industries. Now the Institution is offering Nine Bachelor Programmes in the field of Agriculture Engineering, Biomedical Engineering, Biotechnology, Civil Engineering, Computer Science Engineering, Electronic and Communication Engineering, Electrical and Electronics Engineering, Food Technology, Information Technology, Mechanical Engineering. Our Institute also offers Master’s Programme in the field of Computer Applications, Communication Systems, CAD/CAM, Embedded System Technologies, VLSI Design, Structural Engineering. SIET has recently crowned the status of Autonomous Institution.

SIET is ranked among top 10 percent of 3000 colleges across India to receive national employability award. The Times Group award of Excellence in Education was also given to SIET by his Excellency, K. Rosaiah, Governor of Tamilnadu in the presence of AICTE Chairman Prof. S.S. Mantha. Many distinguished speakers, including Padamashri Dr. A. Sivathanu Pillai, inspired our students during our flagship events. Various research Projects with funding of approx. INR 1 Crore are being currently pursued with the support from various Government Agencies’ and Industries. Through our International Conference, we publish about 150 research paper every year and index in IEEE Xplore.

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MESSAGE FROM CHAIRMAN

I am glad that Department of Civil Engineering, Sri Shakthi Institute of Engineering and Technology is organizing "International Conference on Material Science and Civil Engineering" (ICMSCE - 2021).

Civil Engineering is the most important field for development of Peoples and Civilization. There is an urgent need for proper assessment in our country using various advanced techniques in Civil Engineering. My firm belief of the prospect of this Conference will provide great opportunity for the participants who are working in the area of Construction and Material Science to share their recent innovation and venture through the interaction among themselves. I anticipate this mutual interaction among the delegates will help to update the knowledge and create a path way for new collaboration and exploration leading to development in the emerging area of Civil Engineering.

My best wishes for grand success of the conference.

Dr. S. Thangavelu

Chairman

Sri Shakthi Institute of Engineering and Technology

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PREFACE

The 1st International Conference on Material Science and Civil Engineering (ICMSCE), held in Sri Shakthi Institute of Engineering and Technology, Coimbatore on 26th – 27th, October 2021. ICMSCE focuses on both systems and applications in the fields of civil engineering and material science. The Conference, which operates under the theme of **"Material Science and Civil Engineering"** disseminates research results and promotes knowledge sharing among current researchers.

The Vision of ICMSCE is to foster communication among researchers and practitioners working in a wide variety of areas in Construction and Material Science. On this occasion, we feel immensely happy and proud in welcoming everyone to the conference.

We begin by thanking and applauding to Dr. S. Thangavelu, Founder and Chairman, Sri Shakthi Institute of Engineering and Technology for his guidance, insight and encouragement were indispensable during all aspects of this conference, and without these grand events would not have succeeded. We extending my deep sense of gratitude to Er. T. Dheepan, Secretary and Mr. T. Sheelan, Joint Secretary for their valuable suggestion and kind support in organizing the conference.

We express our profound gratitude to Dr. A. R. Ravikumar, Principal, Sri Shakthi Institute of Engineering and Technology for extending his unlimited support in all aspects without which this conference could not have been arranged.

We would like to thank everyone who has shown interest in participating the conference, we record my sincere thanks and full appreciation to all the guests and invite speakers who have readily accept our invitation and delivered talks.

Dr. R. Anuradha,

Conference Chairperson,

Head of Civil Engineering Department,

SIET.

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Management Of Triple Constraints In Projects

P. Deepthika [1,a)] and G. Chitra [1,b)]

[1,a),b)] *Department of Civil Engineering, Thiyagarajar College of Engineering, Madurai-625015, Tamil Nadu, India.*

Corresponding Author – [a)]*deeptadarshini@gmail.com*
[b)]*gcciv@tce.edu*

Abstract. Triple constraints (or) project management triangle (or) iron triangle are three main factors that relate to the quality of a project. They are Scope,Time and Cost. Scope constitutes all the products and facilities to be provided to the project. Time represents the duration the project takes to complete it's assigned task. Cost represents the amount of money spent to complete theproject. Quality of a project can be enhanced by managing triple constraints effectively. Statistics show that most of the real time projects fail due to improper management of triple constraint. Hence it is necessary to properly manage them. There are few factors that influence these constraints. Some factors that influence the scope are new change in assigned design, financing of projects, communication barrier among the project team. Factors influencing time are scope change, rework, conflicts or disputes among project managers. Some factors influencing cost are inexperienced project manager, change indesign, price fluctuation. Various literatures related to triple constraints along with case studies were reviewed and presented in this paper. It also includes different methodologiesto manage triple constraints efficiently.
Keywords: Triple Constraints, Scope, Time, Cost, Management

INTRODUCTION

Projects are temporary endeavor leading to an outcome. They may be both small or large scale. Triple constraints are the three factors that mainly control the quality of a project. Figure 1.1 shows the iron triangle or triple constraints in a project. It is important to manage these triple constraints for successful completion of projects. When projects are handled without any planning or management, they will lead to lots of problems and struggles during its execution stage. Numerous projects were stopped midway for several reasons; some being due to insufficient funds, improper planning, improper scheduling, uneven allocation of resources, communication barrier among the workers and several other reasons. For successful completion, it is mandatory to manage these triple constraints to enable the best quality in projects. Hence, by considering the influencing factors and framing a proper schedule with accurate budget, projects can be effectively and efficiently executed meeting the desired goals.

Fig 1 Iron Triangle

AIM AND OBJECTIVES

The aim of this paper is to learn efficient methods to manage the triple constraints for successful completion of a project. The following are the objectives of this work,

- To review literature related to the influencing factors affecting the triple constraints in projects
- To identify efficient methodologies to manage the triple constraints
- To study different cases through literatures related to the management of triple constraints.

NEED FOR TRIPLE CONSTRAINTS

The report of the Indian Ministry of Statistics and Programme Implementation (MOSPI) [1] (2019) states that out of the 951 projects that were scrutinized; 309 projects had cost overruns and 474 projects had time overruns. It's a rare scenario in construction industry, that projects are completed within the estimated budget and time, with desired quality. Hence, it is essential to manage the triple constraints in projects.

FACTORS AFFECTING TRIPLE CONSTRAINTS

Various factors influence the triple constraints in project. Some of the major factors identified from the literatures are:

- Land acquisition delay
- Delay in getting forest/environment clearances
- Deficiency in infrastructure support and linkages
- Delay in tie-up of project financing
- Postponement in finalization of detailed engineering
- Deviations in scope
- Delay in tendering, ordering and equipment supply
- Problems related to law and order
- Geological uncertainties
- Pre commissioning and contractual issues.

Before commencing a project, it is necessary to understand these factors that are responsible for major failure and plan accordingly to enable its successful execution.

LITERATURE REVIEW

Numerous literatures were reviewed related to the topic and few are presented here.

Ahmed et al (2016)[14] studied the reasons behind delay in construction projects in Karachi, Pakistan. From his findings he has listed few factors that are causes for delays in Pakistan construction projects that include poor planning, changes in design, slow decision making of the clients and poor financial management. These were the most rated factors from his study. Similar to his study there are other authors who have conducted similar studies and have a list of other factors, some already matching with the other authors. **Fred Rugenyi et al (2016)[16]** reviewed the projects carried out in Kenya and says that project management experience and project management professional certification also to be vital in projects.

Aynur Kazaz et al (2016)[15] examined the various mathematical models on Time, Cost, Quality(TCQ) tradeoff problems. Here two different approaches were used, namely continuous approach and discrete approach. In continuous approach the three components were expressed by continuous functions. Team formation and the team overtime policy impacted on the project triple constraints in the discrete approach. The developed model was also evaluated for its applicability by testing it on small projects with limited activities. **Shanmuganathan et al (2016)[10]**, investigated the top techniques used for managing cost and time along with software to control construction projects. The data through questionnaire survey were collected from engineers, contractors and clients working in various construction industry. Forecasting Cash Flow, Planning and Control of Cost, Critical Path Method, Programme Evaluation and Review Technique were some of the best techniques obtained from the study. Software such as Primavera, Microsoft Project were considered to be the finest methods for controlling projects.

Qais Hashil Salim Al-Rubaiei et.al.(2018)[17] focused on scope management. Ill managed scope will lead to scope creep which would be primarily responsible for cost, time overruns and ultimate loss of project's credibility. Once the creditability is lost the stakeholders are most likely to abandon the project. The steps involved in proper management are Plan scope, collect requirements, define scope, create WBS, validate scope and control scope.

Manlian Ronald A et.al.(2018)[15] identifies that the increase in project failures are due to the contractors and project owners did not use the correct management methodology that led to the project delays and cost overruns. His list of factors were the causes of cost overrun, factors and variable project cost management and the increasing project cost management is expected to reduce the potential cost overrun.

Were Susan et al (2018)[4] studied the four variables that contribute to inaccurate cost estimates: estimator knowledge and experience, scope assumptions,

available time and cost models. This study found that contractor's knowledge and experience had a direct and positive influence on cost estimation in plant installation projects in Kenya. This study also listed some factors like pressure to submit the schedule faster, design change and lack of timely communication between contractor and supplier also has a direct influence on cost estimates. The findings from the journal was design change always has an adverse effect on the cost of the project. Timely communication between contractor and supplier or client has a direct influence on the cost estimates. **Zowghi et al (2018)**[1] analyzed that the earned value system (EVM) characterizes scope and combines it with cost and schedule. This paper recovers the ability of the project managers for making better decisions in assessing project's performance by fixing a reliable cost and schedule performance indices.

Craig Lang (2018)[8] developed a 3D project integration model embracing cost, time and risk as a basis to recommend key performance indicators(KPI). The model proposed a tetrahedron with four vertices as Cost Management, Scope Management, Time Management and Risk Management of project. The six edges are Human Resource Management, Procurement Management, Stakeholder Management. Communications Management, Quality Management and Environmental Management of project. The study aimed at identification of core project constraints occupying the four vertices and six KPIs that relate to the constraints of any projects. The model is also capable of measuring objectives of the project. **Hassan et al (2019)**[5], conducted a detailed review of independent variable (triple constraints) and dependent variable (building projects). The purpose of the study was to determine the barriers to construction projects. They were identified as time delay, cost overrun and poor quality of projects. The learning shows emphasizes priority to be given to quality and cost management in order to achieve success in projects. Also it has demonstrated that quality management plays a major role in the growth of building projects.

Priyadarshini et.al. (2020)[9] studied the management of the triple constraints by forecasting the cost of resources- men, material and machinery in construction project to attain enhanced project performance with outstanding efficacy. A questionnaire survey was conducted and the impact level of various factors on construction project was identified. Critical resources with high price escalation was identified and incorporated in planning stage of the project. Suggestions for projects to reach the objectives with enhanced performance were listed in the paper. The findings of the paper were committing project management training for professionals, responsibilities to be shared and documentation of change to avoid discrepancies or mistake in future.

INFERENCE FROM LITERATURE SURVEY

It is evident from the literatures that there is a history for projects that were incomplete or projects that exceeded the estimated schedule and budget. It is essential to consider the reasons behind them. Most of the literatures taken are solely serving this purpose. The authors have studied, analyzed, investigated and conducted surveys on various projects from various places. They have taken all the factors that they find are responsible for the accounted delay of the projects. Most of the authors have also given rectifying measures for those identified factors. Many of the contractors or project managers fail to implement new ways to manage the triple constraints. They tend to follow the traditional ways without proper planning of the entire project. Traditional ways can be suitable for small scale construction works. However, when it comes to projects of large scale; it becomes imperative to adopt new methodologies, strategies or techniques for its successful completion. Some of these popular methodologies mentioned include EVM, Work Breakdown Structure, Critical Path Method, PERT and popularly used software for better monitoring and control of projects were Primavera and MS Project.

CONCLUSION AND DISCUSSION

Importance of Triple constraints for successful accomplishment of projects meeting its desired objectives were identified through review of numerous literatures. Also, the factors influencing iron triangle in projects were studied and discussed in detail. Various journals were reviewed and ideas are handpicked:

- The triple constraints- scope, time and cost are responsible for quality of a project. Hence, it is essential to be controlled and well monitored in projects.

- There are various factors that affect the triple constraints, some of the most recurring factors are project financing, political inference, change in design, communication barriers among the stakeholders, conflicts or disputes between the partners
- There are different methods that can be followed at different situations. Most highly recommended methods framing a TRIJECT model, Baker and Cole's seesaw model, tetrahedron model, fuzzy technology, EVM method, forecasting future rate, two step methodology and process for scope management.
- Some of the most commonly used methods and are in practice till date are work break down structure, resource allocation process, Gantt chart etc.
- Some of the most commonly mentioned software are Primavera and Microsoft Project.

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Productivity and Cost Assessment of Equipments for Highway Project

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Abstract: In the development of infrastructure projects, construction equipment is an important resource. Construction equipment accounts for a large portion of a project's cost, yet inappropriate use of these resources results in a loss of productivity, which has a negative impact on profit. As a result, it is necessary to optimise these activities in order to save costs. Construction equipment plays a crucial part in four-lane construction, accounting for up to 36% of overall project expenses. However, equipment maintenance has not received adequate attention, resulting in a 40% cost overrun. This research paper looks at the best strategy to use construction equipment for the National Highway project. It involves a cost-benefit analysis of the equipment in terms of production, time, and cost. Production capacity, effective working hours, and equipment costs are all taken into account when performing these optimizations. A case study of four lanes of the Chikhali-Tarsod Highway Projects under section Nh-6 (Jalgaon) is used to validate the results.

Key Words: Equipment economics, Productivity, Optimization, etc.

INTRODUCTION

Equipment plays a significant part in road building since earthwork accounts for a large portion of the entire construction cost, hence their cost and productivity are critical in making the project viable for the company. As a result, if accuracy is reached in terms of estimating ownership and operating costs, equipment productivity, and a realistic method of purchasing equipment, the project can be designed with greater precision and at a lower cost. [1].

Each work of a road layer necessitates a particular set of equipment and machineries, each with its own level of application, such as subgrade, granular sub-base, dry lean, and pavement quality concrete. [2]. Equipment productivity control is carried out to determine the length of time it is in use, the amount of output it produces, and its overall productivity on the project site. The primary goal of equipment productivity control is to reduce cost and waste. [4].

Planning for the preparation of detailed cost estimates and timetables is one of the first jobs to be completed on any project. The more accurate the results of the estimator's study are, the better the historical data available to him. This includes deciding which sort of equipment to utilize for a specific project as well as the actual performance qualities of specific equipment components.

The ability of a contractor to get a contract and profit from it is determined by factors such as construction methods used and labour and equipment management. Any project requires appropriate planning and calculations before it can be carried out; therefore, if we can achieve accuracy in terms of calculating operational costs, equipment productivity, and a realistic technique of acquiring equipment, we will be able to manage our project more accurately. Despite the fact that scheduled rates are available, we are unaware of or do not pay attention to the factors that play a big role in the calculation of these figures. [5].

The objective of this research paper is to examine the output and economics of various highway building equipment. Hydraulic Excavator (Backhoe Loader), RMC Plant, HMP, Bitumen Paver, and Tandem Road Roller are among the equipments chosen & hence as a outcome, provide obtained results on various factors included in ownership and operating costs on a per working hour basis when equipment is used to its full potential for its

intended purpose with an efficiency of 50/60 minutes, as well as per hour productivity that equipment can attain if it is working at an efficiency of 50/60 minutes.

RESEARCH METHODOLOGY

The approach used in this research work is divided into two categories.

Methodology for calculation of landed, ownership and operating cost per working hour

The overall cost of construction equipment is divided into two parts: ownership and operating costs (also known as O & O cost of construction equipment). Depreciation, interest, and insurance costs are all included in the cost of ownership (12 % of book value). The number of operating hours, location of the job site, operating circumstances, fuel/energy consumption, and category of equipment are all factors that influence the equipment's operating cost. Finally, it includes labour and equipment operator compensation, as well as maintenance and fuel costs. The procedures for calculating the cost of equipment are as follows: -

1. Data on landed costs of equipment was collected from a seller. Data from retailers, IS 11590:1995, and manufacturer performance reports on the operating life of equipment (age of equipment) in hours were collected (Caterpillar Performance Handbook, 2015).
2. The landed/purchasing cost of equipment is calculated by adding the basic cost, 18 % GST on the basic cost, and transportation/installation costs received from equipment producers, sellers, and owners throughout the course of their life.
3. Calculation of the net worth of ownership costs that will be covered over the equipment's life cycle.
4. Monthly maintenance costs, per hour fuel/electricity consumption, fuel/electricity cost, and operator's monthly salary were gathered by observing equipment on the Chikhali-Tarsod Highway Project, also collected operating cost data from contractors and equipment proprietors, and then converting maintenance costs and operator's wages to a per working hour basis. (Assume per day working hours = 10)
5. Finally, by adding all costs, the cost per effective working hour is calculated, allowing for net value coverage.

Methodology for evaluation of productivity per working hour

All of the methodologies and procedures are based on R.L Peurifoy, Clifford J. Schexnayder, and Avid Shapira's book "Construction Planning, Equipment, and Methods," published by Tata McGraw-Hill Companies in 2010. [6].

Equipment performance

The ratio of per hour Ownership and Operating costs in rupees, as well as equipment productivity in m3/hr., is used to calculate equipment performance.

DATA COLLECTION

Description of the case study

For data collection, case study of National Highway NH-6 (Package –IIA) is selected. The Package-IIA of the project highway starts at Chikhali from km 360.000 to km 422.700 in Buldhana district and ends at Tarsod Jalgaon District observed total length is 62.7 km. The project is located in the State of Maharashtra to be executed on Hybrid Annuity (DBOT Annuity) by National Highway Authority of India (NHAI).

The current state of equipment management is revealed as a result of this research. The method of bituminous pavement construction and the operation of each piece of equipment are extensively studied, and further output and cost analysis, such as values for landed cost, ownership cost, operating cost, maintenance cost, and so on, are collected from equipment working on project sites and construction equipment sellers. Observing equipment on the Chikhali-Tarsod highway construction project provides data for calculating equipment productivity, such as bucket capacity of excavators, quantity of concrete/asphalt produced by plants, average speed of paver & roller to be maintained and effective working hours for hydraulic excavators, RMC, Hot Mix Plant, speed of bitumen paver & road roller, and so on.

Data collection

Data on each equipment production and cost was acquired from the contractor's records from site for primary data collection during the months of October 2020 to May 2021. For further output and economic analysis, data on

fuel consumption, maintenance costs, labour operating costs, and equipment working hours were gathered. The cost of each type of equipment was then computed on an hourly basis, as shown below.

RESULT ANALYSIS

In highway projects, one resource is usually assigned to each action and is referred to as the dynamic resource. The productivity of the entire project is determined by the performance of the equipment, and the ultimate output becomes the resource's output. This section includes result analysis for production (Theoretical output, Effective production / Practical output & Net Production) & cost of five equipments like Hydraulic Excavator (Backhoe Loader), RMC Plant, HMP, Bitumen Paver & Tandem Road Roller for the month of October 2020- May 2021.

Performance of Hydraulic Excavator (Backhoe Loader) Productivity

The excavator's productivity is crucial since it is the dynamic equipment in utmost soil and granular layers where finishing is essential. The NH-6 project's data has been evaluated, and its productivity and cost have been assessed.

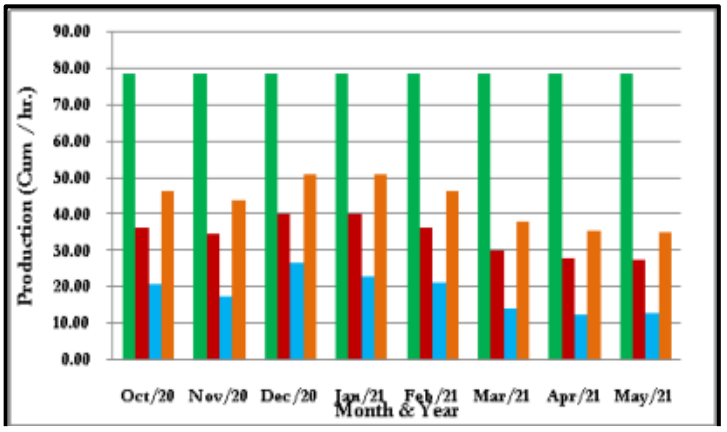

Fig 1. Performance of Excavator

The theoretical Output for Hydraulic Excavator is 78.75 m3/hr. From October 2020 to May 2021, the net production rates of one excavator range from 12.52 m3/hr. to 26.71 m3/hr., whereas from March to May 2021, the excavator performs below the drift of the entire set.

The range of effective production (Prod. Qty. /actual working hours) of the excavator is found to be 40.28 m3/hr. with a standard deviation of 27.78 m3/hr. The efficiency of excavators (Effective Production/Theoretical Production) x 100 ranges from 35.28 % to 51.15 %. Excavator utilization ranges from 44.71 % to 68.17 % (Actual Working Hours / Planned Available Hours) × 100. Variability in job conditions, type of soil, soil conditions, climate situation, and vary in the nature of the task can all be responsible for the fluctuation in production rate.

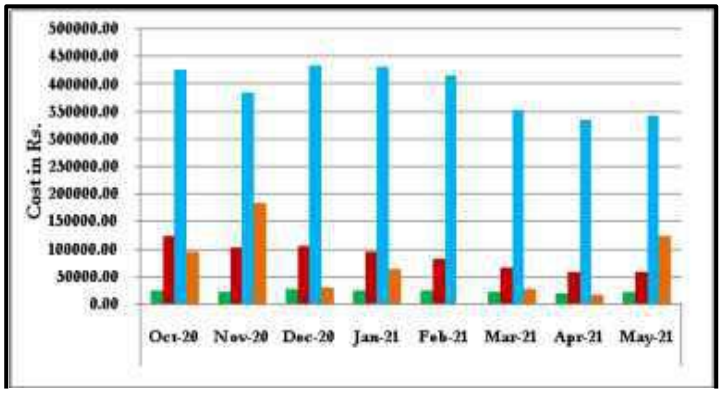

Fig 2. Cost Components of Excavator

The key components of the cost of performance for four excavators at the NH-6 project are operating costs, which range from Rs.3,35,704.17 to Rs. 4,34,098.20/- and an average of Rs.3,90,663.18/- for continuous excavation activity.

With an average of Rs.85,934.56/- and a range of Rs.81,601.11/- to Rs.1,24,128.16/-, the backhoe loader is the second biggest contributor to cost of performance.

Other costs include landing charges, which range from Rs. 19,216.24/- to Rs. 24,939.79/-, with an average of Rs.22390.54/-, and maintenance costs, which range from Rs.16,520.55/- to Rs. 1,82,009.00/-, with an average of Rs.66318.38/-

Performance of Ready Mix Concrete Plant

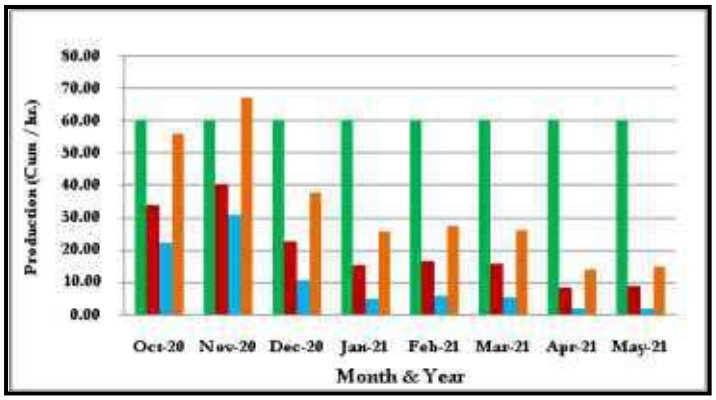

Fig 3. Performance of RMC Plant

The theoretical Output for RMC Plant is 60 m3/hr. The net production rates of RMC plant is vary from 1.80 m3/hr. to 30.85 m3/hr from a period of October 2020- May 2021 while from month January 2021 performs of RMC plant relatively below the drift of the whole set.

The range of effective production of the RMC plant is found to be 40.30 m3/hr. with a standard deviation of 8.30 m3/hr. The efficiency of RMC plant is ranging from 13.83 % to 67.17 %. The utilization range of RMC plant (Actual Working Hours / Planned Available Hours) x 100 is vary from 20.58 % to 76.54 %. Variability in job circumstances, maintenance, weather conditions, and the nature of the task can all contribute to the fluctuation in output rate.

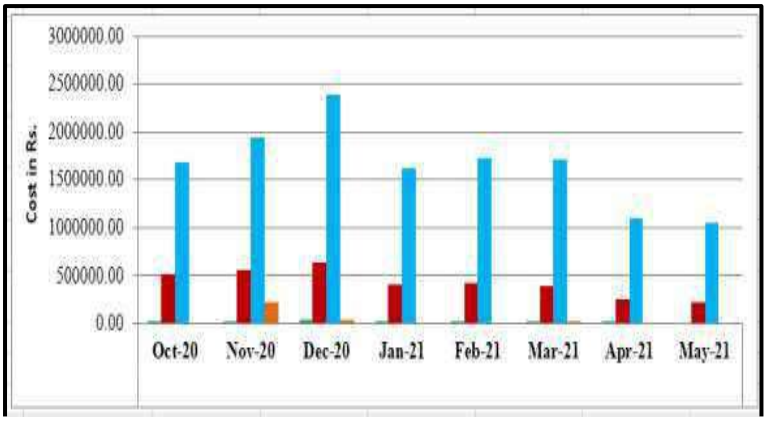

Fig 4. Cost Components of RMC Plant

From the cost components data of RMC Plant at NH-6 project, the larger components of the cost is operating cost with the range of Rs. 10,44,170.43/- to Rs. 23,90,857.53/- & average of Rs. 16,52,225.57/- as the continuous work of RMC Plant. The ownership cost of the RMC Plant is the next key contribution of cost components with an average of Rs. 4,25,938.34/- with a range from Rs. 2,29,306.72/- to Rs. 6,35,773.40/-. The other costs include landed cost is vary from Rs. 15,268.26 /- to Rs. 34,960.05/- & average of Rs.24,150.97/- and maintenance cost is

ranging from Rs. 1750.00/- to Rs. 2,19,261/- with average cost of Rs. 35,998.26/-. The major variation is observed in costs from March 2021- May 2021.

Performance of Bitumen Paver

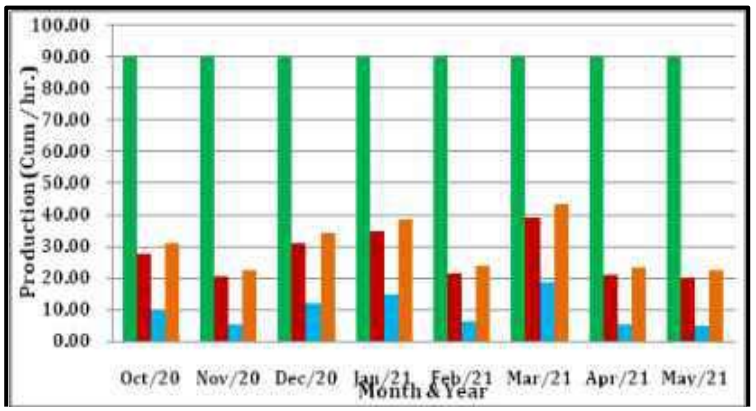

Fig 5. Performance of Bitumen Paver

The theoretical Output for Bitumen Paver is 90 m3/hr. From October 2020 to May 2021, the net production rates of Bitumen Paver range from 4.98 m3/hr. to 18.65 m3/hr.

The Bitumen Paver's effective production range is 38.86 m3/hr., with a standard divergence of 20.09 m3/hr. Bitumen Paver's efficiency ranges from 22.33 % to 43.18 %. Bitumen Paver's utilization ranges from 24.81 % to 47.98 %. Variability in job conditions, paving specifications, maintenance, weather, and the nature of the task can all be responsible for the fluctuation in production rate.

It is a well-known truth that the various stages of a roadway project are extremely interdependent. As we can see from the above section of the report, the excavator's performance has deteriorated, and it was already below average, which worked as a barrier to the next stage of the bitumen paver not working on a larger scale (range).

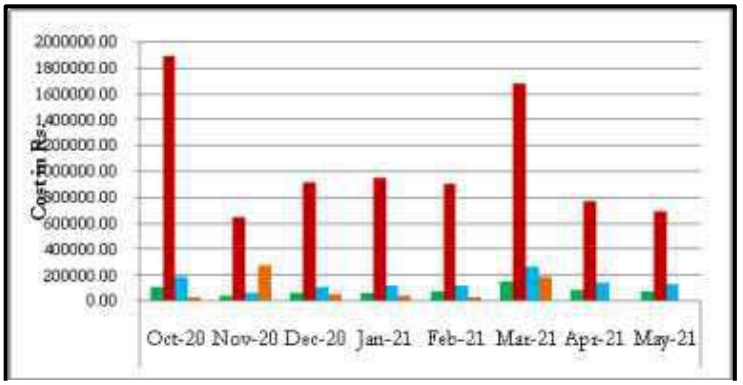

Fig 6. Cost Components of Bitumen Paver

The major parts of the cost of performance for two Bitumen Pavers at the NH-6 project include ownership costs, which range from Rs. 7,73,453.77/- to Rs. 18,84,382.23/-, with an average of Rs.10,56,539.39/- as the continuous work of Bitumen Paver. The Bitumen Paver's operating cost is the next largest contributor to cost of performance, with an average of Rs.1,45,749.64/- and a range of Rs. 70,163.89/- to Rs. 2,68,360.05/-. Other costs include landed charges, which range from Rs.42,027.40/- to Rs. 161320.55/- and average Rs.87449.32/-, and maintenance costs, which range from Rs.5370.00 to Rs.2,78,000.00 and average Rs.77,388.97/-. The major variation is observed in costs from March 2021- May 2021.

Performance of Hot Mix Plant

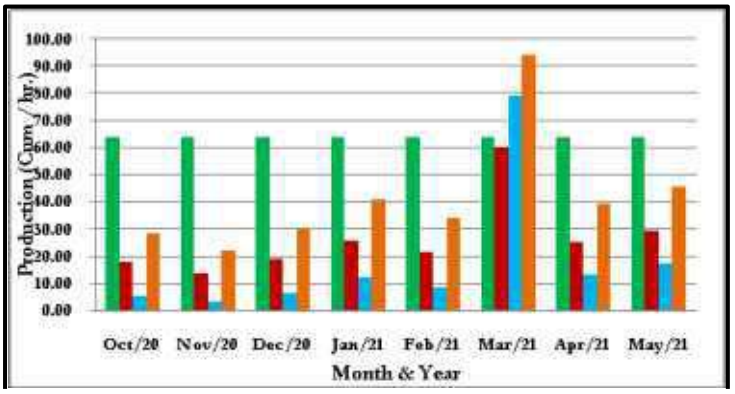

Fig 7. Performance of HMP

The theoretical Output for HMP is 64 m3/hr. From October 2020 to May 2021, the net production rates of HMP range from 3.77 m3/hr. to 78.98 m3/hr. HMP works on paver's demand, and paver's particular lower effective production produced a significant drop in the period from October 2020 to February 2021.

The range of effective production of the HMP is found to be 60.40 m3/hr. with a standard divergence of 14.20 m3/hr. The efficiency of HMP of the HMP is ranging from 22.19 % to 94.38 %. The utilization range of HMP is vary from 26.54 % to 130.77 %. Fluctuation in job conditions, presence of moisture, maintenance, climate situation, and Vary in the nature of the job can all be responsible for the variation in output rate.

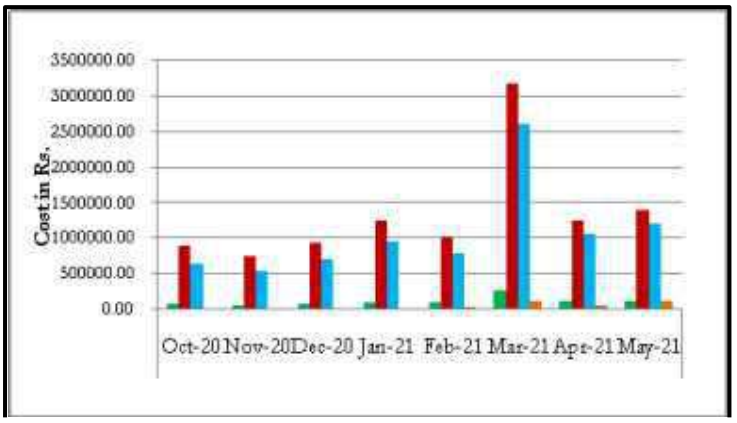

Fig 8. Cost Components of HMP

According to HMP's cost of performance data for the NH-6 project, the major parts of the cost of performance include ownership costs, which range from Rs. 7,37,503.52/- to Rs. 31,77,533.57/-, with an average of Rs.13,30,191.18/-.

The HMP's operating costs are the next largest contributor to cost of performance, averaging Rs.10,58,994.56/- with a range of Rs.532641.67/- to Rs.2622204.30/-. Other costs include landed costs, which range from Rs. 50500.23/- to Rs. 248841.70/-, with an average of Rs.1,00,451.54/-; and maintenance costs, which range from Rs.0.00/- to Rs.1,12,265.00/-, with an average of Rs.39,488.50/-. Costs show the most variance between March and May 2021.

Performance of Tandem Roller

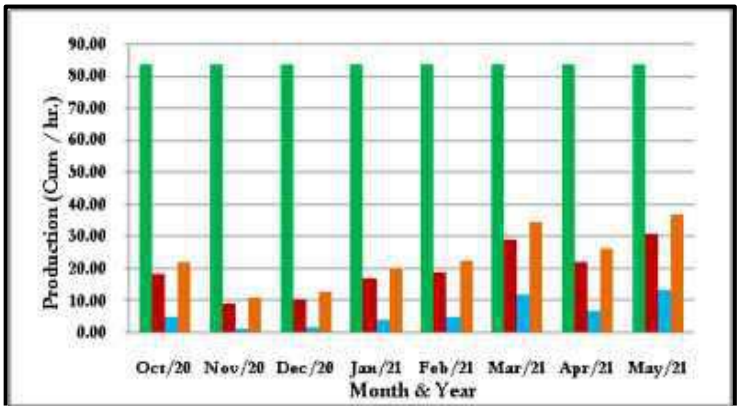

Fig 9. Performance of Tandem Roller

The theoretical Output for Tandem Roller is 83.33 m3/hr. From October 2020 to May 2021, Tandem Roller's net output rates range from 1.21 m3/hr. to 13.58 m3/hr. By bringing it close to completion, the roller applies the last layer of work. Due to a lag in previous activities, two of the three rollers were inactive for an extended length of time, necessitating repair.

With a typical deviation of 9.17 cum/hr. the Tandem Roller's effective production range is found to be 30.71 m3/hr. The Tandem Roller's efficiency ranges from 11.00 percent to 36.86 percent. Tandem Roller's utilization rate ranges from 13.20 percent to 44.23 percent. Variability in task circumstances, wetness, lift thickness, number of roller passes, maintenance, weather, and the type of the project all contribute to the fluctuation in production rate.

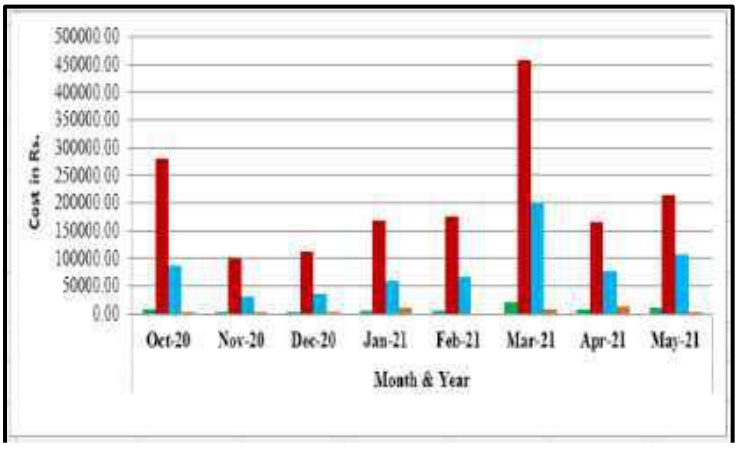

Fig 10. Cost Components of Tandem Roller

The major parts of the cost of performance for three Tandem Roller at the NH-6 project are ownership cost, which ranges from Rs. 1,00,158.29/- to Rs. 4,57,924.27 /- and an average of Rs.2,09,249.71 /- as the continuous work of Tandem Roller. The Tandem Roller's operating cost is the next largest contributor to cost of performance, at Rs. 83782.77/- on average, with a range of Rs. 32235.19/- to Rs. 202455.20/-. Other costs include landed charges, which range from Rs. 3293.10/- to Rs. 20,781.67/-, with an average of Rs. 8580.43/-, and maintenance costs, which range from Rs. 0.00/- to Rs. 13600.00/-, with an average of Rs. 5002.25/-. Costs show the most variance between March and May 2021.

CONCLUSIONS

The equipment seen on highway project sites is usually divided into two categories: driving and non-driving.

1. The average effective production rates of the hydraulic excavator (Backhoe Loader) equipment is found to be nearly 30.92 m3/hr. which is less than theoretical production 78.75 m3/hr.

2. The average effective production rate of the RMC Plant & Hot Mix Plant at project site is got to be nearby 14.93 m3/hr. & 21.41 m3/hr. as the capacity of plant is 60 m3/hr. & 64 m3/hr.
3. Similarly, the average effective production rate of the Bitumen Paver & Tandem Roller in a project site is calculated to be nearby 49.85 m3/hr. & 46.67 m3/hr. as the theoretical production is 90 m3/hr. & 83.33 m3/hr.
4. When evaluating the availability and usefulness elements of the equipment, the gap in performance becomes apparent. The use of the equipments, on average, is quite low, ranging from (25-55%) percent, showing that the equipments are not acting in accordance and maintained inside the site.
5. The impact of Covid 19 on the construction industry has been ongoing, causing delays in scheduled activities and a lack of manpower, with a clear reflection in October 2020-May 2021. As a result, equipment performance has been below averaged for the same time period.
6. The total cost of the equipments is mostly proportional to the landed cost, ownership cost, operating cost & maintenance cost having more variation due to working hours, as the second wave the of Covid 19 came and the worst is we were not prepared for it by any means hoping for it not to come. In fact, second wave proved more dangerous and had quite higher influence of increase in Covid patients in urban areas as compared to its impact in first wave in metro cities and urban areas. So, it takes the largest part (50-60) % of the total costs.

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Impact Of ICT On Enhancing Knowledge Sharing And Dissemination: A Case Study Of Famers In Coastal Andhra Region

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Abstract: The Research is undertaken among farmers in various regions of Coastal Andhra the study is formulated to analyse perceptions and opinions of farmers on effectiveness of knowledge sharing and dissemination. By this research the researcher made a attempt to assess and evaluate impact of ICT on enhancing knowledge sharing and dissemination among famers in coastal Andhra. The results are elicited by conducting survey among farmers in different regions of coastal Andhra. The survey was executed by selecting farmers purposefully among various regions in Coastal Andhra. For critical investigation on variables associated with research problem three categories are undertaken i.e. knowledge on crop management, competencies on irrigation technologies and Knowledge on applying agriculture information. The study results are extracted by analysing and evaluating perceptions of farmers on developing mechanism for enhancing knowledge sharing and dissemination.
Keywords: Knowledge sharing, knowledge dissemination, Farming technologies, Crop management, Irrigation technologies, Agriculture information, ICT.

INTRODUCTION

Technological advancement has been the critical driving force for enhancing agricultural productivity and promoting agriculture development in all developing countries. Agro knowledge resource has wider impact on increasing agriculture production and productivity. Farmer education, learning, knowledge enhancement and training have strong impact on choice and adoption of advance agro technologies. Effective knowledge sharing and dissemination is required for enhancing agricultural competencies for farmers in usage and application of farming technologies. The critical issues in knowledge sharing like sources of knowledge acquisition, knowledge sharing methods and channels of dissemination have wider application in learning and developing agriculture technologies [1].

In Andhra Pradesh, coastal regions are having significant importance in commercial crops. There are many evidences that most of the farmers are facing agriculture problems due to lack of effective knowledge sharing practices and integrating to agriculture technologies. Even though government departments are initiating many interventions for filling knowledge gap in agriculture sector but results are not reaching to the farmers. In most of the cases farmers are unable to develop and integrate to sustainable agriculture and cultivation technologies which are very essential for improving domestic and international agriculture quality standards. In this context the present study focuses on evaluating the farmer's perception on effectiveness of knowledge sharing and dissemination practices for enhancing agriculture knowledge among farmers [2].

RESEARCH PROBLEM

An extensive investigation of the literature provides numerous studies on the topic of knowledge sharing and dissemination. However, very few studies are identified by relating to evaluate impact of ICT on enhancing knowledge sharing practices. Even though some of the researcher made an attempt in correlating ICT and knowledge sharing for enhancing effectiveness of agriculture knowledge but results are not adding any value to farmer community in Coastal Andhra. In this context present study will support farmer community by providing inputs for integrating ICT and knowledge sharing and dissemination for enhancing quality of agriculture knowledge.

NATURE AND SCOPE OF THE STUDY

The nature of the study is descriptive as the study focused on finding perceptions of farmers on significance of ICT in enhancing quality of knowledge sharing practices in developing effective agriculture knowledge. The study was undertaken by investigating variables like knowledge on crop management, Expertise on usage of knowledge sharing technologies and Knowledge dissemination. The study is executed by considering the opinions of farmers from various regions of Coastal Andhra.

OBJECTIVES OF THE STUDY

1. To analyze the impact of ICT on effectiveness of knowledge sharing and dissemination practices for enhancing quality of agriculture knowledge base.
2. To evaluate the perceptual differences among the farmers from various regions of Coastal Andhra on effective knowledge sharing practices.
3. To offer feasible recommendation for improving effectiveness of knowledge sharing and dissemination practices.

RESEARCH METHODOLOGY

A brief outline of the methodology for the study is given below:

Data Sources

Data sources are primary and secondary. Data relating to opinions and perceptions of farmer are pooled by using primary data and primary data is collected by structured questionnaire method.

Sample design

Sampling

For the present study, purposeful sampling technique is adopted for selecting the respondents from the various regions of Rayalaseema. The respondents comprise the farmers of Krishnna, Guntur and East Godavari regions of Andhra Pradesh.

DATA ANALYSIS AND INTERPRETATION

Validity and Reliability Test

Table 1 Exploratory Factor Analysis of Krishnna Region Farmers

Factors	Knowledge on crop Management	Expertise on usage of knowledge sharing technologies	Application of knowledge dissemination channels
Advantages and benefits of mixed cropping	7.45	-11.09	7.58
Knowledge on crop rotations	6.01	-1.887	82
Irrigation Technologies	5.39	82.7	-0.60
Application of new Agriculture software	-0.48	-0.16	-2.0

Application of ICT	-0.15	-3.149	-3.5

Interpretation

In case of Knowledge on crop Management farmer knowledge on Advantages and benefits of mixed cropping has maximum correlative value; in case of Expertise on usage of knowledge sharing technologies knowledge on irrigation technologies has highest correlative value. The items mentioned in above table are having strong correlation value and these factors can be considered.

Table 2 Exploratory Factor Analysis of Guntur Region Farmers

Factors	Knowledge on crop Management	Expertise on usage of knowledge sharing technologies	Application of knowledge dissemination channels
Advantages and benefits of mixed cropping	-4.19	-11.29	69.58
Knowledge on crop rotations	-8.48	-0.8	84
Irrigation Technologies	-0.72	86.74	-0.49
Application of new Agriculture software	81.68	-0.10	-1.94
Application of ICT	-10.37	-3.10	-3.46

Interpretation

In case of Knowledge on crop Management Application of new Agriculture software is having higher correlative value. In Expertise on usage of knowledge sharing technologies Irrigation Technologies is having highest correlated value and in case of Application of knowledge dissemination channels Knowledge on crop rotations is having highest correlated value. The items mentioned in above table are having strong correlation value and these factors can be considered.

Table 3 Exploratory Factor Analysis of Godavari Region Farmers

Factors	Knowledge on crop Management	Expertise on usage of knowledge sharing technologies	Application of knowledge dissemination channels
Advantages and benefits of mixed cropping	-3.11	-11.29	49.44
Knowledge on crop rotations	-7.48	-0.2	82
Irrigation Technologies	-0.82	87.4	-0.39
Application of new Agriculture software	85.68	-0.09	-0.84
Application of ICT	-11.37	-2.11	-2.56

Interpretation

In case of Knowledge on crop Application of new Agriculture software is having higher correlative value. In case of Expertise on usage of knowledge sharing technologies, irrigation technologies are having highest correlated value and in case of Application of knowledge dissemination Knowledge on crop rotations channels is having highest correlated value. The items mentioned in above table are having strong correlation value and these factors can be considered.

Table 4 Cronbach's Alpha Results for Farmer Perceptions of Coastal Andhra Region

Farmer views on variables relating to knowledge sharing and dissemination practices	Guntur Region	Krishnna Region	East Godavari
Advantages and benefits of mixed cropping	0.92	0.82	0.83
Knowledge on crop rotations	0.83	0.84	0.90
Irrigation Technologies	0.80	0.81	0.78
Application of new Agriculture software	0.91	0.92	0.93
Application of ICT	0.87	0.89	0.83

Interpretation

Cronbach's Alpha values are compared among various variables relating to knowledge sharing and dissemination practices. In case of farmers from Guntur region Advantages and benefits of mixed cropping has highest Cronbach's value and in case of farmers from Krishnna region Application of new Agriculture software has highest Cronbach's value. The value for all the variables mentioned above is having more than 0.6 hence the variables considered for study are reliable.

Table 5 Mean values of Farmers perception on Knowledge on crop Management

Farmer Perceptions on Knowledge on Crop Management		
Geographical Region	**N**	**Mean Squares**
Krishnna Region	100	3.41
Guntur Region	100	1.82
East Godavari Region	123	1.64

Interpretation

By undertaking opinions of farmers from Krishna, Guntur and east Godavari regions on knowledge on crop management it is revealed that respondents of Krishna region are having highest mean value. From this it can be conclude that farmers from Krishnna region are having strong perceptual difference on knowledge on crop management.

FINDINGS

1. The factors undertaken in study for analysis are having acceptable reliability and validity. (i.e: knowledge on crop management, Expertise on usage of knowledge sharing technologies, Application of knowledge dissemination channels)
2. Strong perceptual difference is identified among farmers from Krishnna region on knowledge crop management.
3. Results of study reveal that there are significant differences in the opinions of farmers on expertise of irrigation technologies.
4. The study reveals that there are significant differences in the views of farmers on application on ICT are noticed.

SUGGESTIONS

1. Even though government and NGO are initiating new knowledge sharing practices among farmers to acquire knowledge on integrating to agriculture knowledge sources.
2. Most of the farmers are not able to reach international agriculture standards in this connection agriculture departments need initiate mechanism for adopting knowledge sharing practices.
3. 3) Technological advancements and developments in agriculture are having vital significance in enhancing quality of agriculture in this connection government should take initiative for integrating ICT and knowledge sharing and dissemination practices.

CONCLUSION

The results of study extracted by pooling and analysing perceptive of farmers in three regions of Coastal Andhra Region on knowledge sharing practices. The study reveals that most of the farmers are not initiating mechanism for integrating knowledge management ecosystem to technological developments in agriculture. Even though state and central governments are focusing on agriculture sector by initiating research and development in agriculture technology but at the ground level these results are not contributing expected value to agriculture. The respondents are having positive approach for application of knowledge sharing and dissemination practices but farmer are not well trained and educated in using technologies relating to agriculture. In this context it is necessary for the government and NGOs to initiate training interventions for adopting and integrating knowledge sharing practices for enhancement of agriculture knowledge.

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Integration Of Lean And Value Management In Construction Projects

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ABSTRACT. Environmental Protection Agency (EPA) estimates that 150 million tonnes of construction waste is produced each year. As per Bigrentz article, 2021 it is expected that 2.2 billion tonnes of construction and demolition waste will be generated globally by 2025. Also, India has generated construction and demolition waste of 150 million tonnes in 2020. According to these statistics, it can be found that waste generated during construction processes is a crucial factor, which imparts time and cost overrun in construction projects. Many construction industries are finding innovative ways to reduce their waste contribution. The principles application of lean construction and value engineering are aimed at minimizing waste generation and maximizing value in construction process. Lot of research has been conducted related to introducing concept of lean construction and value engineering separately in projects. However only limited research has been done related to integration of lean construction and value engineering application of construction projects. Extensive research review has been made on lean construction and value engineering principles and their summary are presented in this paper along with case study works.
Keywords: Lean construction, Value management.

INTRODUCTION

Construction industry is one of India's fundamental and vital businesses. The construction industry is an essential and basic requirement for all in the infrastructure sector. However, it is challenged with many issues. Lots of techniques have been introduced to resolve time and cost escalation in projects.

LEAN CONSTRUCTION

The construction industry must increase their performance in order to thrive in today's competitive business. With ever-increasing client demand, projects are rarely completed on schedule or under budget these days, posing considerable problems for construction companies. Several ways have lately arisen to address these difficulties, with Lean Construction being one of them. Lean is a method of managing construction project that aims at **eliminating waste and creating value** for the end users. Lean construction technology ensures that a project is quickly done, with lower cost during the building process, and also reduces waste. The traditional approach focuses on efficiency rather than value, but lean construction focuses on minimizing waste and maximizing value.

Lean principles

- Specific value, (Find value that defines the customer's need for a specified product).
- Identify and map the value stream, (separate value & non-value activities).
- Flows, (remove non-value activities that make the flow).
- Pull, (limit inventory & work in progress).
- Perfection. (Continue improvement).

Lean eliminates wastes

- Overproduction:

Over production is producing more than needed. It is very difficult because it appears in the project all types of waste appear.

- Inventory:
  Inventory waste occurs when over production results & on-site storing material, unused material or equipment are inventory wastes.
- Motion:
  Motion is defined as movement of labor or material. This includes lifting, moving, stretching
- Defects:
  Defects are incorrect work, they required to be replaced or repaired.
- Over-processing:
  Over processing is unnecessary work that adds more non-value added to a project
- Waiting time:
  Waiting waste is sitting that is idle.
- Transportation:
  Transportation waste includes movement of people, inventory, and equipment other than necessary.

Figure.1 represents waste elimination from lean construction. These types of wastes are eliminated by implementing lean in construction sites.

Fig 1.Lean eliminates wastes

Value Management

Value management is a technique that aims to appreciate the importance of value for finance spent by providing required functions at the minimum cost without compromising the levels of quality and performance. Value Management (VM) is a professional plan that evaluates whether a facility can produce the best functionality at the minimum cost. Value management is a team approach used to outline the customer's objectives and guarantee best value, to merge all stakeholders' views, and achieve greatest balance between fulfilled needs and resources. The three types of processes that can be included in a value programmed are as follows:

Value Engineering: Details a value study on a project that is being developed. It also examines the cost of the project as it is being planned.

Value Analysis: Defines a value study of a project that is already built and investigates the product to see if it can be enhanced

Value management: Finds the methodology used in value work of a project

AIM AND OBJECTIVE OF THE STUDY

This study aims to investigate the factors influencing lean and value management in construction projects. Thereby enhance the performance of projects related to time and cost.

Objectives of this study are:

- To identify and study factors influencing waste reduction in projects
- To identify value and non-value-added tasks throughout the life cycle of construction projects
- To apply processes enabling customer satisfaction of products with cost effective and timely delivery by increasing value and waste reduction.

NEED FOR THIS PROJECT

Often construction industry is affected by cost and time overruns. Hence, there is huge price escalation, delays in planning activity and lack of co-ordination. Also, it is estimated that around 150 million tonnes of construction waste is being produced each year. This would endanger living organisms and the environment. This challenge can be overcome by incorporating lean principles in construction processes.

The ultimate goal of lean construction is increasing value, similar to value engineering which aims at value enhancement throughout the entire life cycle of the construction processes.

Lean and value engineering principles can be introduced into construction projects to rectify issues and complete project successfully, thereby reducing cost, time delays and saving useful resources in projects.

Through literature review the following advantages are evident when lean is integrated into projects:

- Overall cost reductions by 22% to 33 % is achievable.
- Optimization on manpower, skills, and training is possible.
- Reduced on-site labor activities by 30 % is achievable.
- Improved project schedule is attainable.
- Parallel production activities are well manageable.

LEAN INTEGRATED VALUE ENGINEERING FRAMEWORK

Integration of lean construction and value engineering consists of eight stages as per Ekanayake, Senanayake [32]. They are:

- Value initiation stage (Specifying customer's value, project scope and perfection)
- Value establishment stage (Establishing project scope and customer needs to accomplish customer's value and perfection)
- Value functional analysis stage (Enhancing customer pulled functional wants using value stream mapping)
- Value creativity phase (Proposing original ideas to improve value flow in order to minimize non-value accumulation tasks)
- Value evaluation phase (Evaluate original ideas for flow enhancement and select best operative ideas)
- Value development phase (Create value flow development proposals with execution plans)
- Value verification phase (Present findings of customer's value, value stream mapping, original ideas to improve value flow, client pulled functional requirements and expected precision and get confirmed from the customer)
- Value achievement phase (Pull new functional requirements and all resources at the precise time in precise quantity and quality, while attaining precision through constant enhancement)

LITERATURE REVIEW

Lean Construction

Lean construction is also called a panacea for weekly construction [11]. Lean construction is an improvement on traditional construction. Traditional construction focuses only on efficiency than value. However, lean construction focuses on waste minimization and value maximization. Lean construction tools use value creation, perfect planning, waste reduction, and managing the site [34]. **According to** Enas Saad et al[4]**,** the lean manufacturing technique originated in the manufacturing industry. The first level aims at directly applying the lean techniques; the

second level aims at the modification of lean techniques and that of the third level aims to create new lean construction techniques.

Following are lean construction principles: value, value stream, flow, pull, perfection, or continuous improvement. Value identifies goals of project incorporating customer's requirement. Value Stream distinguishes between value-added and non-value-added activities in a project. The third principle of flow intents to remove non-value-added activities and make a perfect flow using value-added activities in a project. The next principle pull, has the purpose to limit inventory that would improve the work flow. The final principle is continuous improvement aims at constant improvement leading to perfection of processes [4,5, 6, 13, 15, 16, 30,32, 37,38, 39].

Transportation, inventory, motion, waiting, over processing, overproduction, and defects can be eliminated by lean [5,6, 21, 30,38, 39]. The application of lean construction tools on the construction site is greatly beneficial since it supports in planning, organizing, visualizing, and error-proofing activities. The benefits of implementing lean construction tools are reducing time and cost overruns, improving schedules, reducing material, productivity wastes, reducing defects [4,5, 16,30,37, 38 and 39] thereby promoting safety in projects [35,37].

The critical success factors were found due to the lean implementation in the construction project. They were divided into four categories namely 1. Managerial, 2. Structural, 3. Organizational and 4. External [1]. A lean tool of the last planner system was discussed. It increases the good relationship among workers, reducing accidents with its safety increase. Lean construction's key performance indicators were namely waste, value, quality, speed, and cost. The lean supply chain was created to demonstrate the relationship between the supplier and the client. This proposed strategy was for value increase, work flow increase, and waste minimization [29]. Waste material is a critical problem in the construction industry. It leads to a cost overrun. Waste material accumulates for a variety of reasons, including poor management, design changes, natural and environmental factors. The smart PLS technique discussed uses data analysis. The model simulates the effect of lean construction and waste material reduction on project cost performance. By increasing the control on waste material and implementing lean construction, the cost performance was found to improve [20].

Identification barriers

Bangladesh's construction industry has identified barriers in the implementation of lean construction. The four challenges acknowledged were sub-divided into three categories. There were three levels of ranking: the highest, middle, and lowest. High-level barriers include a reluctance to switch from traditional to lean construction and management, lacking execution. The middle-level barriers are technical and technological barriers, a lack of teamwork, and government support. The lowest level barriers are unclear client's goals, delay in planning [13]. The lean construction barriers were identified through literature review and a questionnaire survey. Thirty such barriers were identified [7].

The barriers such as the breakdown of equipment, lacking of skilled labor, defects in work, and using substandard quality materials can have great impact on successful completion of projects. Hence identification of barriers is also crucial for success of projects. The causes of barriers and control measures were also discussed [9]. According to Zhilli Gao[10]; the hurdles were identified and split into three population types within the construction sector based on their acquaintance with and implementation degree of Lean Construction (LC). As a result, there were fifty-eight barriers to adopting LC and sixty-nine ways for overcoming them.

Case Studies of implementing lean in construction projects

A South African construction industry adopted lean techniques and were able to reduce the physical resources explicitly material, man power, machinery, money and space in their projects [28]. Reduction of cost, eco-friendliness to the environment, improved quality, productivity increase, profitability and market advantages, benefits of time and work flow, increased waste reduction are the benefits of using lean in construction [15]. Richard Hannis Ansah [39] used the construction management techniques namely the critical path method, work break down structure in projects. However, wastes were generated. Integration of lean construction tools namely 5s, total quality management, value stream mapping, standard work were applied in projects. Lean construction eliminated waste, and the project's planning and scheduling have been successfully adhered to. The value flow map was combined with the standard work and overall quality management, making the project more efficient. The continuous improvement tool was integrated with the value stream map, allowing the work to progress and improve [4]. Mohamed Saad Bajjou [21]; conducted a case study on a reinforcement process using a discrete event simulation process. The primary and secondary data were collected and discovered to have a correlation. Based on the fit-quality tests, the optimum probability density functions for each activity time were identified. Following the validation of the real-world model, an ARENA-based lean simulation model was created to study the impact of lean

construction principles on the performance of such processes. As a result, a 41% increase in the productivity process, a 14% rise in efficiency improvement, and a 17% reduction in cycle time were achieved [21].

Value Engineering

Value engineering is a function-oriented approach. Value engineering is the ratio of function to cost. Value can be increased by any of the following methods [41].

- increasing function with constant cost;
- constant function with reducing cost;
- increasing function with cost decreasing;
- increasing function with cost increasing;
- decreasing function and cost decreasing;

The value engineering job plan can be explained in each phase they are [40].

1. Information phase
2. Function analysis
3. Creativity phase
4. Evaluation phase
5. Development phase
6. Presentation phase
7. Implementation phase

Value engineering (VE) is mainly used for reducing costs and improving project performance. VE has many tools namely: FAST diagrams, function analysis, function-cost analysis, BIM based idea banks, and group decision support systems [8]. Implementation of VE leads serves the following benefits; namely: time and cost overrun, quality improvement [3, 5, 18,22,26,27, 40, 32, 33].

Arivazhagan [31] applied VE procedure in the early stages of a project in the design phase to benefit the maximum. A questionnaire survey was conducted. It was found that about 80% of them knew VE and the remaining 20% only followed VE in their projects. It was concluded that by implementation VE in projects 20 to 25% reduction in costs can be possible.

The complexity of construction projects was identified to be due to social, environmental, and economic factors. Such conditions, can lead to risk with cost and time overruns, as well as material waste in projects. By adopting VE technique optimum usage of resources, materials, and money [19] is achievable.

Barriers to value management were identified [22] as stakeholder's non - awareness on VE, standardization of processes, culture and environment, and workshop dynamics. VE methodology was compared to present project management techniques for getting profit maximization and saving resources. The design matrix technique was used to standardize material choices to yields the intended outcome [3]. Hence VE is considered a technique for lowering costs without sacrificing quality.

Case Studies of implementing VE in construction projects

In a Malaysian main electric distribution station, VE was required to be implemented. By implementing value engineering in the creative phases, large numbers of ideas were generated. From those ideas best three should were selected and implemented. In the first idea, the room size was reduced in the building and therefore the cost reduced by 17.1%. The second idea was to replace plaster painting by normal painting thereby reducing the total cost of ceiling painting by 69.8%. The third idea was the reduce the height of painting from 1.5 m to 1m in walls, which hence reduced the total cost of painting by 41.6%[17].

The second case study was implementing value engineering in an infrastructure project. A value engineering job plan has been followed. The fast technique was used. Multiple ideas were created and finally the best alternative was selected. [33].

Another case study was that of an on-going educational building. By implementing value management resulted in 7% reduction in overall cost. The advantages of value management are reduction in cost and time overruns, and improved quality. The value management methodology can be applied for all buildings [18].

VE was applied to the project in Maspero Underground Station, Line three, and Phase three study. BIM was used for visualization. The original design was revised incorporating VE concept. It was found that there was a reduction in cost due to implementation of revised design however; the time of the project remained the same [24].

INTEGRATING LEAN CONSTRUCTION AND VALUE ENGINEERING

Gokhan Demirdogen [25] ,have developed a framework for integrating Lean, VE, BIM and Big Data for successful completion of projects into four parts. In lean construction, Level 0 was carried out by traditional approach, which was followed by Level 1 carried out by Lean construction approach. The author has identified that by applying lean construction in projects greater benefits can be obtained, however, it is posing lots of challenges. The challenges can be overcome by integrating VE as a part of the lean process. This was referred to as level 2. Lean construction, VE, and BIM are all part of Level 3. This level also includes demolition in addition to construction. Lean construction, VE, BIM and Big Data are all part of Level 4. The Big Data from this level enables to analyze the data sources and creates Value-oriented solutions [25]. By adopting Lean integrating value engineering (LIVE) approach, eight phases were identified [32]. They are:

1. Value initiation,
2. Value establishment,
3. Value functional analysis,
4. Value creativity,
5. Value evaluation,
6. Value development,
7. Value verification, and
8. Value achievement.

Continuous improvement methodology evaluation is a hybrid methodology combining lean and value engineering techniques. Interchangeable use, concurrent use, and interdependent usage are all part of the framework design [12]. The focus of lean construction is on reduced cost and timeliness. Quality and cost are priorities for value management. A survey was carried out using a questionnaire. Waste generation in project was eliminated by the lean construction method. Cost-cutting by value management [5] was done.

Both lean construction and value management have been demonstrated to be beneficial on their own, but they are even more so when used together [36]. Each project can be finished on schedule and on budget due to the effectiveness of lean construction and value engineering implemented by selecting an activity according to Pareto's principle. Identification and reduction of waste can be achieved by lean construction. Cost and time savings can be carried out by Value engineering. As a result, productivity was found to increase, waste was reduced and cost was saved [14].

Cost and time overruns are still a serious issue. The five main parameters that can be considered for reducing cost and time overruns in projects are:

1. Suitable working methods.
2. Increased worker productivity.
3. Alternative Material Selection.
4. Material waste reduction.
5. Integration of BIM technology, VE and Lean Construction [2].

CRITICAL REVIEW

Manufacturing industry originated lean technique. The construction industry has some modification of lean techniques. The lean construction has five principles, namely: Value, Value Stream, Flow, Pull, and Perfection. The lean principles make the project successful without time and cost overruns. Lean construction has many lean tools that can be effectively used in construction. Some important lean tools are: Value Stream Mapping, Last Planner System, 5S, Visual Management, Error Proofing, Just In Time, etc. The lean tools also include some automation for error proofing such as I-site, QR code in industrial projects. The main purpose of lean construction is reduction in manpower, materials, machinery, money, and space. Lean construction reduces wastes in processes such as transportation, inventory, motion, overproduction, over processing, waiting and defects.

Value engineering is a team-based approach and is used to define client's objectives. It is a set of planning tools and procedures for determining the best balance of project benefits versus project costs and risks. The value is increased without increasing the cost.

Value engineering and cost reduction have separate processes. Value engineering is a function-oriented approach. But, cost reduction is production-oriented. However, the implementation of value engineering mainly reduces cost and time. A value engineering job plan has seven phases, namely Information phase, Function analysis phase, creativity phase, Evaluation phase, Development phase, presentation phase, and Implementation phase. The Indian construction industry also includes the audit phase as the last VE phase, which is divided into two categories:

operational and financial. The operational audit phase ensures the implementation of value engineering change proposal. By the financial audit both profit and loss can be calculated in projects.

The implementation of lean construction in projects has many greater benefits, however there is limited guarantee that the value will definitely increase. Also, the lean construction methodology is difficult to implement. So, the value engineering is integrated into the lean construction, to reap the benefits of both the techniques. The benefits that can be reaped are minimization of waste, increase in value, schedule improvement, proper planning, reduction of project time and cost.

SUMMARY AND CONCLUSION

The construction industry is well developed, however there are still numerous concerns to be resolved. Overproduction, inventory, motion, errors, over processing, waiting, and transportation waste are few issues related to construction processes. LC is a technique that can be used to reduce these challenges. Similarly, VE can be used to enhance performance of projects. Also, it was found from reviewing numerous literatures that by integrating both these techniques LC and VE in projects, benefits were found to multiply. Through the literatures reviewed it can be concluded that the strategies of Lean integrated Value Engineering (LIVE) approach was found to minimize project delivery time, non-value-addition in processes of projects and also reduce construction wastes.

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Suitability Analysis Of PMI Project Management Plans And Techniques To Civil And Multi-Disciplinary Projects

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Abstract: The present study was conducted to analyze the engineering students' ability to apply project management techniques in the projects planned using the concepts given by Project Management Institute (PMBOK). Selected student projects related to civil and multi-disciplinary nature are verified from project charter preparation. The techniques used are related to scheduling, Milestones, work breakdown structure, cost estimation methods and different management plans. Feedback is taken from the student batches regarding the applicability of techniques, time taken for project plans, charter document, difficulty levels and other aspects of suitability of techniques. Out of 100 projects analyzed, 66% of student groups felt easy to apply PMI project management techniques. Bottom-up technique is applied by 76%teams for cost estimation and second-best technique is top down with 16% applicability. 69% teams used PERT technique for scheduling with second best as CPM for 19% projects.
Key words: Project Management, Network Analysis, Suitability of technique, Project planning techniques.

INTRODUCTION

Project management techniques are widely used by all branches of engineering. Construction projects need proper planning and execution for timely completion of project within the budget. This is due to number of physical activities, high cost associated and laborious work associated along with large material procurement, storage, conversion process. Several management processes are involved to control the operations.

Total project life cycle is divided broadly into three categories. The categories are Pre-Project stage, Implementation stage and post-project stage. Conceptualization, brainstorming sessions, documentation for planning, budget preparation, approval by the sponsor and designs and prototypes if applicable are some of critical elements in pre-project stage. During implementation stage, the design drawings, procurement, erection, fabrication, supervision of work packages, follow up of quality and deliverables, controlling workforce, performance issues etc., post-project stage includes closing activities, testing and commissioning, handover of project to the client/customer, maintenance if necessary.

The stakeholders list, justification for the project, roles and responsibilities of different team members are decided and allocated.

Several tools and techniques are recommended by PMI in the Project Management Body of Knowledge (PMBOK). Project charter is the main document at planning stage which includes Deliverable and milestones, work breakdown structure, Network analysis for scheduling, HR plan, Risk management plan, Communications management plan, Quality management plan and procurement plan. Scheduling of several activities are done using network diagrams either critical path method (CPM) or Program Evaluation Review Technique (PERT). Several techniques are used in the cost estimation calculations, like Top-down, Bottom Up, Expert advice, Parametric modeling etc.. These techniques are used based on the data available regarding individual components of costing for materials, man power, conversion process, transportation and other elements of cost. Where ever possible the costing teams get estimate quotations to calculate the total costs, which are termed as bottom-up method. The data is taken from work breakdown structure (WBS) and each element is estimating its cost. The work components are carefully disintegrated to segregate type of work package and sub-packages to create a WBS. The WBS is made based on certain rules given in PMBOK.

Scheduling is done using Gantt chart, CPM or PERT based on complexity of project, data available, linkages, predecessors etc., PERT is a probabilistic method where three time estimates are taken for calculation of total time of project and critical path. In case of CPM, the onetime estimate is used and which is termed as a deterministic method. Some of the series and parallel activities are identified and connected in the network diagram which is also called as arrow diagram. Critical path is calculated based on the longest path from first node to the last node of project. All combinations of paths are calculated and path which takes longest travel is decided as critical path. Project managers keep more focus, follow-up mechanism and resources on the activities which fall in critical path.

Quality management plan provided the need and requirements of quality in all aspects of project. Both quality control and quality assurance protocols are prepared in advance and suitable allocation is made for quality checks during implementation stage. Quality charts, sheets are formed and implemented for compliance. Specification's compliance, meeting the standards specified in the design drawings/customer requirements. Where ever possible international standards like ISI, ISO, DIN or EN etc., are referred to for fixing the quality tests. The tests can be conducted at the suppliers premised before dispatch of materials/machines to be procured or upon receipt at the project site and/or before use. Tests are also conducted during erection/post-construction. The sampling plans with statistical quality control procedures are enforced for meeting the standards without spending unnecessary efforts and cost on inspection. Different quality control charts like Mean chart, Range chart, check sheets etc., are used to continuously record the quality data for monitoring and overall quality of project. The data is also used for future reference and corrective actions

Different organization structures are considered before choosing best structure for project work. Projectized structure, matrix structure, line structure, line and staff structure are some of the structures used. The authority and responsibility levels are considered for the formation of structure.

Several risk management strategies are used for dealing with unforeseen risks in projects. Both positive and negative risk strategies are well prepared in advance. Accepting, transferring and avoiding or mitigating is some of the negative risk strategies. Accepting, enhancing and transferring are some of positive risk management strategies to take the benefit of changes positively. Monitoring and controlling mechanisms must be in place for ensuring timely completion of work with quality. Suitable monitoring systems are designed to check the deliverables, milestones, performance of workmen, compliance of work with specifications, cost of execution with respect to budget approval. Corrective actions are taken for any deviations. Cost, time and scope are controlled during this monitoring and controlling stage. PMI refers these three as project triad.

Project preparation time and complexity of preparation are some of the concerns for preparation team. Depending on data available, expertise of the team dealing with the new project, kind and complexity involved in the preparation etc., are the constraints for charter preparation. Projects during implementation stage perform efficiently with proper planning in charter preparation stage. The project charter must give clarity on all critical components through planning documentation [1].

In the past without knowing of project management techniques and tools number of prestigious projects done in the history with at most care and planning. Where the people come together and work coordinately to achieve some desired results is treated as project management. This scenario could be followed by people to construct big projects without any hurdle. Examples of such projects in the history like the pyramid of Giza, Great Wall of China and coliseum. There are numerous projects in the past fulfilled with project management knowledge but documentation of such techniques till 1950 was not done constructively. At present the trend focuses on the importance of project management. It is widely accepted by all type of projects. The specialized skills in project management are the need of the hour and in future the people with skills of project management mostly will be sought [2]. PERT and CPM techniques widely are using in construction, Information technology, defense related projects. These techniques are together helpful for projects and yields grate advantage for decision makers. By comparing two methods with their time and cost with the help of earned value techniques, there has been a lot of difference between these two PERT and CPM techniques. CPM and PERT both methods can be utilized with fuzzy logic for better completion of the projects accordance to schedule with in the minimum cost [3]. For large construction projects contemporary and traditional management tools both are essential to forecast cost and time of the project accurately. To check and connect project activities it is essential to observe finish to start, start to start and finish to finish activities. Contemporary technique Microsoft project alone not feasible to check all the activities and plan accordance to project schedule. Traditional method linear programming time /cost trade off method is helpful when the project is modeled in precedence chart. So, both contemporary and traditional linear modelings are to be blended for better anticipation of time and cost of the project. In construction projects the best solution for time/cost trade off difficulties extended some of the activities duration to shorten the entire project [4].

Project evaluation and review technique (PERT) allocates distributions to corresponding activity times of the project. Critical path method (CPM) specifies activity times are constant but in real scenario that would not be. Process model simulation advanced than PERT and CPM techniques. It can project activity times of the projects with diversity of distributions [5]. Over the last two decades importance of the project management increased. This

is because all sort of emerging business applications. The business process as a project management now is in the position to maintain all sort business applications as projects. The projects like IT, product development, change development and software developments. The management of modern projects is indeed different from maintenance of traditional projects. PERT and CPM techniques made the project maintenance is easy. But new knowledge in this area still in cross roads. Considerable research has to be done in project management that can bring out a lot of new techniques and tools. This orientation would be helpful for all sorts of projects from small to bigger ones [6]. In distinction to PERT/CPM, Critical chain focuses on certain technical aspects of the project management. Critical chain dealt with price (subcontracting activities) but on lead time or reliability of the project management. It focuses on how senior management can observe behaviors of people while building project network and managing afterwards. It concerns to identify critical areas in project and make them as buffers over try to avoid mile stones of the projects [7].

Artificial intelligence is helpful to find out the opportunities for HRM offered by investigation have been acknowledged by bosses and associations; however there stays a colossal space for development in the territory and the investigation of the pertinence of examination inside the different classifications that fall under HRM. Effect of feasibility study, human resource management and impact of planning and managing project activities on project success are well documented. Planning the activities, identifying tasks and preparation of schedule impacted the success of projects. Successful projects found to have sufficient user involvement, good planning and estimations, right leadership along with technical skills of the team members [8-9].

OBJECTIVES

The present investigation focuses on:

1. To identify different PMI techniques used in project planning documents.
2. To analyze the applicability and ease of use of these PMI techniques in project charter preparation.

METHODOLOGY

100 students from project preparation teams were selected to conduct the research work. Each team was given the task to identify projects of multi-disciplinary nature. Project charter documents were developed by the five member team.

RESULTS AND DISCUSSION

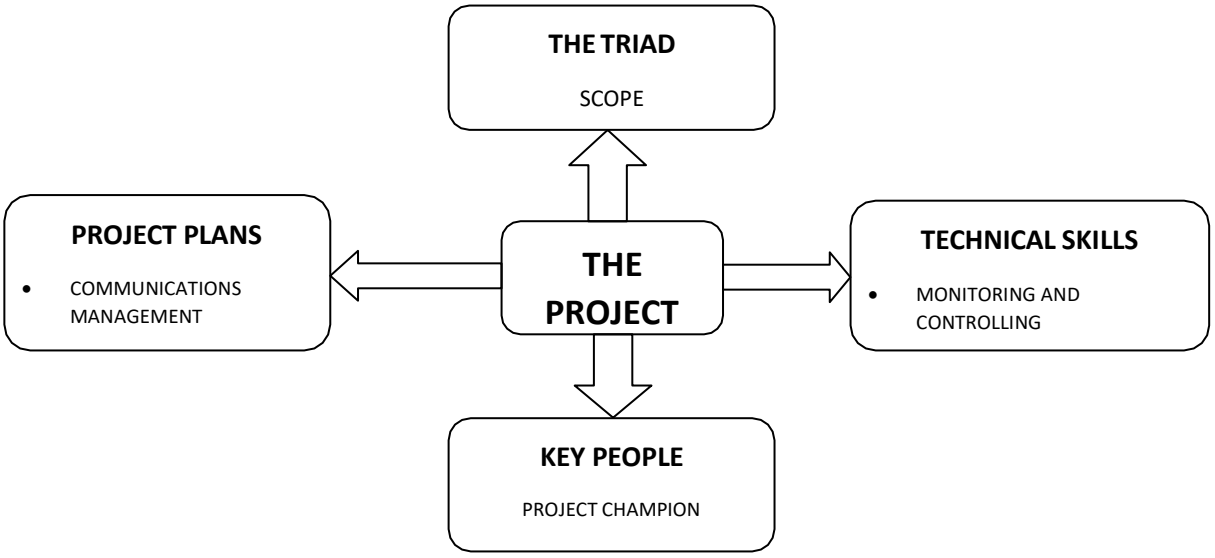

Fig 1. Flow chart showing project charter elements

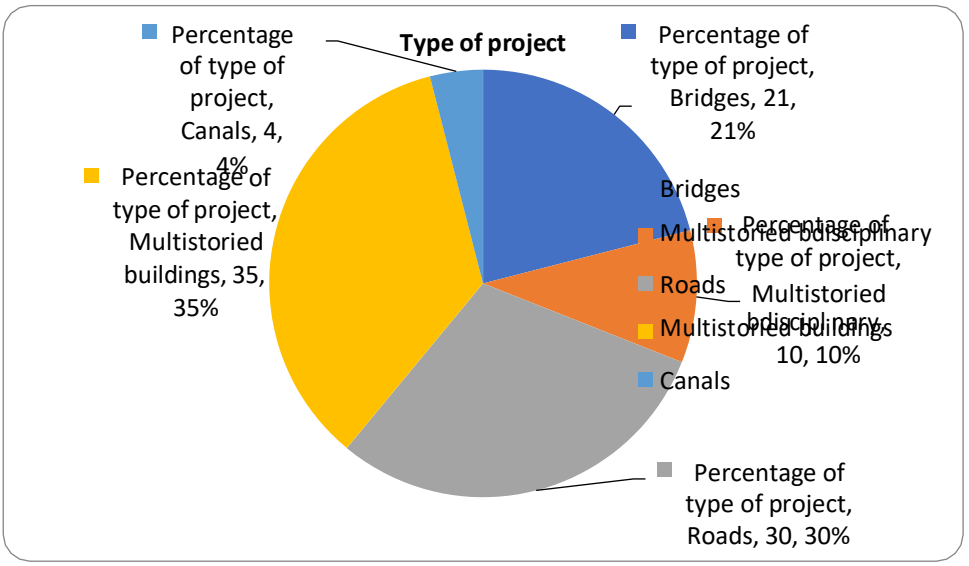

Fig 2 Type of projects

The students opted different projects to plan with the support of planning techniques what have been learnt in their project management course. The types of projects for planning were selected by students Viz. Bridges, Canals, Multistoried Buildings and disciplinary and roads.

Thirty five percentages of students selected Buildings and thirty percentages of students chosen roads projects to plan with different techniques. Canals, bridges and disciplinary projects picked by four, twenty one and ten proportion of students respectively.

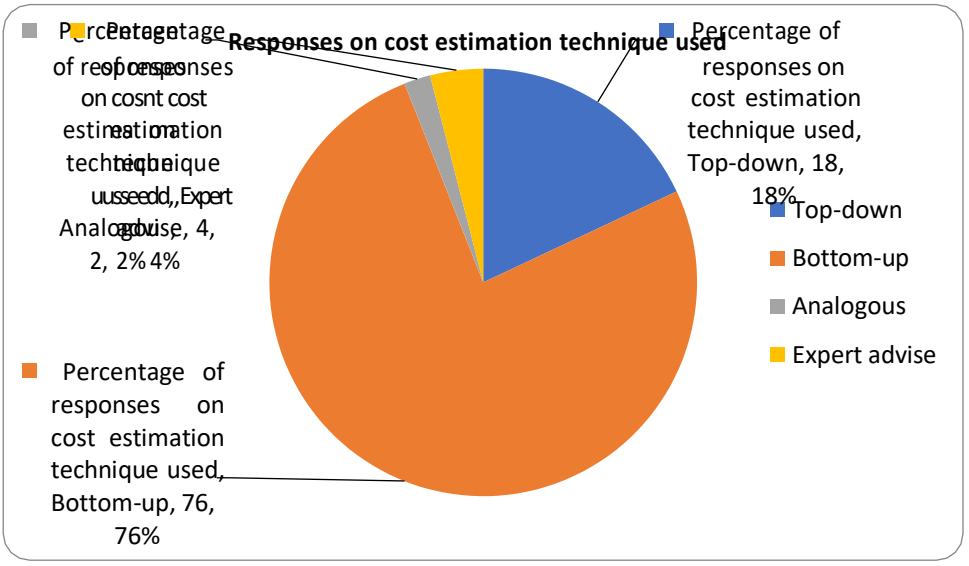

Fig 3: Details of cost estimation technique used

The students applied cost estimation techniques for those selected projects are top-down, bottom-up, analogous and expert advice. The responses of learners clearly specified that seventy-six portion of the students utilized bottom approach technique for their cost estimation. Eighteen percentage of students got help from top-down technique. Analogous and expert advice techniques have been taken in to account to cost estimation for those projects by two and four portion of the students respectively.

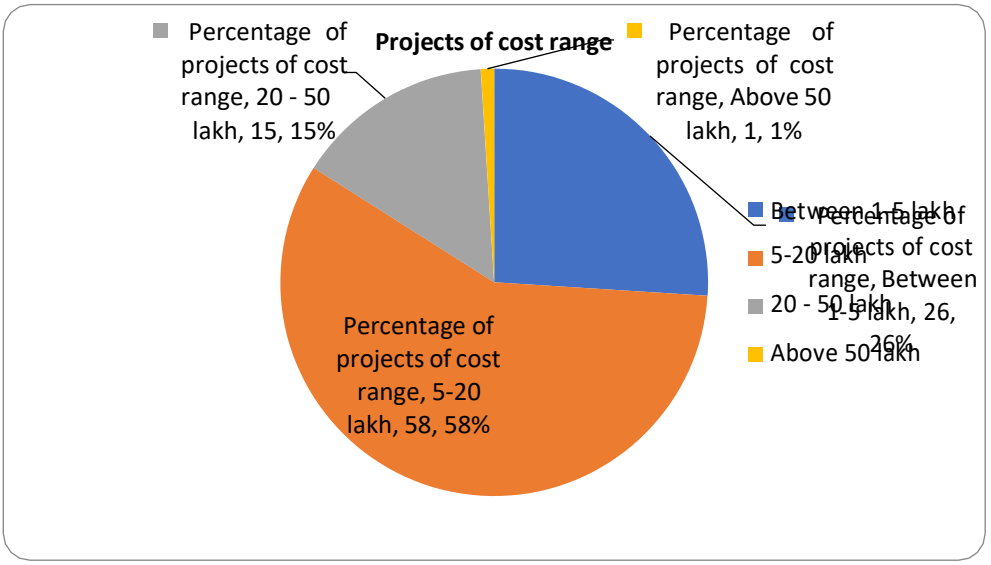

Fig 4: Cost range of the projects

Students planned those selected projects in the range between one to fifty lacks. Fifty eight percentages of students estimated their projects cost within the range of five to twenty lacks. One to five , twenty to fifty and above fifty cost ranges fixed by twenty six, fifteen and one portion of the students respectively.

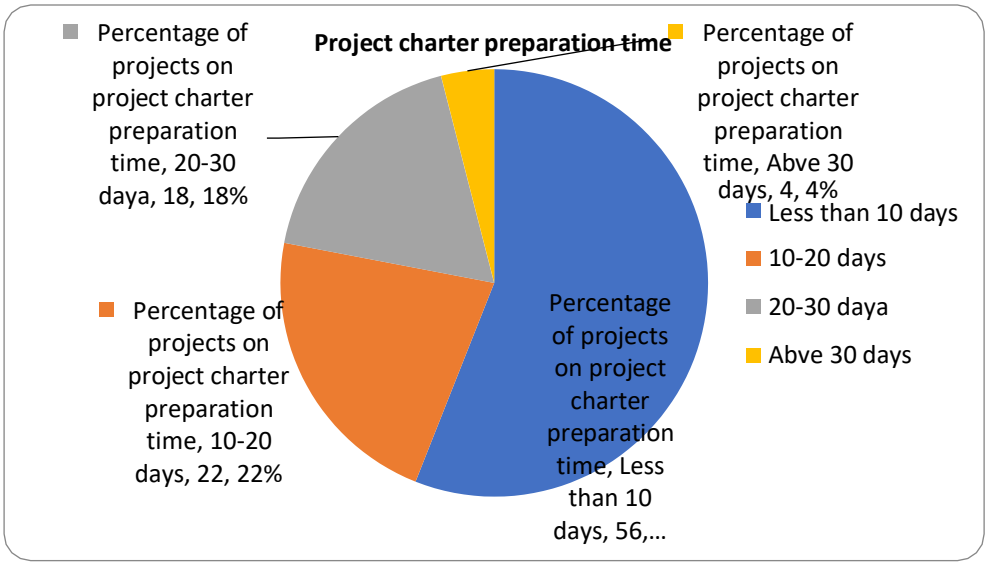

Fig 5: Time taken project charter preparation

Based on responses of the respondents it is indeed understood that maximum number of students took less than ten days to project charter preparation. Twenty two portions of students have taken ten to twenty days to charter making plan. Twenty to thirty and above thirty days were taken by eighteen and four percentage of students for their project charter preparation.

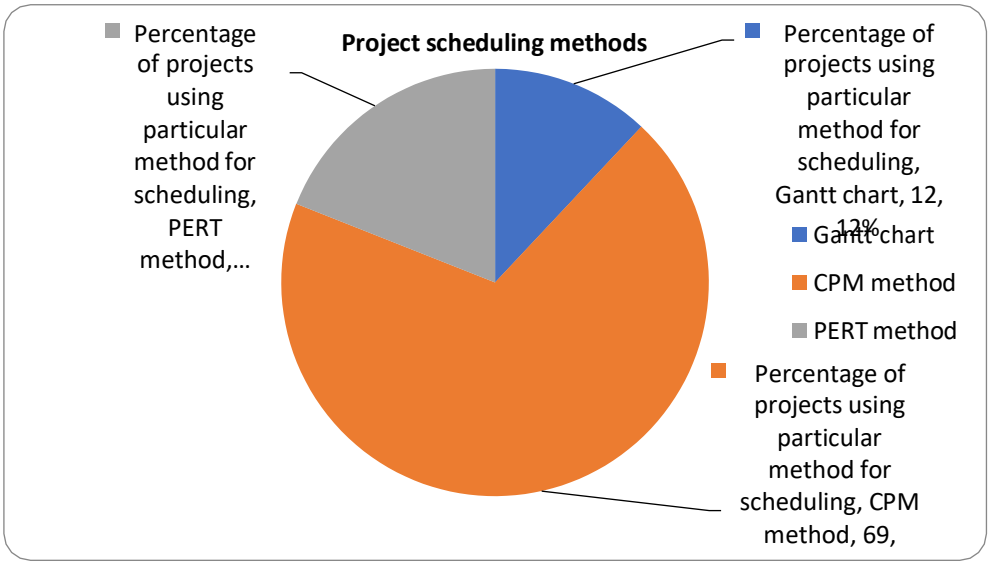

Fig 6 Details of scheduling methods used in different project teams

From the above chart it is cleared that students opted Gantt, CPM and PERT methods for project scheduling. At maximum extent sixty nine percentage of students used CPM method for scheduling to those chosen projects. Nineteen and twelve percentages of the respondent students have taken PERT and Gantt methods respectively for their project scheduling.

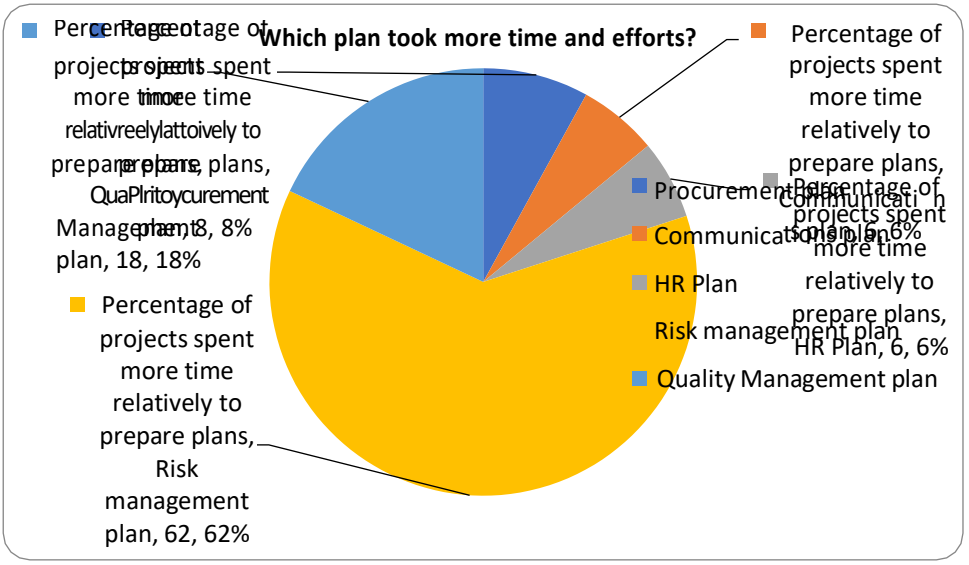

Fig 7 Relative time taken to prepare different project management plans

Majority of students spent more time to plan risk management, it is evidently understood by students responses. Sixty percentage of students felt that thay spent vast time on risk managemet exercise. Only few percentage of students opined that thay spent a lot of time to prepare procurment, communication and HR planfor their preferred projects.Cosiderable amount of students with eighteen percentages supposed that thay were manged to spend some how more time on quality management than other plans.

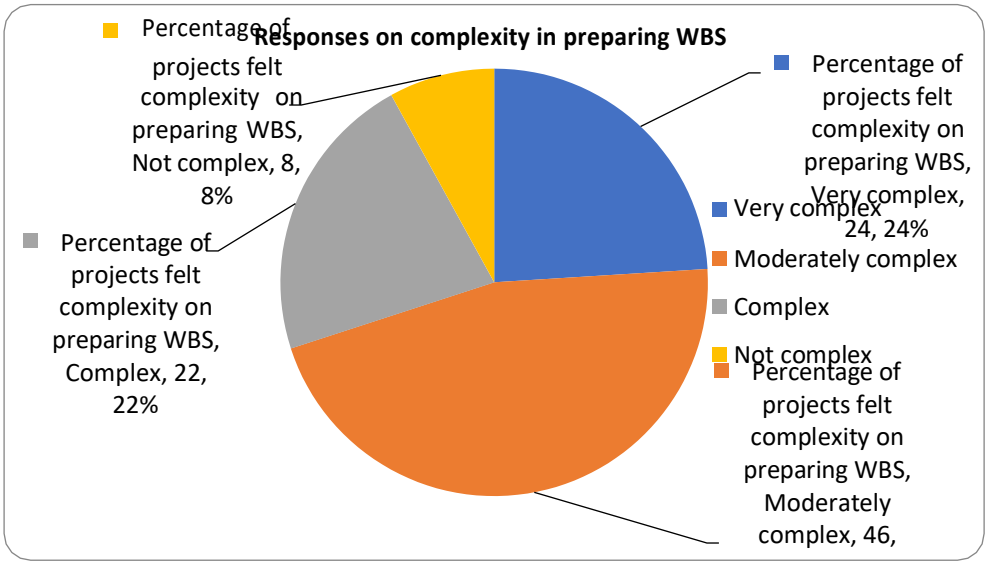

Fig 8 Complexity of Work breakdown structure

Mixed response have been solicited from students on work break down structure. The response from students on this WBS has been not clear. Only eight portion of the students felt not complex while preparig the structure of work break down.

Forty six percentage of students agreed that thay were facing moderately complex when they were in break down tasks systematically. Twenty and twenty four percentages of students felt complex and very complex respectively whilst charting work break down structure.

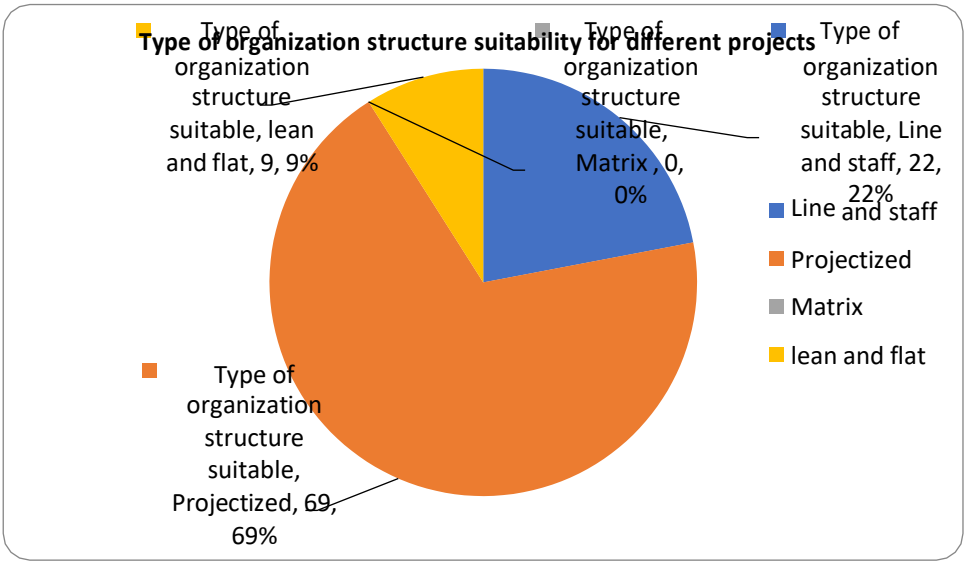

Fig 9 Type of organization structures developed based on suitability of projects

Based on projects respondents have identified suitability of the organization structures. Sixty nine portion of the students decided projectised structure for their projects. Line and staff and lean and flat organizational structures selected by twenty two and nine percentage of the students respectively for those chosen projects.

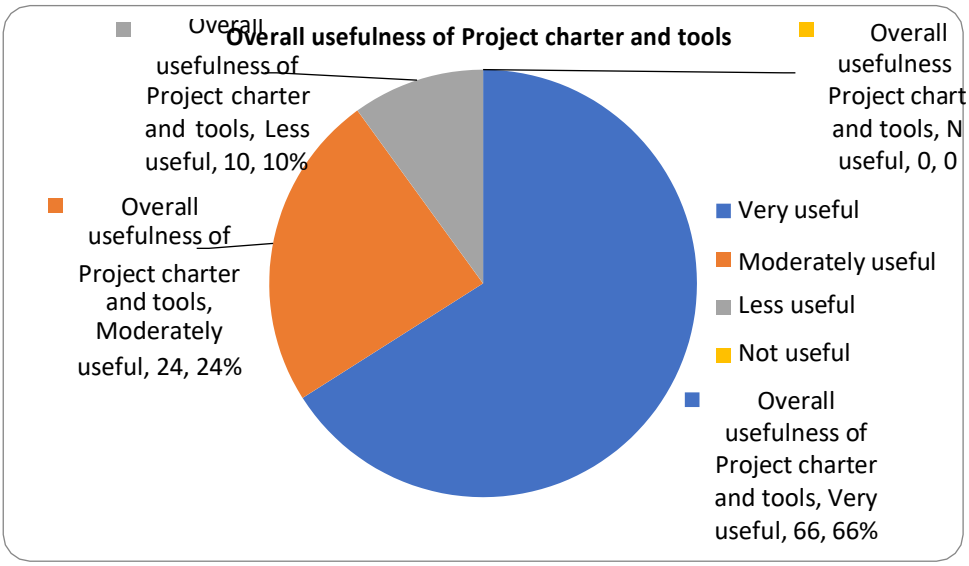

Fig 10 Overall usefulness of project management tools

The students expressed overall usefulness of project management course. In that course what they have learnt charter and tools indeed are helpful and very useful while they are in planning for those selected projects this is expressed by sixty six percentage of the students. Twenty portion of the students opined that those tools have been helpful moderately. Only ten percentages of the students highlighted that the tools in project management have been less useful.

CONCLUSION

Uses of project management tools are specified by Project Management Institute through project charter document are tested for applicability in the current investigation. Student project plans are evaluated after implementing the PMI charter tools. A structured survey is conducted to analyze the critical issues during charter document preparation for various projects. With respect to application of PMI project management techniques, 66 percent of project groups felt “very useful, 24% opined that “moderately useful” and 10% felt “less useful”. 76% teams used bottom-up method for cost estimation and second best technique is top down with 16% applicability. PERT technique has been applied by 69 percent of teams for scheduling and CPM has been found to be applied for 19% projects. The opinion on different phases of students selected projects were mainly divided in between pre-project planning, implementation stages and post project phase. Fifty six percentage of students responded that they have been faced complicatedness by plan pre-project. Fourty fraction of students agreed that they faced difficulty in implementaton phase. Only four portion of the students highlighted that they could face complexity in post project phase.

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The Reverse Mortgage Conundrum: Perspectives of Households In India

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ABSTARCT. There was always a vacuum felt for a financial product that can support the ageing population of the society in terms of guaranteed income for their sustenance. To assist them and to cope up with challenges, experts in the market exclusively designed the product of Reverse Mortgage. However, the product is only a decade old in India but has not shown promising growth. This paper focuses on Indian circumstances and is based on the survey of Indian citizens and their awareness about the products. This study is expected to give a new perspective of the product as living conditions and the ageing populations are witnessing a faster growth in India than in other countries. The study uses six demographic variables: age, education, homeownership, monthly income, gender, and living district. Purposive sampling is used to collect data by administering a structured questionnaire with 16 questions. Chi-Square test using SPSS software is applied to test the hypothesis. Of the six demographic variables analysed age, education level, homeownership, and monthly income are found to be significantly associated with the awareness level for reverse mortgage. The study recommends that the goal of every authority such as government/ bank/ lender should be to educate consumers regarding its importance. Relevant language focus on lower-income groups and improved infrastructure can facilitate to build awareness and dissipate fears about the product.

INTRODUCTION

With substantial increase in the older population world over, almost every country is experiencing significant increase in its ageing population. According to World Population Prospects data, the older population is expected to grow by 56% until 2030. Another report by the United Nations 2015, estimates the older population to inch near 2.1 billion by 2050 (UN Report, 2015). Ageing population is increasing much rapidly in lesser developed nations than in developed nations (See fig 1).

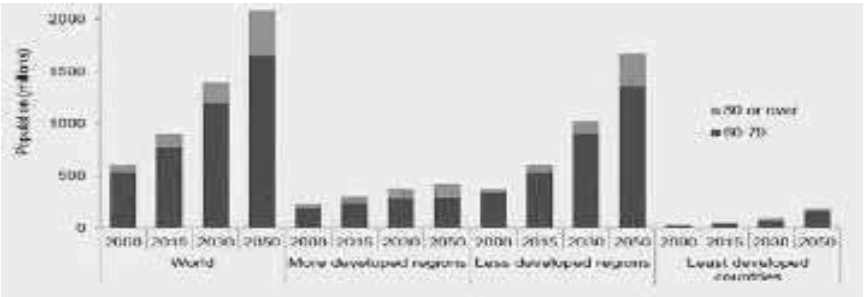
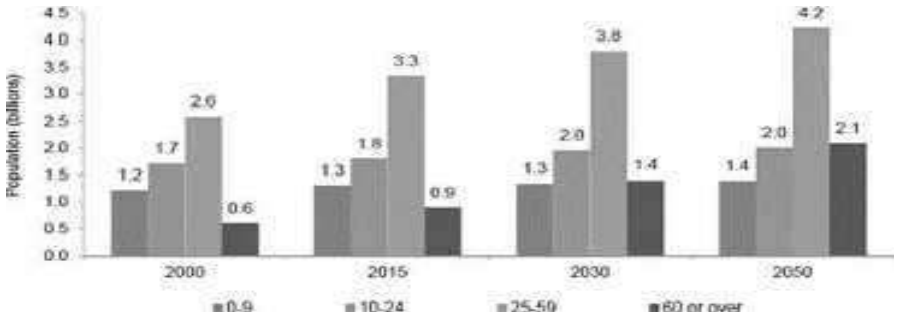


Fig 1. Population aged 60- 79 years and 80 years or over by development group

India is experiencing a similar trend, but the pace of population ageing is much faster in India than in other countries. While the United States took nearly 50 years to double its elderly population, India only took 20 to 30 years. This significant increase in elderly population is the result of the combined impact of increasing life expectancy and reduced fertility rate. In a report published by Times of India (leading Indian English daily) dated 16th August2018, statistics reveal that India is ageing much faster than anticipated. According to the most recent government data, the number of people over the age of 60 is expected to be around 340 million by 2050, up from 316.8 million projected by the UN and 324 million projected by HelpAge India.



Source: United Nations: 2015, World population Prospects: The 2015 Revision

Fig 2. depicts the global population by broad age group

According to Figure 2, by 2030, older people will outnumber children aged 0-9 years, and by 2050, there will be more people over 60 than adolescents and youth aged 10- 24 years. It is primarily the living conditions of elderly that poses a major challenge. Globally, half of the people who have reached the pensionable age, either do not receive pension and for many who receive pension, the amount is inadequate. The harsh reality of ageing was recognized by developed economies, particularly the United States and Western European countries, as early as the mid-1980s. The policymakers in these countries scouted for innovative financial products that could assist the elderly to provide for their long-term care. With increasing home ownership rates across the world, the possibility of supplementing elderly income through utilization of real estate emerged as a viable option. (Mayer and Simons, 1994 in Matic, 2010). Thus, reverse mortgage was introduced as an innovative financial instrument that facilitates conversion of an an illiquid asset (home) into a liquid one (Ramos, 2015). It allows a home to become a source of income, with the added benefit that the owner retains the right to live in his home until he (or his spouse) dies: The following are some of the fundamental characteristics of Reverse Mortgage products:

- The loan is only available to senior citizens who own a home.
- The loan can be in the form of a lump sum or multiple payments, such as an annuity.
- The homeowner is not required to repay the loan until the house is his primary residence.

The reverse mortgage as a method of financing dates back to the 1930s, when it was first introduced in the United Kingdom (Huan & Mahoney, 2002 in Matic, 2010). Reverse mortgages have been around since the 1960s in the United States. By the 1970s, it had spread to parts of Europe, and by the 1980s, it had also been observed in Australia, New Zealand, and Canada. Ward (2004); Law Reform Commission of Saskatchewan (2006); Matic (2010)

As a supplement and last resort to finance retirement lives, Reverse Mortgage can provide a way to tackle the financial problem and release some of the burdens without moving out of the house. The fact that Reverse Mortgage is set to benefit the elderly is accepted and applied worldwide. After its success in other countries, it seems to be the right solution for the Indian elderly too. In the absence of state-funded pensions, most of the urban affluent Indians primarily rely on the self-funded corpus to finance their retired lives. This, combined with India's high homeownership rate of 86.6 percent, results in the majority of them being asset rich but cash poor in old age. These retirees throughout their earnings years have invested their savings primarily into building a house, and thus, by retire mentthey find themselves sitting on high-value properties with little cash flow to finance their living costs. With India's elderly population expected to reach 19 percent by 2050, Reverse Mortgage appears to be the last resort. This would not only allow the elderly to remain in their own homes, but would also provide additional income to help them finance their retirement life. The success of the product in United States, Australia and Great Britain presents an opportunity in the Indian context.

SIGNIFICANCE OF THE STUDY

The success of Reverse Mortgage on the foreign shores provided impetus to the Indian government and Reverse Mortgage was finally introduced in India in the Budget of 2007- 2008. NHB (National Housing Bank) was chosen as the primary institution responsible to formulate the guidelines for Reverse Mortgage applicable to the primary lending institutions such as banks and housing finance companies.

Even after more than a decade post its implementation, reverse mortgage has failed to be successful in India. With an achievement of only Rs 1800 Crore loans sanctioned against the market potential of more than Rs

20,000 Crore, there seems to be serious lack of effort both on the part of sellers (banks) and the regulator- the National Housing Bank (NHB) to demystify the product and present it as a viable solution to the target beneficiaries.

There is only limited literature that discusses the current situation in India. Existing studies, such as Paul and Chakrapani (2007), Desai (2010), Tripathi and Iyer (2009), are limited to understanding the reasons for the product's unpopularity and are focused either on the benefits of the reverse mortgage or on continuing foreign practices in this area. Other studies reveal the low awareness level of reverse mortgage in India; however, none have ascertained the reasons for reduced awareness in India.

This paper aims to fill that void by attempting to investigate the reasons for the stifled acceptance of Reverse Mortgage loans in India. The study is conducted by analyzing the association of demographic variables like gender, age, income level, monthly income, education level, and living district on the awareness level of Reverse Mortgage in India. It is expected that this study can be beneficial for the policymakers to get a new perspective on the Indian Reverse Mortgage market. Findings of the study are expected to facilitate the policymakers to create greater awareness and dissipate fears about the product giving a new lease of life to the Indian Reverse Mortgage market.

LITERATURE REVIEW

The primary goal of Reverse Mortgage loans is to benefit the third generation. The theoretical foundation of a reverse mortgage is deeply rooted in the life cycle hypothesis proposed by Modigliani and Miller in 1954. The life cycle hypothesis explains the elderly's desire to finance consumption by liquidating assets acquired in their youth (Merrill et al, 1994). The emergence of Reverse Mortgage from the life cycle hypothesis is supported by the fact that income earned during working years should ideally be distributed throughout all stages of life, including retirement.

The reverse mortgage as a method of financing dates back to the 1930s, when it was first introduced in the United Kingdom (Huan & Mahoney, 2002 in Matic, 2010). Reverse mortgages have been around since the 1960s in the United States. By the 1970s, it had spread to parts of Europe, and by the 1980s, it had also been observed in Australia, New Zealand, and Canada. Ward (2004); Law Reform Commission of Saskatchewan (2006); Matic (2010) The Department of Housing and Urban Development officially introduced Reverse Mortgages in the United States in 1987 under the name Home Equity Conversion or Reverse Annuity Mortgages. However, they became known as Home Equity Conversion Mortgages (or HECMs) over time.

Worldwide, many studies have been conducted to identify the factors influencing the awareness level of reverse mortgage loans. Innumerable studies have explored the impact of demographic variables on the awareness of reverse mortgage loans. Case and Schnare (1994) evaluated HECM (Home Equity Conversion Mortgage) loans in terms of borrower characteristics that influence their Reverse Mortgage product choice using a sample of approximately 2,500 loans. The study takes into account factors such as age, family composition, property value, and property location. Their research found that:

1. Younger borrowers are more likely than older borrowers to choose tenure payments.
2. Product choice was very highly dependent on the income
3. Women and couples are more likely than single men to choose the line of credit option.
4. The line of credit option was chosen more by borrowers with lesser valued properties.

According to Mayer and Simons (1994), the primary reason for low Reverse Mortgage loan intake is a lack of consumer awareness. Similar study by Richardson & Kilty (1995) concluded age affecting human behavior towards retirement planning. In a study by Joe & Grapple (2001), people with higher incomes were found to be more inclined in seeking professional financial assistance for retirement planning than people in lower-income groups. According to Joo and Pauwels (2002), higher education equips individuals to better explore available financial information and thus affects awareness levels.

According to a study conducted by Chou et al (2006), people with higher educational backgrounds understand the concept of a complex financial product better. Reed (2009) in his study has acknowledged reduced awareness of Reverse Mortgages in Australia stressing its importance in educating current and prospective older households. Shan (2009) investigated the USA market and discovered that in recent years, Reverse Mortgage borrowers differ significantly from previous borrowers in terms of age, demographics, and so on. At the time of loan origination, recent borrowers were found to be much younger indicating loans among the younger homeowners. Smith & Searle (2008) studied the effect of factors such as age, gender, education, and living district on the awareness levels for Reverse Mortgage in Spain. The study concluded that knowledge of Reverse Mortgage varies with education level, with people with a university education having a high awareness level, and people with primary or lower education having a low awareness level. The study also found that the awareness for Reverse Mortgage is influenced by gender with males reporting higher awareness levels as compared to females. In their study, awareness levels exhibited the effect of regional disparities as well, with some regions showing higher awareness levels and

vice versa. According to a study conducted by Lusardi and Mitchel (2008), men are better prepared for retirement planning than women; however, the majority of women do not plan for their retirement years.

Limited studies exploring the awareness of reverse mortgage loans have been done in the Indian context. Paul and Chakrapani (2007) compared the various banks that offered the loan. Desai (2010) conducted a survey in Gujarat to assess the potential of Reverse Mortgage loans in India. Rajagopalan (2002) investigated the potential of Reverse Mortgage products in India. Kumar et al. (2008) proposed ways to improve reverse mortgage marketability in India, and Tripathi & Iyer (2009) examined the opportunities, threats, issues, and challenges of reverse mortgage in India. Shruti and Madhu (2020) conducted a study in India on the determinants of reverse mortgage purchase decision and identified bequest motive and negative perception as significant contributors to the reverse mortgage purchase decision. Few Indian studies have looked into the risk factor in reverse mortgage loans. Kumar et al (2008) has identified crossover risk and longevity risks as the most critical risks in Reverse Mortgage loans. Paul & Chakrapani (2007) studied the impact of the risk of moral hazard in reverse mortgage loans on the lender. Rajagopalan (2006) investigated the various risks inherent in reverse mortgages, characterizing them as a rising debt instrument. Shruti & Deepika (2020) explored the impact of reverse mortgage on a senior citizen's financial planning and concluded it as a net worth enhancing option. A study conducted by Shruti & Madhu (2019) explored the relationship of reverse mortgage market with macro-economic variables in India using multiple regression and found interest rates, GDP to be significantly influencing the Indian reverse mortgage market.

Socio-demographic factors and retirement planning are dependent upon each other as the demographic factors are found to have an impact on the knowledge and the awareness of the product. Mansor et al. (2015) investigated the link between demographic factors and retirement planning. Petkoska et al. (2009) investigated whether demographic and psychological factors hampered or aided retirement planning. Since demographic variables and retirement planning are interrelated, it becomes pertinent to explore the impact of these variables on the awareness for reverse mortgage in India.

A thorough review of the existing literature on reverse mortgages in India and elsewhere reveals gaps in the scope and reach of studies in India. In comparison with the international studies, Indian studies lack the focus to evaluate Reverse Mortgage effectively. Survey work done to elicit the opinion of the eligible senior citizens is also limited.

Taking cues from the international studies, research needs to be conducted to identify the association of demographic variables on the awareness of reverse mortgage in India. The present research study based on a survey of Indian citizens is a modest attempt to cover this gap. Based on the above studies, factors like age, gender, education, income level, living district, and homeownership were identified as factors associated with the awareness of Reverse Mortgage in India. The empirically testable research hypotheses identified are:

- Age does not have any association with awareness of Reverse Mortgage loans
- Gender does not have any association with awareness of Reverse Mortgage loans
- Education level does not have any association with awareness of Reverse Mortgage loans
- Living District does not have any association with awareness of Reverse Mortgage loans
- Monthly Income does not have any association with awareness of Reverse Mortgage loans
- Home Ownership does not have any association with awareness of Reverse Mortgage Loans

Dependent Variable

Awareness level for Reverse Mortgage is identified as the dependent variable in this study.

Independent Variables

Based in the exiting literature, the following demographic variables are identified as independent variables in the study:

1. **Gender:** The respondents were categorized into male and female
2. **Age:** The respondents were divided into five age groups: those between the ages of 30 and 40, those between the ages of 41 and 55, those between the ages of 56 and 60, those between the ages of 60 and 75, and those over 75.
3. **Educational Qualifications:** The respondents were categorized into 5 categories: Primary, Secondary, Graduate, Postgraduate, and above Postgraduate.
4. **Living District:** The respondents were categorized into living in Noida, Ghaziabad, Delhi, Gurgaon, and outside Delhi
5. **Monthly Income:** The respondents were divided into five income categories: monthly income ranging from Rs 50,000 to Rs 1,00,000, monthly income ranging from Rs 1,00,000 to Rs 2,00,000, monthly income

ranging from Rs 2,00,000 to Rs 5,00,000, monthly income ranging from Rs 5,00,000 to Rs 10,00,000, and monthly income exceeding Rs 10,00,000.

6. **Home Ownership:** The respondents were categorized as to whether owning a home or not.

RESEARCH METHODOLOGY

The empirical studies were carried out using primary data. The premise of the primary study is built on the survey method to explore the relationship between demographic variables and the awareness of Reverse Mortgage loans in India. Purposive sampling is used to collect data via a questionnaire containing 16 questions about the respondents' demographic information. The target respondent was anyone above the age of 30, owing a house and residing in India. The total number of target respondents is 360. The sample does not include very rich and very poor respondents, as the product is not meant for them. The sample was not random and covered a wide range of respondents in terms of their socio-economic attributes. The questionnaire was distributed to 360 people, and 330 of them filled it out. Following corrections to the questionnaire for missing data, outliers, and so on, the final total sample size was 310 respondents.

Validity of the questionnaire was carried out seeking the guidance of experts and academicians in this field. Pilot study was conducted on 100 respondents, in Delhi, NCR region of India. The questionnaires were also sent to senior academicians and senior banking professionals, their views and valuable feedback was incorporated in the questionnaire.

Chi-Square test using the SPSS software is applied to test the hypothesis. Chi-Square test is applied to categorical data for which mean, median, and mode cannot be calculated. It is used to determine whether or not there is a statistically significant relationship between two nominal (categorical) variables. One nominal variable's frequency is compared to different values of the other nominal variable. Table 1 presents an example showing the Chi-Square statistic calculation.

Table 1. Chi-Square calculation

Variable	Data Type 1	Data Type 2	Total
Category 1	A	B	A+B
Category 2	C	D	C+D
Total	A+C	B+D	A+B+C+D = N

Source: http://math.hws.edu/javamath/ryan/ChiSquare.html

Based on table 1, the Chi-Square statistic is calculated as:

$$\chi 2 = \frac{(ad-bc)^2\,(a+b+c+d)}{(a+c)(b+d)(a+b)(c+d)}$$

The general hypothesis formulated for Chi-Square is as follows:

- Ho: There is no statistically significant difference between the various group counts.
- Ha: There is a statistically significant difference between the various group counts.

The present study uses the Chi-Square test to compare the awareness level of respondents concerning their age, gender, income level, education level, living district, and homeownership.

PRELIMINARY INVESTIGATION

Before proceeding with the analysis of the data collected, the preliminary investigation of the data collected becomes imminent. The intention here is to gauge the awareness level of Reverse Mortgage amongst prospective customers. The primary data collected through the questionnaire shows equal numbers of both male and female respondents. Approximately 78% of the total respondents belong to the age category of 30-40 years. Senior citizens constitute almost 9% of the total respondents. 54% of the total respondents are employed in the service sector, while approximately 18% constitute the business category. The maximum numbers of respondents are from Delhi and Noida, closely followed by 45% from the other cities. 58% of the total respondents are postgraduate. Approximately 30 % of the respondents fall into the monthly income category of Rs 200000 - Rs 500000. Finally, 68% of the respondents are homeowners, making them eligible for Reverse Mortgage loans.

Previous studies have proved that knowledge/awareness about a product is positively related to product demand (Davidoff et al, 2015). Table 2 shows that 68% of respondents are aware of Reverse Mortgage, with the remaining 32% having no clue about it. Almost 2/3rd of the entire sample size exhibit awareness for Reverse Mortgage, bringing forth the point that, even though the awareness levels for Reverse Mortgage is high in India, yet its intake has not been very encouraging. Conversely, 1/3rd of the total number of respondents, or 32% of

respondents are completely unaware of the product. This presents a huge opportunity for educating and creating awareness for Reverse Mortgage in the Indian markets.

Table 2. Awareness level of Reverse Mortgage loans

Are you aware of Reverse Mortgage?	
Yes	67.9%
No	32.1%

ANALYSIS

To test these hypotheses, cross-tabulation with the Chi-Square test was used. Each hypothesis focuses on determining the impact of each respondent's demographic factors (gender, age, education level, employment status, living district, monthly income, and homeownership) on Reverse Mortgage loan awareness.

Age

H1: Age does not have any association with awareness of Reverse Mortgage loans

Numerous studies conducted abroad have found age affecting awareness of Reverse Mortgage. A study by Richardson & Kilty (1995) found that age affects human behaviour towards retirement planning. Case and Schnare (1994) in their study concluded that younger borrowers are more likely to select tenure payments. Thus, the first hypothesis tests whether age affects the awareness level for Reverse Mortgage in India or not. Table 3 shows the Chi-Square value to test for the relationship between the two variables. Pearson's Chi-Square test yielded a Chi-Square value of 10.2. Since this value produced a significant difference at .05 level (p-value as 0.037), it is concluded that age is significantly associated with awareness of Reverse Mortgage in India.

Table 3. Testing significance between age and awareness for Reverse Mortgage

Variable	Pearson Chi-Square Value	P-Value	Result	Cross Tab Results	
				Categories	Awareness for Reverse Mortgage Loans
Age	10.2	0.037*	Significant	30 - 40 yrs.	72.97%
				41- 55 yrs.	9.01%
				56 - 60 yrs.	0
				61 -75 yrs.	12.61%
				Above 75 yrs.	5.41%

*Significant at 0.05 level

Source: Based on SPSS output

To focus on significant relationships, values on crosstab between age and awareness level has been analysed. As per the table, the basic awareness about Reverse Mortgage is found to have a U shape across all age groups, with knowledge levels peaking at 30-40 years, touching a bottom in the 56-60 years age group, and finally going up in the 61-75 years age group. With the increasing financial literacy in India, people in the younger age bracket of 30-40 years are more aware of the financial investment possibilities and are continuously exploring effective retirement financing solutions. As compared to the 41-55 yeas age bracket, the respondents in the 61-75 years age are more aware of the product, possibly because at this age, they are more concerned about pension and related financial matters and they also explore possible options to fund retirement when the savings/pensions do not suffice to lead a comfortable life. The awareness of Reverse Mortgage is low in the age bracket of above 75 years understandably due to the reason that the respondents in this age category might be too old to understand the complexities of Reverse Mortgage.

Gender

H2: Gender does not have any association with awareness of Reverse Mortgage loans.

Smith and Searle (2008) discovered that gender influences Reverse Mortgage awareness, with males reporting higher levels of awareness than females. According to a study conducted by Lusardi and Mitchel (2008), men are better prepared for retirement planning than women. Therefore, the second hypothesis tests whether gender has a significant association with awareness level for Reverse Mortgage. The Chi-Square value for the relationship between the two variables is shown in Table 4. Pearson's Chi-Square test produced a value of 2.608. Since this value did not produce a significant difference at .05 level (p-value as 0.106), it is concluded that gender does not have a significant association with awareness of Reverse Mortgage in India.

Table 4. Testing significance between gender and awareness for Reverse Mortgage

Variable	Pearson Chi-Square Value	P-Value	Result	Cross Tab Results	
				Categories	Awareness for Reverse Mortgage Loans
Gender	2.608	0.106	Insignificant	Male	54.80%
				Female	45.20%

Source: Based on SPSS output

To focus on significant relationships, values on crosstab between gender and awareness level have also been analysed. Even though insignificant, it is found that the awareness level amongst males is marginally higher than amongst the females. (Please note that the sample had an almost equal number of respondents from both the genders). The males are possibly more informed and aware of the product as compared to the females. This finding most likely reflects Indian society's traditional division of domestic roles.

Education Level

H3: Education level does not have any association with awareness of Reverse Mortgage loans

This hypothesis examines the significance of the association between education level and awareness of Reverse Mortgage in India. According to Joo and Pauwels (2002), higher education equips individuals to better explore available financial information and thus affects awareness levels. Smith & Searle (2008) concluded that the knowledge of Reverse Mortgage varies with the level of education, ranging from high awareness level exhibited by people with a university education, and low awareness level by people with primary or below education.

Table 5 shows the Chi-Square test yielding a value of 8.772. Since this value produced a significant difference at .01 level (p-value as 0.067), it is concluded that education level is significantly associated with awareness of Reverse Mortgage in India.

Table 5: Testing significance between education level and awareness for Reverse Mortgage

Variable	Pearson Chi-Square Value	P-Value	Result	Cross Tab Results	
				Categories	**Awareness for Reverse Mortgage Loans**
Education Level	8.772	0.067**	Significant	Primary	13.80%
				Secondary	8.30%
				Graduate	11.00%
				Post Graduate	55.00%
				Above Post Graduate	11.90%

**significant at 0.1 level

Source: Based on SPSS output

To focus on significant relationships, crosstab values between education level and awareness level are analyzed. The results indicate that respondents with higher education (Postgraduate 55%) show greater awareness of Reverse Mortgage possibly because the complexities of Reverse Mortgage are more understandable to them. Conversely, respondents with lower education (Primary 13.8% and Secondary 8.3%), exhibit reduced awareness of Reverse Mortgage loans. These results are in line with previous international studies that concluded that awareness levels increase with higher education.

Living District

H4: Living District does not have any association with awareness of Reverse Mortgage loans

The next hypothesis tests the association between the living district and the awareness of Reverse Mortgage in India. A study by Smith & Searle (2008) in Spain, found some regions showing higher awareness levels for reverse mortgage loans. Table 6 shows the Chi-square value for the relationship between the two variables. The Chi-Square test by Pearson yielded a Chi-Square value of 3.36. Since this value did not produce a significant difference at .05 level (p-value as 0.499), it is concluded that the living district is not significantly associated with the awareness of Reverse Mortgage in India.

Table 6: Testing significance between the living district and awareness for Reverse Mortgage

Variable	Pearson Chi-Square Value	P-Value	Result	Cross Tab Results	
				Categories	**Awareness for Reverse Mortgage Loans**
Living District	3.36	0.499	Insignificant	Noida	22.1%
				Ghaziabad	3.8%
				Delhi	26.0%
				Gurgaon	5.8%
				Outside Delhi	42.3%

Source: Primary data

Even though insignificant, earlier studies have shown that regional disparities do affect reverse mortgage awareness levels. However, in the Indian context, such regional disparities are not very evident, and the results do not exhibit marked differences in the attitudes of the respondents.

Monthly Income

H5: Monthly Income does not have any association with awareness of Reverse Mortgage loans

This hypothesis tests the association between monthly income and awareness of Reverse Mortgage loans in India. Study by Joe & Grapple (2001) found people with higher incomes to be more inclined to

seek professional financial assistance for retirement planning than ones in lower-income groups. Davidoff et al (2015) concluded that people in the lower-income group are not aware of Reverse Mortgage and its benefits. Table 7 shows the Chi-Square value for the relationship between the two variables. Pearson's Chi-Square test yielded a Chi-Square value of 7.931. Since this value produced a significant difference at .01 level (p-value of 0.094,) it is concluded that monthly income is significantly associated with the awareness of Reverse Mortgage in India**.**

Table 7: Testing significance between education level and awareness for Reverse Mortgage

Variable	Pearson Chi-Square Value	P-Value	Result	Cross Tab Results	
				Categories	**Awareness for Reverse Mortgage Loans**
Monthly Income	7.931	0.094**	Significant	Rs 50,000-Rs 1,00,000	16.2%
				Rs. 1,000,000-Rs. 2,000,000	20.2%
				Rs 2,00,000-Rs 5,00,000	29.3%
				Rs 500,000-Rs 1,000,000	19.2%
				Above Rs 10,00,000	15.2%

** Significant at 0.1 level

Source: Based on SPSS output

To focus on significant relationships, values on crosstab between monthly income and awareness level is studied. The crosstab results indicate that the income group of Rs 2,00,000 - Rs 5,00,000 exhibits maximum awareness of Reverse Mortgage vis a vis other income category. Least awareness level (15.2%) in the highest income category can be justified, as these respondents would have saved/ will save enough for their retirement, such that the need for Reverse Mortgage will not arise. However, reduced awareness level in the lower-income groups is a concern. These results point out that effort should be concentrated on educating and creating awareness about Reverse Mortgage in the lower-income group.

Home Ownership

H6: Home Ownership does not have any association with awareness of Reverse Mortgage Loan

The last hypothesis tests the association between homeownership and awareness level for Reverse Mortgage. Table 8 shows the Chi-Square value for this association. Pearson's Chi-Square test yielded a Chi-Square value of 13.809. Since this value produced a significant difference at .05 level (p-value as 0.000), it is concluded that homeownership is significantly associated with the awareness of Reverse Mortgage in India.

Table 8: Testing significance between homeownership and awareness for Reverse Mortgage

Variable	Pearson Chi-Square Value	P-Value	Result	Cross Tab Results	
				Categories	**Awareness for Reverse Mortgage Loans**
Home Ownership	13.809	0.000*	Significant	Yes	77.3%
				No	22.7%

*Significant at 0.05 level

Source: Based on SPSS output

To focus on significant relationships, values on crosstab between homeownership and awareness level are also studied. The results indicate that 77.3% of percentages of homeowners are aware of Reverse Mortgage. The fact that homeownership is a prerequisite to qualify for a Reverse Mortgage loan makes these homeowners eligible for Reverse Mortgage. Thus, the enormous potential of Reverse Mortgage

loans in India can be judged by the fact that 77% of homeowners amongst the respondents are aware of Reverse Mortgage. Table 9 summarizes all the statistical results using the SPSS software.

Table 9: Testing the significance of respondent's demographic factors in awareness for Reverse Mortgage

Demographic Factors	Pearson Chi-square Values	Degrees of Freedom	P values	Results
Gender	2.608	1	0.106	Do not Reject
Age	10.2	4	0.037*	Reject
Education Level	8.772	4	0.067**	Reject
Living District	3.36	4	0.499	Do not Reject
Monthly Income	7.931	4	0.0948**	Reject
Home Ownership	13.809	1	.000*	Reject

Source: Based on SPSS output

SUMMARY OF EMPIRICAL FINDINGS

In the analysis of the primary data, 77% of the respondents are found to be aware of Reverse Mortgage in India. Of the six variables, four variables: age, education level, homeownership, and higher income levels were found to be significantly related to awareness levels. The awareness for Reverse Mortgage is found to be very low in the age bracket of above 75 years understandably due to the reason that this age category might be too old to understand the complexities of Reverse Mortgage. Maximum awareness is found in the age bracket of 30- 40 years, bringing forth the fact that financial literacy is gaining ground in India and that the younger lot is seeking innovative financial solutions to plan for their retirement needs beforehand. Higher awareness for Reverse Mortgage was found at higher levels of education and vice versa. Homeowners exhibited greater awareness for Reverse Mortgage loans while respondents in the highest income bracket displayed the least awareness, primarily due to them being financially stable thus ruling out the need for Reverse Mortgage.

CONCLUSION AND RECOMMENDATIONS OF THE STUDY

The association of socio-demographic influences and retirement planning has an impact on the knowledge and the awareness of the product. This study analyzed the demographic factors in the Indian context to gauge their impact on the understanding and awareness of reverse mortgage in India. Of the six demographic variables analysed, four are found to be significantly related to awareness level for Reverse Mortgage in India. The findings indicate that age, education level, homeownership, and monthly income significantly impact the awareness level, thereby supporting these hypotheses. The other variables like gender and living district are not found to have any impact on the dependent variable. These results are in line with the existing studies on the subject.

This study provided an opportunity to examine the significance, necessity, and application of Reverse Mortgage in the Indian context. The study's findings have important implications for regulators and lending/banking institutions.

IMPLICATIONS FOR THE REGULATOR

The research has found that income, age, and education affect the awareness level for Reverse Mortgage. Based on these results, the following recommendations are suggested:

- Reduced awareness level in the lower-income groups is a concern. This puts forth the point that efforts should be concentrated on educating and creating awareness about Reverse Mortgage, particularly in the lower-income group.
- The study identifies education having a significant relationship with awareness for Reverse Mortgage loans. It is recommended that the government focusses its effort on improving financial literacy in India. The need for retirement planning should be stressed upon with a special focus on the option's available post-retirement.
- Education and effective counselling can help Indian seniors understand the difference between the vulnerability they feel when tied to traditional loans and the emotional, social, and psychological comforts that Reverse Mortgage provides.

- To increase product awareness, the government could appoint a nodal agency to market Reverse Mortgage through brokers/consultants. The incentive scheme can motivate these brokers/consultants to sell Reverse Mortgage loans.
- To summarize, the goal should be to educate, educate, and educate again. Every organisation, whether government, bank, or lending, should strive to educate and inform consumers about the importance and necessity of Reverse Mortgage products. Educating them would not only raise their awareness of Reverse Mortgages, but would also allay their concerns about the product.

LIMITATIONS AND SCOPE FOR FURTHER RESEARCH

The study's findings are constrained by certain limitations, which provide opportunities for additional research. The absence of any such work in the area of Reverse Mortgage in India is a major limitation in the current body of research. Because reverse mortgages are a relatively new concept, there is a scarcity of empirical research in the Indian context. Some more determinants such as control and interactive variables affecting the Reverse Mortgage purchase decision could have been considered for the study.

This study can be further extended to evaluate the impact of specific demographic variables (age, education level, income level) on the purchase decision for Reverse Mortgage loans. A study on the cash requirements for different income categories in senior citizens, city-wise can be conducted. This study can help the government envisage the possible variants of Reverse Mortgage loans, most suitable for various income categories, city wise.

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Ground Water Treatment Using Agro-Based Absorbent Materials

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Abstract. In most rural and urban places, people are utilizing groundwater for their domestic purposes. The rural area population is mainly exposed to groundwater through dug wells since its hard-to-get purified drinking water is feasible. The people were not aware of the adverse effects of water-borne diseases on their well-being caused by the abnormal levels of chemicals present in the untreated groundwater. In this study, the groundwater was treated using activated carbon as an adsorbent, and the mineral content was analyzed to assess the groundwater quality to incorporate as drinking water. The sample was collected in the Dharmapuri district located in Tamil Nadu, India. The bamboo and pomegranate peel were used as the adsorbents to remove pollutants from the groundwater. The Physical, chemical, and biological characterization for the sample were determined. The results showed that the agro-based water holds good in minimizing the acceptable limit of chloride, calcium, and manganese. The treated water determined to have a permissible limit of fluoride content (less than 1.2 mg/l), thereby chosen activated carbon, is an effective adsorbent in purifying the groundwater.
Keywords: Chlorides, Conductivity, Groundwater, Hardness, Quality, TDS and Turbidity.

INTRODUCTION

Nature's most significant resource is water, and all living beings survive because of its vital role (R. M. Ali et al., 2016). Drinking safe and pure water is a critical requirement for every human being. However, because of the pollution of water and overexploitation, freshwater becomes a scarce commodity. Groundwater usages now rectify the primary demand for water (N & Poongothai, 2008). Hence the need to protect the quality of groundwater became a considerable responsibility for the welfare of the human community. Even water budget planning became mandatory for policy planners because of the usage of groundwater for drinking purposes, irrigation for crops, and other purposes (F. Ahmed et al., 2014). The domestic water collected at three different locations in the Dharmapuri district is contributed by the fluoride-bearing rocks, which are the primary resource of fluoride in groundwater, that possess rock-producing minerals (Alvarez-Bastida et al., 2018). The calcium level decreases with a higher level of fluoride because of the carbonate precipitation in an aquifer; the substitution of Na by Ca (Shanmugasundharam et al., 2017) decreases the amplitude of the endplate potential and produces a slight decrease in quantal content neuromuscular junction study. However, the fluorites of these ions have low solubility (Nethaji Mariappan, 2015).

Acknowledging the filtration through a medium concentrated with Ca of underground water, the positive correlation of Ca2+ with fluoride indicates that the hardness of water rises with depth. Therefore, high fluoride content is reported in many geographical areas, and the allowable fluoride levels can be calculated based on climatic conditions (Adekola et al., 2016).

The air temperature influences the consumption level of water and subsequently the ingested quantity of fluoride. If groundwater quality gets affected, it is not easy to revive its originality (Florence et al., 2012). The nature of groundwater quality might get affected by the temporal changes in the different layers of soil mass, hydrologic and human activities. There is a rapid development occurring in the industries, and simultaneously, it creates a massive demand for fresh water supplies. Removal of heavy metal content in water before it reaches aquatic environment makes desirable for drinking purpose.

Adsorption process

The adsorption process offers an adaptable design and procedure to produce treated waste matter without any odor, color, and sludge. The low energy consumption, along with low concentrations, adsorption also can remove pollutants (R. M. Ali et al., 2016). An interactive process can be done either physically or chemically by combining the surface of solid adsorbent depending on the intermolecular forces(Rudi et al., 2020). Adsorption is a kind of segregation process for isolating the chosen metal ion from the reaction mixture, adsorption, a segregation process is used, and it can be done by continuous experimentation or semi-batch, or batch as explained infig.1.

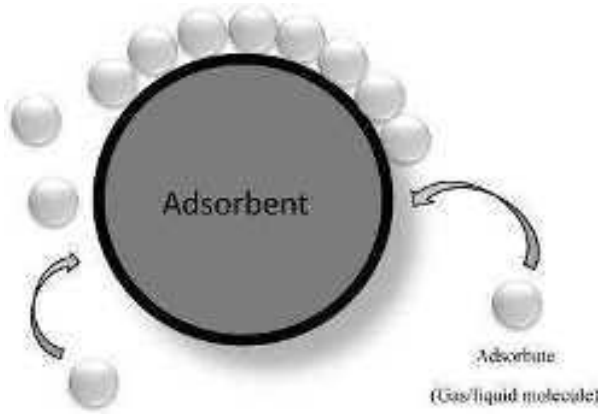


FIG. 1: Adsorption process involving adsorbate and adsorbent

Physical and chemical adsorption is the two forms of the Adsorption process. When the adsorbate and absorbent go through polarity, hydrogen bonding, dipole-dipole interactions, and through weak Vander Waals forces, physical adsorption takes place. Through the materials' surface, this physical process absorbs metal ions electrostatically(I. Ali et al., 2012). Chemical adsorption is a type of adsorption in which chemicals in one state become adsorbed by chemicals in another state (e.g., gases adsorbed by a liquid or solid). Chemical adsorption specifically refers to adsorption caused by a chemical reaction between the adsorbent and adsorbing elements (Fatombi et al., 2012).

MATERIALS AND METHODS

An effective adsorbent for treating water is activated carbon(A. Akl, 2013). It removes sediment, chlorine, taste, volatile organic compounds (VOCs), and odor from water (M. J. K. Ahmed & Ahmaruzzaman, 2016) (Abdeen et al., 2014). The smallest particles of size ranging from 0.5 to 50 micrometers can be removed with a carbon filter scan. For this process, peels of bamboo and pomegranate with pH in a range of 6-8 are utilized (A. Ali et al., 2016). The peel of bamboo and pomegranate must get carbonized before utilizing it, and the optimum time is taken for carbonization is 100 mins. The carbonization absorbed the optimum absorbent (0.35g) from bamboo and pomegranate peels(Omar et al., 2020).These materials were collected and treated for preparing carbon filter beds large quantities of wastewater treated by adopting the Fixed Bed Column Adsorption System (Alaei Shahmirzadi et al., 2018).

Characterization and Properties of Activated Carbon

Activated carbon's (AC) characterization must be noted before utilizing it for specific purposes (Anastopoulos et al., 2019). Characteristic features of the AC will differ based on the physical and chemical properties of the raw materials and based on the method used for activation. Initially, natural carbon sources must undergo selection and classification for the process of activated carbon(Abdić et al., 2018). The selection process will be done based

on the activated carbon's design specifications and its different properties. Bamboo and pomegranate peels are few among the familiar raw sources utilized for the process of activated carbon.

Characteristics of adsorbents

The adsorbent should satisfy two requirements:

- The diameter of the pore should be large enough to the size of the adsorbate molecule.
- Its surface functional groups must be suitable for attracting the adsorbate molecule.

Advantages of activated carbons as adsorbents

- During the process of adsorption, the capacity of the activated carbon becomes proportional to the internal surface area, pore size distribution, and pore volume, particularly in surface chemistry(I. Ali & Gupta, 2006).
- Further removal efficiency can be done by utilizing the electric force between the carbon surface and the adsorbate.

RESULTS AND DISCUSSION

Hardness

The quality of water that resists forming lather with soap is the hardness of the water. Hence for producing lather in hard water, a considerable amount of soap is required. Calcium and magnesium are the principle ions that create the hardness(Natarajan et al., 2020). While boiling the water, it can be removed if its anion is carbonate, and it is not possible if the anions are sulfates, chlorides, and nitrates. While comparing with surface water, groundwater is often more complex because it contains high solubilizing potentials. Especially the water from rocks has gypsum, calcite, and dolomite. Sewage, run-off from soils, especially the limestone formations, and the building materials, which consist of calcium, oxide containing magnesium, are some of the sources of the hardness. In Tables 1,2 and 3, hardness test results are summarized.

TABLE 1: Total hardness test before treatment

Sample No	Vol of Sample(ml)	Burette Reading		Vol of EDTA(ml)
		Initial	Final	
1	20	0	6.2	155
2	20	6.2	11.4	130
3	20	11.4	15.8	110

TABLE 2: Total hardness test after treatment

Sample No	Vol of sample(ml)	Burette reading		Vol of EDTA(ml)
		Initial	Final	
1	20	0	4.8	120
2	20	4.8	9.2	110
3	20	9.2	12.8	90

The results of the total hardness test show that the treatment process decreases the hardness of water (120 mg/l) compared with the untreated sample (155mg/ l). The presence of calcium and magnesium is the primary cause for the hardness, and it also contains carbonate in higher proportions, which makes the pH value of the water inappropriate for drinking purposes.

TABLE 3: Total hardness test for before and after treatment

Sample no	Before treatment result (mg/l)	After treatment result (mg/l)
1	155	120
2	130	110

3	110	90

Inference

The result from the above tables shows that sample 1, among all other samples, contains maximum hardness (155 mg/l), and it is reduced to 120 mg/l after the treatment is completed.

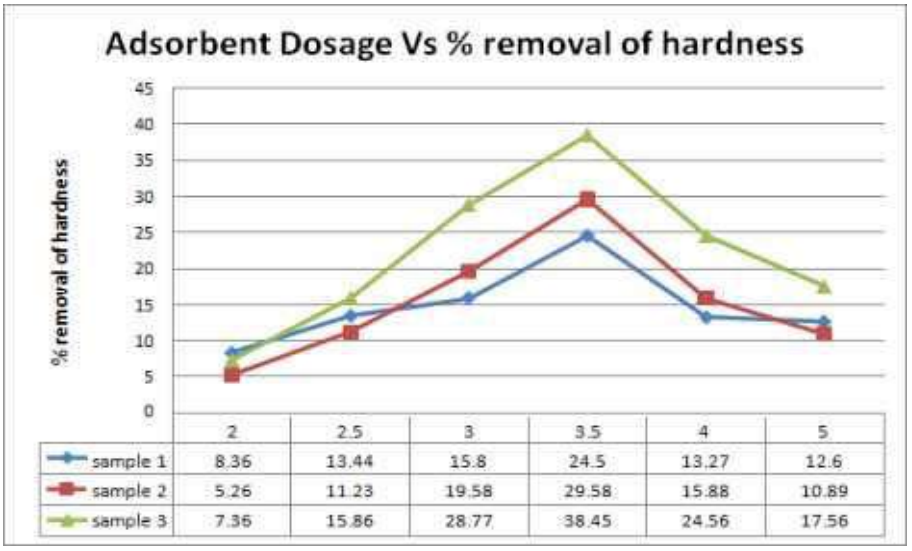


FIG. 1 Adsorbent dosage Vs percentage removal of hardness

Adsorbent Dosage

Absorbent dosage Vs. Removal of hardness's optimum range increased with the ranges from 38.45 to 40%. The hardness in water has the possibility of occurring manually in the groundwater by the wastages from chemical and mining industries or with the excessive usage of lime to the soil in agricultural areas (M. J. K. Ahmed & Ahmaruzzaman, 2016) (Kannaujiya et al., 2013).

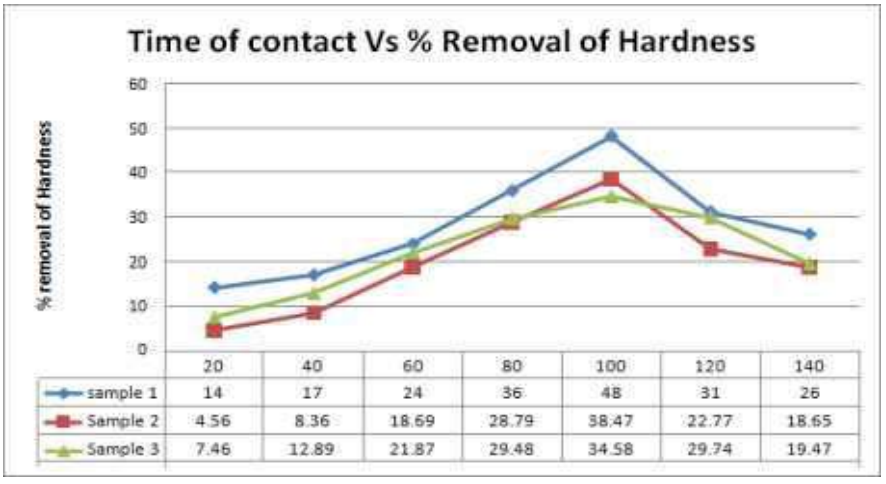


FIG. 2 Time of contact Vs percentage removal of hardness

Time of contact

The fig. 2 represents the optimum range of Time of contact Vs. Removal of hardness in drinking water and irrigation purpose water. The value increases from 50% to 48 in the tested samples. In most of the regions of the province, water with hardness is poor. Because of the unpleasant taste, which possesses calcium in higher concentrations and other ions, the hardness of the hard water becomes a visual concern, and the ability of soap to produce lather is also reduced.

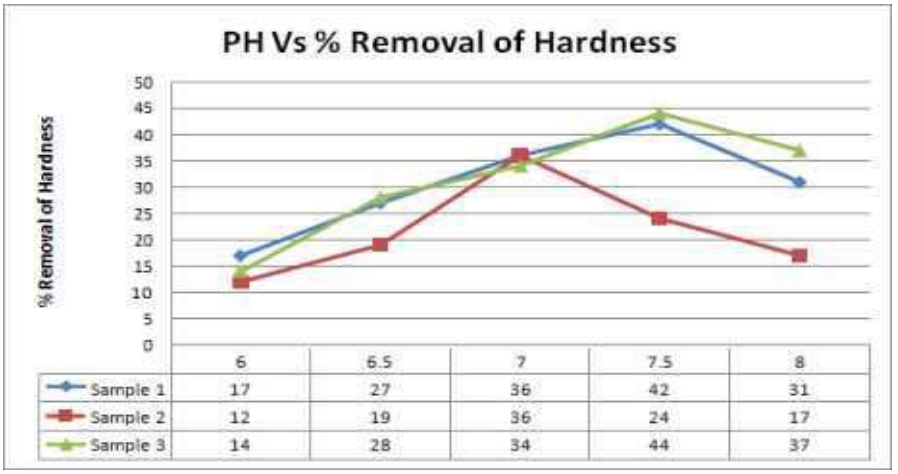


FIG. 3: pH Vs Removal of hardness

pH of Adsorbent

The fig. 3 shows that the optimum range of pH Vs. Removal of hardness range increased in the tested samples with the range of 45% to 44. The hardness of the water is removed, and the pH value is reduced simultaneously. It makes the water suitable for drinking, irrigation as well as industrial purposes.

Particle Size of Adsorbent

The fig. 4 displays the optimum range of Particle Size of Adsorbent Vs. Removal of hardness range in the tested samples. The range increases from 50% to 48 in the tested samples. The hardness of water creates precipitation in other metals. Therefore, the bioavailability and scaling in boilers and industrial equipment are reduced.

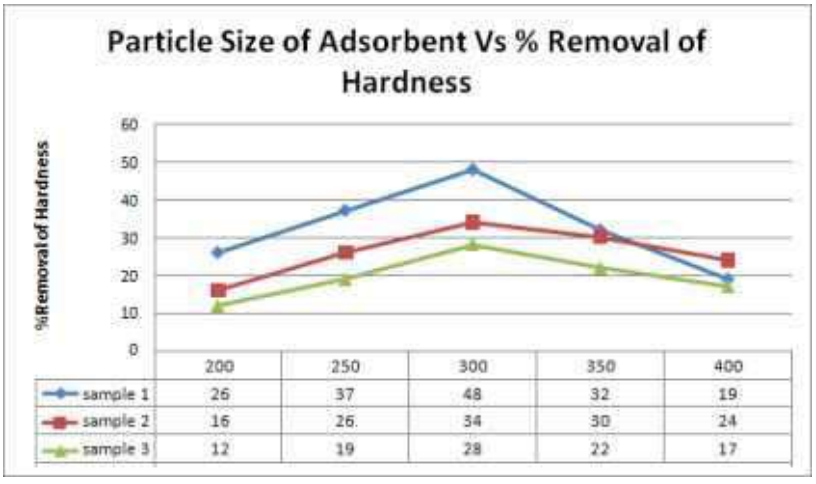


FIG.4: Particle size of Adsorbent Vs Removal of hardness

Chlorides

Chlorides are formed in the groundwater through various manual interruptions like sewage discharge, brine in oil well operations, saline, draining irrigation water, and toxic colored water discharge. The desirable amount of chloride that can be present in drinking water is Cl in mg/l is 250mg/l according to BIS 105000 standard, which is displayed in table 4. Fixed Bed Column Adsorption System of Chloride test after treatment is given in table 5.

TABLE 4: The observations of chlorides test before treatment

Sample no	Vol of sample (ml)	Burette reading		Vol of EDTA(ml)
		Initial	Final	
1	20	0	7.3	182.44
2	20	7.3	15.8	212.43
3	20	15.8	23.4	189.94

TABLE 5: The observations of chlorides test after treatment

Sample no	Vol of sample (ml)	Burette reading		Vol of EDTA (ml)
		Initial	Final	
1	20	0	4.2	104.22
2	20	4.2	8.8	114.14
3	20	8.8	12.5	91.81

Results of chlorides test for all samples

The total Chloride level was high in the samples, and after it gets treated, it reduced ranges from 212.43mg/l to 114.14mg/l. Hence its desirable for drinking purposes. Though hardness has no harmful impacts on health, the maximum permitted value recommended for drinking water is set as 250 mg/l in table 6.

TABLE 6: Total Chlorides test for before treatment result and after treatment result

Sample No.	Before treatment Result (mg/l)	Before treatment Result (mg/l)
1	182.44	104.22
2	212.43	114.14
3	189.94	91.81

Inference

The result from the table 5 shows that all the water samples used for treatments are hard water. However, water sample 2 had a maximum amount of chloride of 212 mg/l and reduced to 114.14 mg/l after it was treated.

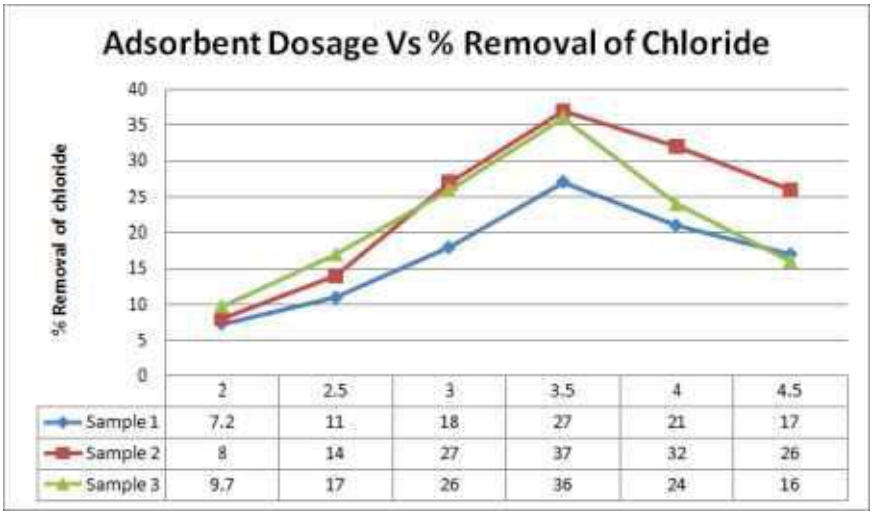


FIG.5: Optimum range of Adsorbent dosage Vs Removal of chloride

Adsorbent dosage

The fig. 5 displays the optimum range of Adsorbent dosage Vs. Removal of chloride. Its samples range increase from 37% to 38. The maximum value for the acceptable limit for chloride is 250mg/l, and the value resulted in the current study is under the permitted limit. The higher value of chloride will cause some potential health effects; it also affects the taste of the water and causes corrosion.

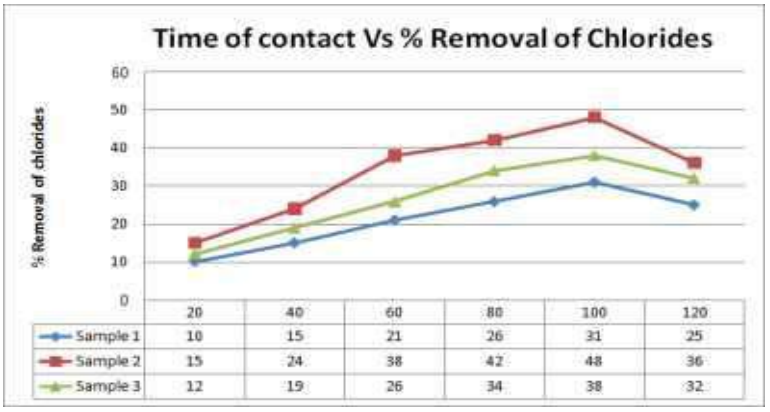


FIG.6: Time of contact Vs removal of chlorides

Time of contact

The fig. 6 displays the optimum range of Time of contact Vs. Removal of chlorides in the water. Its samples range increase from 50% to 48. In most of the region's province, water with the removal of chlorides is considered flawed. The unpleasant taste of the water became an aesthetic concern because of the higher intensity of calcium and other ions that appear in the water. The chloride level was in the desired level in all tested samples as the recommended standard for drinking water. Thus, it reveals that the chloride content present in the tested sample was slightly alkaline.

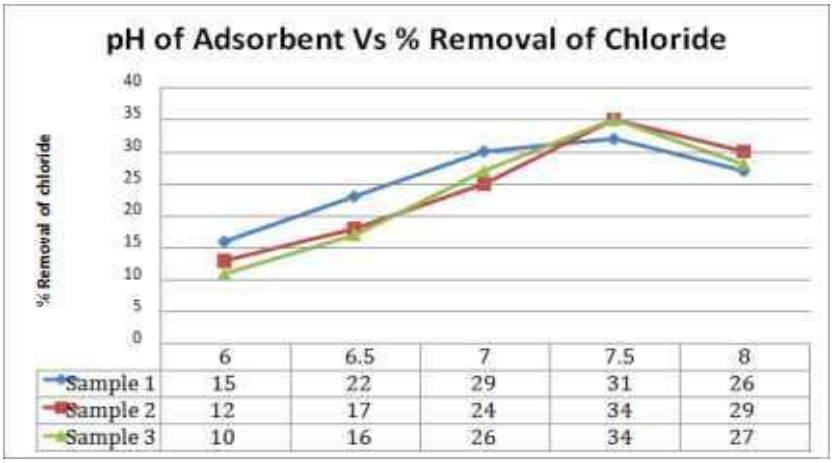


FIG.7: pH of Absorbent Vs Removal of Chloride

pH of Absorbent

The groundwater sample analysis from fig. 7 includes the level of concentration of pH of Absorbent Vs. Removal of Chloride of inorganic constituents. During the analysis, the sample ranges increased from 35% to 34. It is based on the physical and chemical parameters of the samples. The pH of all samples appears within the desirable limit of chloride range, i.e., 250mg/l, which is necessary for drinking water according to the limit prescribed for the drinking water standard.

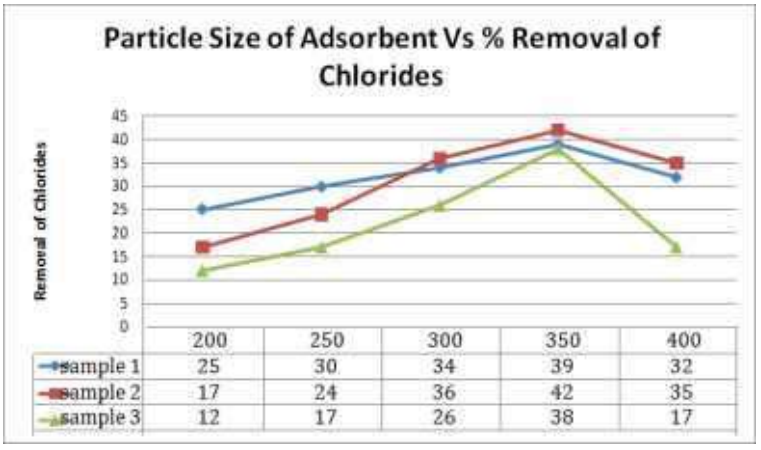


FIG.8: Particle Size of Adsorbent Vs removal of chloride

Particle Size of Adsorbent

The fig. 8 displays the optimum range of Particle Size of Adsorbent Vs. removal of chloride. The range of the samples increases from 44%to42. An unacceptable limit of chloride content in water constitutes incrustation on the exposed area, thereby minimizes its future production rate of material.

Turbidity

The expression of specific properties of water that creates light scattering and light-absorbing phenomena is known as turbidity. For turbidity water analysis, samples are taken from the water resources which contain silt, clay, colloidal particles, plankton, suspended matter, and other micro-organisms. This can be analyzed through nephelometry and turbidity tests. Water's turbidity decreases the water quality by various parameters like change

in color, which occurs because of the colloidal particles, which in turn promotes microbial proliferation. It also modifies the chemical parameter of drinking water by creating chemical reactions by causing humid matter and heavy metals(Alalwan et al., 2020)(Abed et al., 2011). The study of water's turbidity before and after treatment is given below in table 7 and table 8.

Table 7: The observation of the turbidity before Treatment

Sample No.	Turbidity
1	3.2
2	4.5
3	2.7

Table 8: The observation of the turbidity After Treatment

Sample No.	Turbidity
1	0.5
2	0.8
3	0.4

Results of turbidity test for all samples

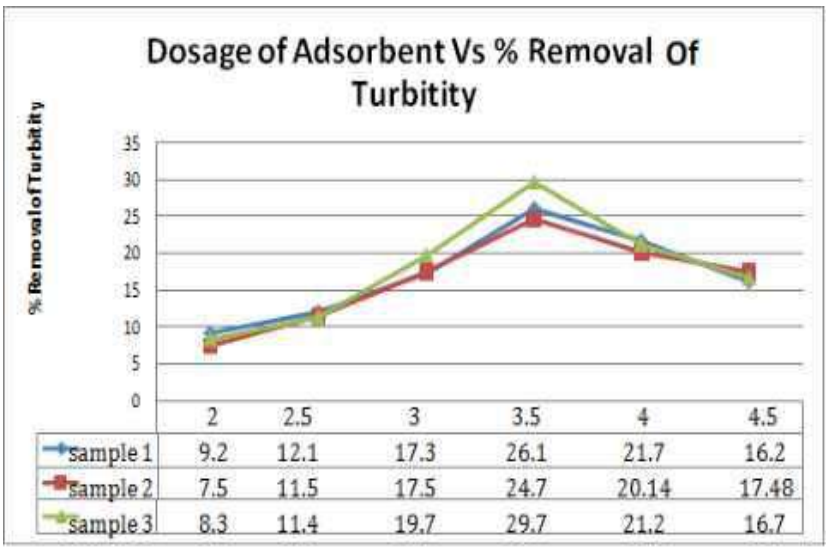
The turbidity test result shows that the level of turbidity in the treated samples was high before the treatment, and it reduced to the level that is preferable for drinking purposes. Its ranges are reduced from 4.5(NTU) to 0.8(NTU). Though there is no proven research to claim that turbidity creates adverse effects on earth, it must be under acceptable drinking water standards. It is essential to keep the turbidity level under control since it might affect the acceptability of the consumers and the efficiency of disinfection with chlorine. Since it decreases the efficiency of disinfection, it might protect the survival and growth of the microorganisms. The result of the observation is given below in table 9.

Table 9: Results of turbidity test for before and after test samples

Sample no	Before treatment result (NTU)	After treatment result (NTU)
1	3.2	0.5
2	4.5	0.8
3	2.7	0.4

Inference

The above test results show that the water samples taken from all 3 locations were turbid, but it reduced to a permissible limit of the given standards after getting treated.

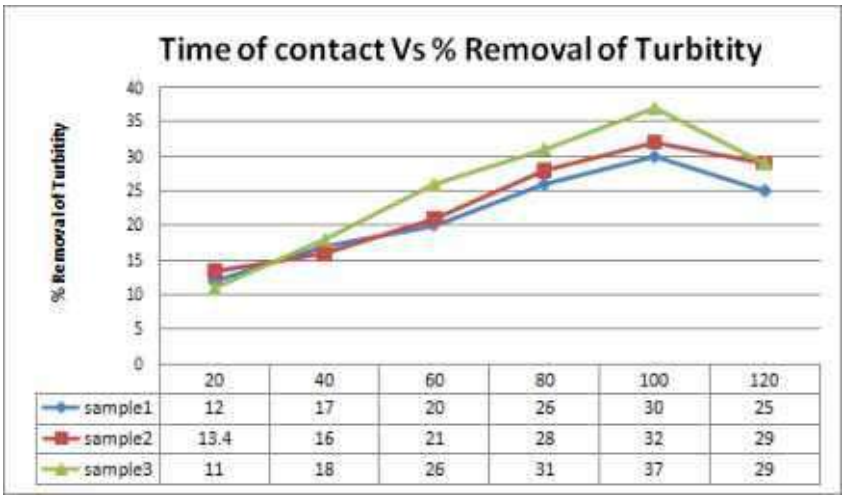


	2	2.5	3	3.5	4	4.5
sample 1	9.2	12.1	17.3	26.1	21.7	16.2
sample 2	7.5	11.5	17.5	24.7	20.14	17.48
sample 3	8.3	11.4	19.7	29.7	21.2	16.7

FIG 9: Dosage of adsorbent Vs removal of turbidity

Dosage of Adsorbent

The fig. 9 displays the optimum range of Adsorbent of dosage Vs. Removal Turbidity. The ranges of the samples increased from 30% to 29.7. When the adsorbent dosage is increased, a greater surface area is provided, and simultaneously, it increases adsorption. Moreover, when the adsorbent dosage is increased beyond the optimum dosage, improvement in the removal efficiency of turbidity is noticed, yet it decreases adsorption capacity.



	20	40	60	80	100	120
sample1	12	17	20	26	30	25
sample2	13.4	16	21	28	32	29
sample3	11	18	26	31	37	29

FIG 10: Time of contact Vs removal of turbidity

Time of contact

The fig.10 displays the optimum range of Time of contact Vs. Removal of turbidity. The ranges of the tested samples increased from 38% to 37. Initially, the selection and classification of a raw carbon source are made for the process of turbidity. The design specification with different properties during contact appears as the primary criteria in the selection process.

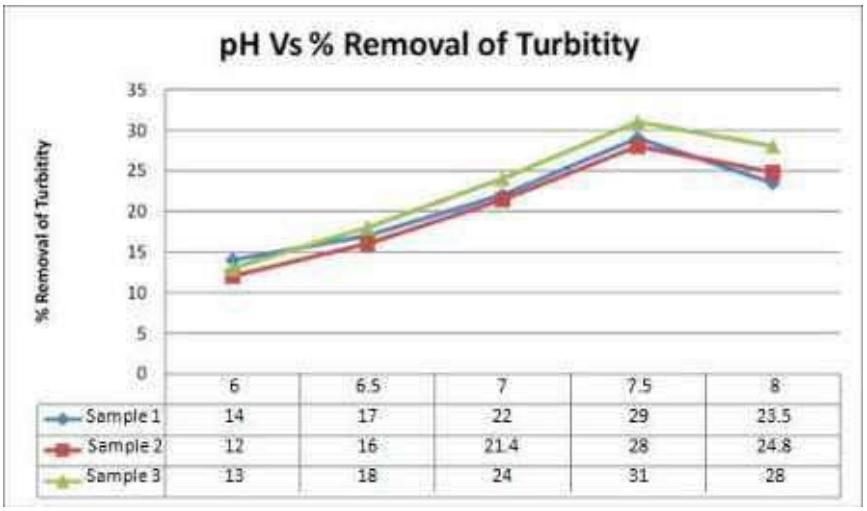


FIG 11: pH of Absorbent Vs Removal of Turbidity

pH of adsorbent

The fig.11 displays the assessment of groundwater samples in which the concentration of pH of Absorbent Vs. Removal of Turbidity of inorganic constituents is observed. In the observed samples, the ranges increase from 32% to 31. The physical and chemical parameters show extreme pH values, resulting in irritation in the eyes, skin, and mucous membranes. It might also cause gastrointestinal irritation in sensitive individuals.

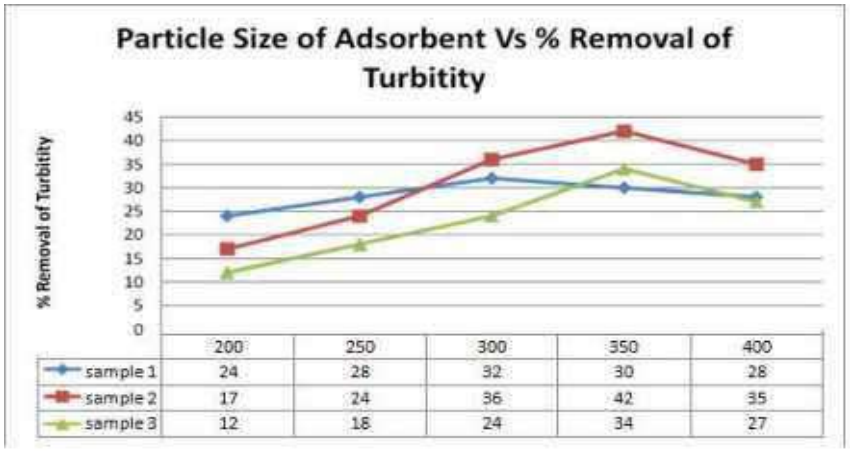


FIG 12: Particle Size of Adsorbent Vs removal of Turbidity

Particle Size of Adsorbent

The fig.11 displays the optimum range of Particle Size of Adsorbent Vs. removal of Turbidity. The ranges of the tested samples increased from 44% to 42%removal of metals that causes precipitation in the process of Turbidity. Before discharging water into the aquatic environment or drinking usages, removing heavy metals will make a huge difference.

pH

The pH value of water defines the hydrogen ion activity of a non-concentrated solution. It works as an indicator to indicate whether the given solution or water is acidic or alkaline and its intensity. It also accurately says whether the water is hard or soft. The stable level of pH in pure water is 7, and if the water level goes below, it is termed acidic. If its value is higher than 7, then it is alkaline. Before getting treated, the pH level of surface water was in

the range of 6.7 to 6.95, and its level got increased between7.65to 8.95 after it got treated. These observations were tabulated and listed below in table 10 and 11. The capacity to resist the changes in the pH value, which makes the water more acidic, is termed alkalinity. P-value also helps us determine whether the water is corrosive or toxic. Hence, it is necessary to determine the corrosiveness of the water.

TABLE 10: The observations of the pH Before Treatment

Sample No	pH
1	6.95
2	6.75
3	6.82

TABLE 11: The observations of the pH After Treatment

Sample No	pH
1	8.95
2	7.65
3	7.84

Results of pH for all samples

The level of pH in all the liquids influences the taste and odor of that liquid. The flavor is measured based on the blend of taste, temperature, odor, and feel of the given liquid. Moreover, the pH value has control over the equilibrium strength of the ionized and neutral forms of a substance in solution. The treatment made in the water samples increases the threshold of pH in ranges from 6.95 to 8.95, which is tabulated below in table 12.

TABLE 12: Results of pH for samples

Sample No	Before treatment result	After treatment result
1	6.95	8.95
2	6.75	7.65
3	6.82	7.84

Inference

The above test result shows that the pH level of the surface water system of all the tested samples lies within the allowable limit, i.e., 6.5 - 8.5.

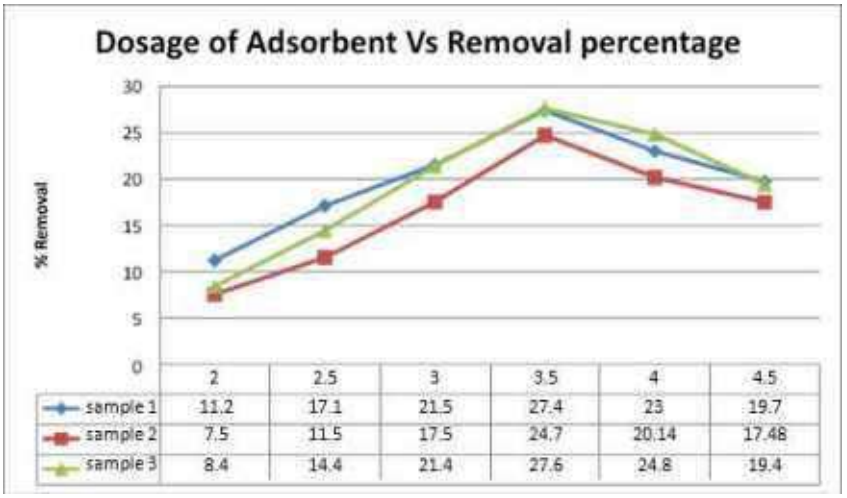


FIG 13: Adsorbent of dosage Vs removal percentage

Dosage of Adsorbent

The fig.13 displays the optimum range of adsorbent dosage Vs. Removal percentage. The treated sample ranges increase from 28.6% to 27.6%. The higher-level pH value is in the water creates some adverse effects on reproduction and reduction in biodiversity. Furthermore, it might interrupt the potential health, taste and causes corrosion. The value observed in the present study appears to be within the permissible limit.

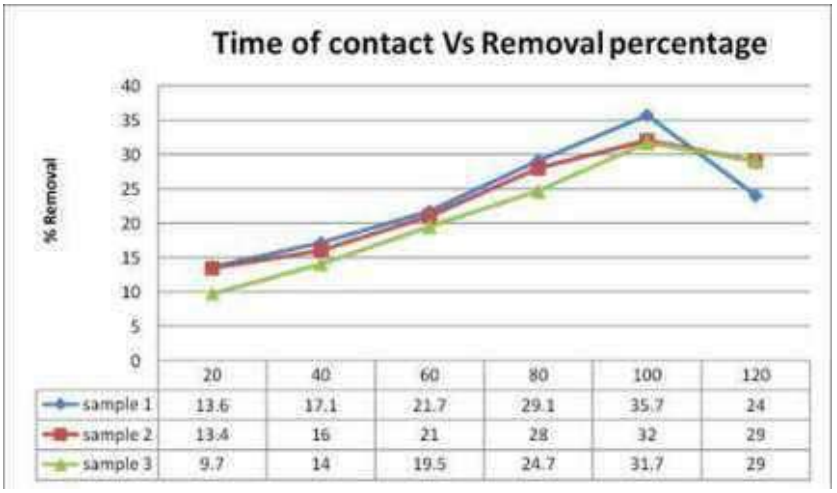


FIG. 14: Time of contact Vs removal of percentage

Time of Contact

The fig. 14 displays the optimum range of Time of contact Vs. Removal of percentage. In the tested samples, these ranges increase from 37% to 35.7. The sources were chosen based on the design specifications along with different properties during the Time of contact. The solubility of oxygen level in water decreases when the temperature of the water is increased.

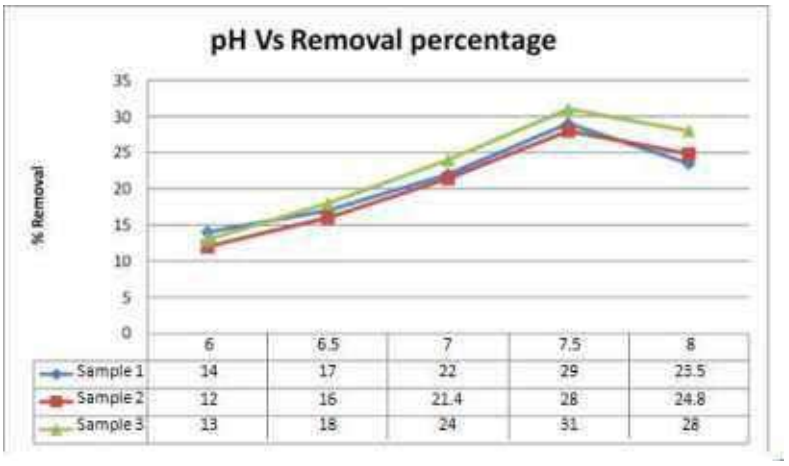


FIG.15: pH of Absorbent Vs Removal of percentage

pH of adsorbent

The assessment of groundwater samples involves the determination of the concentration of pH of Absorbent Vs. Removal of the percentage of inorganic constituents. The selections range increase from 32% to31. The desirable pH range is 6.95 to 8.95which is necessary for drinking water. Otherwise, it creates some effects on humans while exposed to extreme pH values, irritates the skin, eyes, and exacerbation of skin disorders.

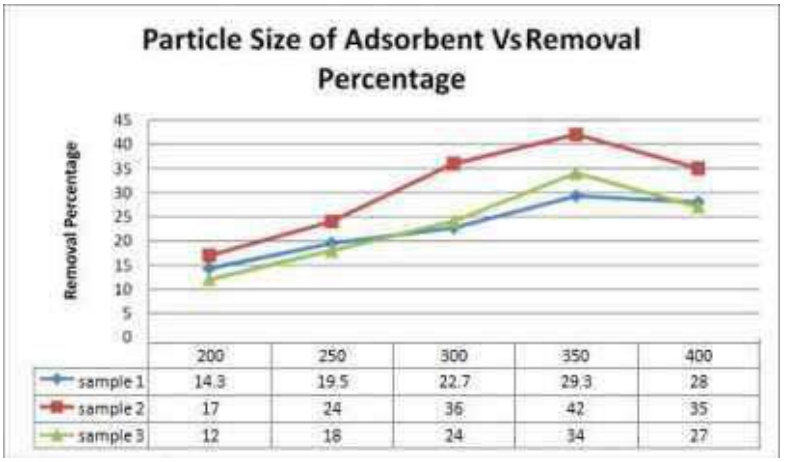


FIG.16: Particle Size of Adsorbent Vs removal of percentage

Particle Size of Adsorbent

The fig.16 displays the optimum range of Particle Size of removal of percentage. The tested samples ranges increase from 44% to 42%. Reduction of rate creates an Impact by causing precipitation on other metals, thereby reducing their bioavailability and scaling in boilers and industrial equipment. It also causes some acute effects.

Fluoride

According to the guideline, the recommended value of Fluoride is less than the indicated value of polluted water with Fluoride(Gorchev & Ozolins, 2004). The observation of the fluoride before and after treatment is given below in table 13 and table 14.

TABLE 13: The observations of the fluoride before treatment

Sample No.	Fluoride
1	2.3

2	3.6
3	4.8

TABLE 14: The observations of the Fluoride After Treatment

Sample No.	Fluoride
1	0.62
2	0.98
3	1.12

Results of fluoride for all samples

Total Fluoride found in the samples range was high before treatment and the result reduced after treatment which ranges from 4.8 mg/l to 1.121mg/lit indicates that the water is harm less to drink. Hardness has no proven harmful effects on health. Still, it is under the maximum permissible level prescribed for drinking water The observation of the total result is listed in table 15.

TABLE 15: Results of fluoride for all samples

Sample No.	Before treatment result	After treatment result
1	2.3	0.62
2	3.6	0.98
3	4.8	1.12

Inference

From the above test it has been estimated that the fluoride of the water samples washing and after the water treatment, it was reduced to a desirable limit.

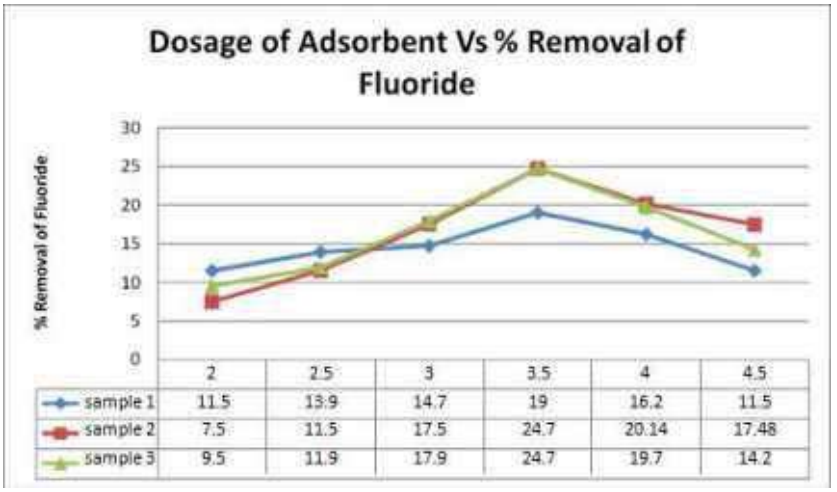


FIG 17: Adsorbent dosage Vs removal of fluoride

Dosage of Absorbent

The treated samples range increases from 25 % to24.7. If the fluoride content is in higher value, it will cause some potential health effects on taste and corrosion. The value stated in the current study is under the permissible limit.

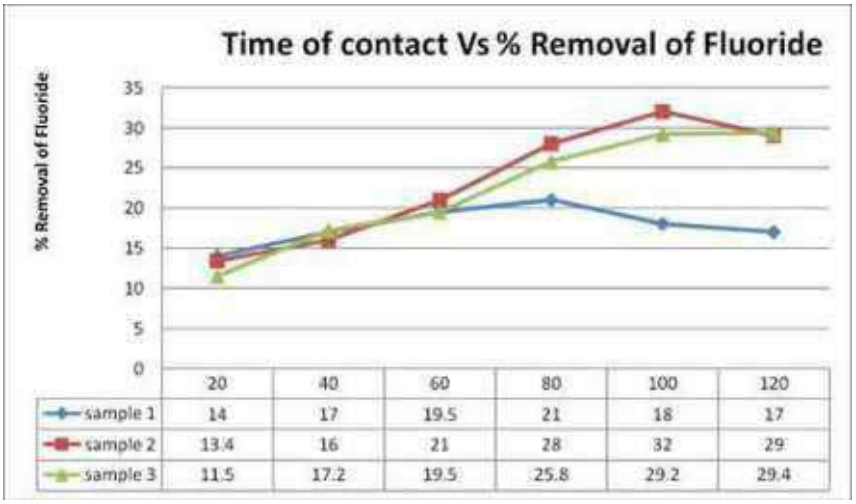


FIG 18: Time of contact Vs removal of fluorides

Time of Contact

The fig.8 displays the optimum range of time of contact Vs. Removal of fluorides in water. The samples were taken increases in the fields from 33% to 32. In most regions, water with fluoride removal is considered inferior to water with a time of contact. Hard water is mainly an aesthetic concern because of its unpleasant taste.

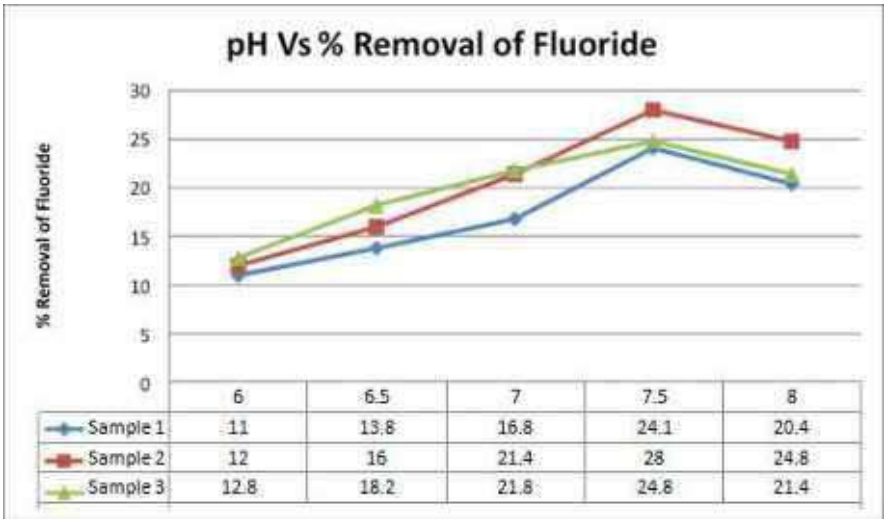


FIG 19: pH Vs removal of fluorides

pH of Absorbent

From, the parameter that strongly affects the adsorption capacity is the concentration of the pH. The effect of pH level of Absorbent on the removal of fluoride from groundwater was studied at removal fluoride concentration of sample1 for25%/24.1, sample 2 for27%/28and sample 3 for 20%24.8. The fluoride content varies between6.95.-7.84. The values of the fluoride appeared to be within the recommended limits. It creates potential health effects on affects mucous membrane, bitter taste, corrosion(Adeogun et al., 2012).

The fig.19 shows that the parameters strongly affect the adsorption capacity when there is a concentration of the pH level(Luchi et al., 1976). The effect of the pH level of Absorbent on the removal of fluoride from groundwater was studied. During the removal of fluoride concentration, in sample 1 for25%/24.1, sample 2 for27%/28and sample 3 for 20%24.8. In all these samples, the fluoride content varies between6.95.-7.84. The values of the fluoride appeared to be within the recommended limits. Increased dosage of fluoride concentration leads to adverse health effects like hyperglycemic and testosterone problems. It creates a sour flavor and induces a rust formation on metals.

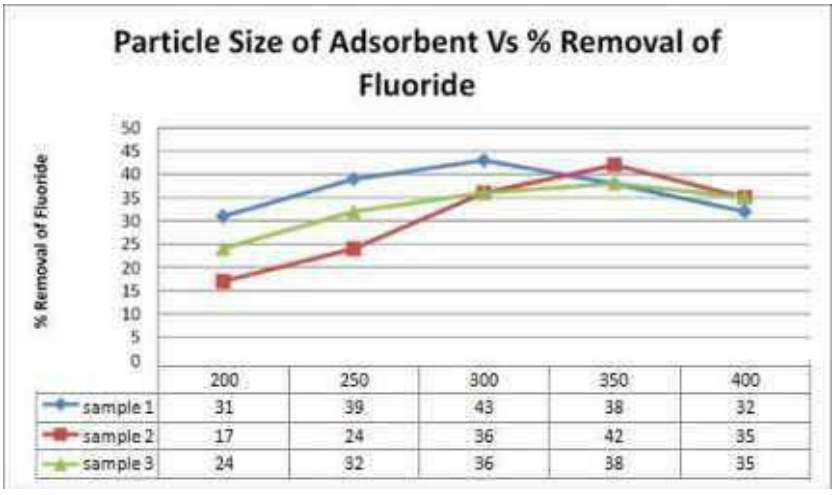


FIG 20: Particle size of adsorbent Vs removal of fluorides

Particle Size of Absorbent

In the fig.20, one of the parameters called an ion-selective electrode strongly affects the adsorption capacity is the concentration of the adsorbents. When noted, the effect of particle size of adsorbent increases Vs. Removal of fluoride reduced ranges from 44%-43on the given samples. The fluoride concentration appeared to be within the recommended limits when studied the removal of fluoride from groundwater.

TOTAL DISSOLVED SOLIDS

Total Dissolved solids in water contain both inorganic salts and organic matter, which might arrive from the sewage, urban run-off, effluent discharge, or natural sodium, chlorides, nitrate, sulfate, calcium, potassium, magnesium, and bicarbonates [27]. The geochemical characteristic of the ground is the primary determinant of the TDS level in the water. The below-given table 16 and 17, tabulates the observation of TDS value before and after getting treated.

TABLE 16: The observation of the TDS before treatment

Sample no	Total solids	Dissolved solids
1	4740	785
2	850	650
3	750	550

TABLE 17: The observations of the TDS After Treatment

Sample no	Total solids	Dissolved solids
1	1150	550
2	650	450
3	450	350

Results of total dissolved solids for all samples

The tables 16 and 17 shows that the total dissolved solids found in the samples were high before it gets treated and reduces after the treatment in the range of 4740-785 to 1150-550, thus makes it safe for drinking purpose. Both the values of before and after treatment are tabulated in table 18.

TABLE 18: Results of total dissolved solids for all samples

Sample no	Before treatment result		After treatment result	
	Total solids	Dissolved solids	Total solids	Dissolved solids
1	4740	785	1150	550
2	850	650	650	450
3	750	550	450	350

Inference

The above test shows that all the water samples contain TDS within the permissible limit. Hence, it does not create harmful reactions in domestic usage.

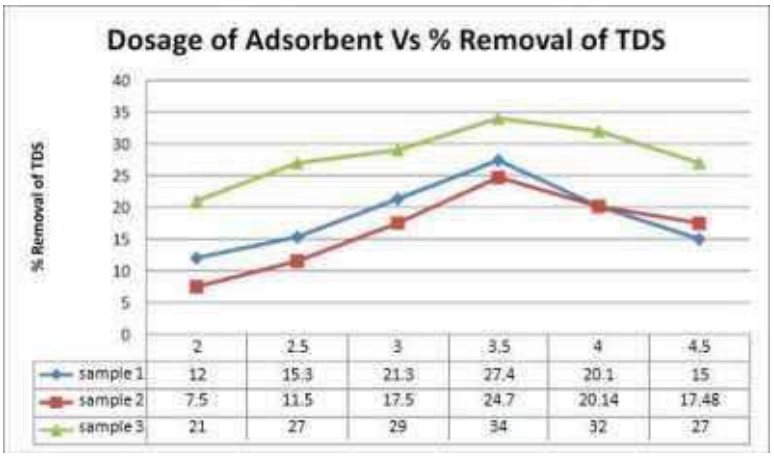


FIG.21: Adsorbent Vs removal of TDS

Dosage of Absorbent

The fig. 21 displays the optimum range of dosage of Adsorbent Vs. removal of TDS in drinking water. The ranges of the samples increase from 35% to 34. The TDS value of the groundwater directly affects the suitability of water for a different purpose are classified and in this study after the removal of a substantial amount of TDS makes the samples suitable for drinking purpose.

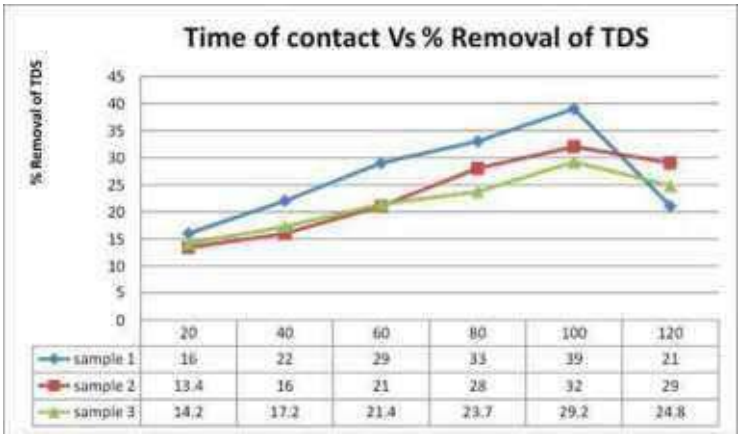


FIG.22: Time of Contact Vs Removal of TDS

Time of Contact

The fig.22 displays the optimum range of Time of Contact Vs. Removal of TDS in drinking water. The ranges of the samples increase from 40% to 39. This range come under the maximum permissible limit for the parameter of drinking water. Therefore, the TDS of this observation is inside the permitted range prescribed by the WHO.

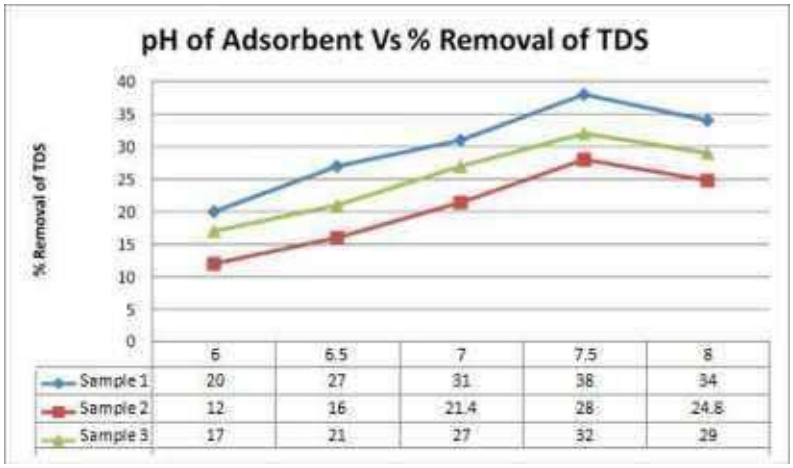


FIG 23: pH of Adsorbent Vs removal of TDS

pH of Absorbent

The above graph displays the optimum range of pH of Adsorbent Vs. removal of TDS in drinking water. The ranges of the samples increase from39% to 38. Nevertheless, during the rainy season, the specific average conductivity goes beyond this limit because of its elevated values.

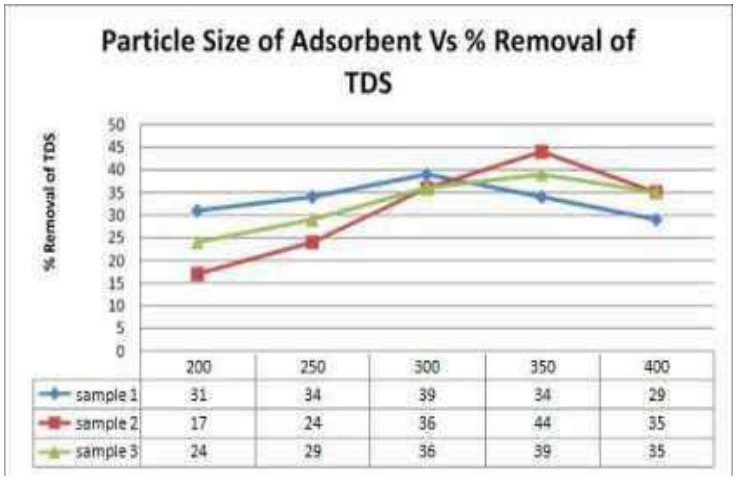


FIG.24: Particle size of Absorbent Vs removal of TDS

The particle size of Absorbent

The fig.24 displays the optimum range of particle size of Absorbent Vs. removal of TDS in drinking water. The sample value increases among the ranges from 45% to 44%the water level in the good increases during the rainy seasons. Thus, the treated water can be served privately, mechanically, and inundation works.

CONCLUSION

The demand for Groundwater increases as new water resources, especially for agricultural and irrigation purposes. Groundwater can be considered to be safe. However, in heavily industrialized areas, the outlet discharged from it consists of toxic chemicals that harm the soil by clogging its pores. Depending on the permeability of rocks and the ground surface, the water infiltrates into the ground is calculated. There is an unsaturated zone below the ground surface. It consists of air in the pore spaces and a saturated zone in which it has all the pores filled with water. Because of insufficient fund generation, water quality gets reduced. It results in the salination effect and waterlogging problems in agricultural land due to pore blocks.

The study's outcome shows that the parameters were analyzed under the permitted limit determined by the WHO for the drinking water apart from turbidity, pH, iron, and ammonia. The water quality parameters, total dissolved solids, electrical conductivity, total hardness, chloride, calcium hardness, total alkalinity, and manganese parameters indicated a significant positive correlation. In addition, total electrical conductivity and dissolved solids have greatly influenced magnesium, calcium, total hardness, total alkalinity, and calcium hardness.

Furthermore, broaden the risk factors involved in consuming low-quality water in a translucent manner among the users and make them aware of the importance of watershed management systems. However, a more adaptable method is needed for an hour to utilize groundwater resources that satisfy both socio-economic settings and biological parameters.

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Treatment Of Wastewater Discharge Into Aliyar River, Anamalai Town Panchayat

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ABSTRACT. Urban wastewater management is a global concern. Rapid urbanisation and indiscriminate natural resources have placed the environment under increasing stress due to human activities and population growth. Different measures are being implemented to prevent further deterioration. In this work, pollution of the Aliyar River passing through the Anaimalai Town panchayat area is studied, and proper water treatment methods are suggested. Aliyar River begins in the eastern slopes of the Anaimalai Hills of the Western Ghats, located in Coimbatore district at 2250 m. For analysing the quality of the river water, samples were collected at eight places and analysed. The test results showed that the parameters such as Alkalinity, Hardness, TDS, Fluorides and Ammonia are more than the permissible limits due to the mixing of contaminated water from domestic and industrial usage. So water treatment is essential, and based on the water sample results, Activated Sludge Process (ASP) and Decentralized Waste Water Treatment (DEWATS) are proposed as the methods of water treatment to remove the excess chemicals in the water so that the water can be let into the river as harmless water and improves the environmental condition of the river and locality. The treated water can be used reused, and mainly it can be used for irrigation. This keeps a check on the water scarcity problem faced by the farmers due to the failure of Monsoon rain.
Keywords: Aliyar, Anaimalai, Water treatment, Samples, Chemical Parameters, ASP, DEWATS.

INTRODUCTION

The world economy mainly depends on water. Around 70% of the freshwater is used in agriculture. One of the ways to reduce the impact of water scarcity and pollution is to expand water usage and wastewater reuse. The water scarcity increase and quick population increase give rise to the need for a proper water management practice. Urban wastewater treatment must be focused more than water supply& treatment.

Anju Singh et al. (2019) explains that a Decentralised Wastewater Treatment System (DEWATS) provide economically feasible and efficient wastewater treatment solution, especially in developing countries. In the state of Maharashtra, India, eight dewars plants are commissioned, and their performance in terms of selected Physico-chemical parameters of the wastewater are compared**.**

K. Singh et al. (2019) explains that Wastewater discharge with high biological oxygen demand (BOD) and high nutrient levels (e.g., nitrate, phosphate) affects water quality and is a significant reason for the degradation of water bodies, including rivers. Phytoremediation algal ponds and Constructed wetlands perform critical roles in treating wastewater by removing nutrients and toxic metals before discharging them into rivers.

Saloua Elfanssi et al. (2017) explains that the efficiency of hybrid constructed wetlands (HCW) in a rural mountainous area must be improved. The removal percentages of TSS, BOD5, COD, TN and TP were correspondingly 95, 93, 91, 67 and 62%. Based on the obtained results, the ANN model could be considered an efficient tool to predict the studied phytoremediation performances using HCWs.

Suganya et al. (2017) explain that wastewater and solid waste generated due to overpopulation, industrialisation and urbanisation these days poses environmental severe pollution problems and improper management of these wastes, in turn, threatens human's health; it has been found that the Eco-WaSH literacy level of the targeted rural SHG women of the selected 15 villages has raised to 80%.

Rajneesh Kumar Gautam et al. (2016) explains that the decentralised wastewater treatment technique checks the overexploitation of available freshwater by providing a sustainable and eco-friendly method of treatment of the wastewater with null energy inputs and reduced complex machines. It demonstrates the essential design criteria of DEWATS with its functioning and application.

In this study Parambikulam-Aliyar Project (PAP) basin in Tamil Nadu is considered. One common problem in Tamil Nadu is that most of the rivers get polluted by human intervention by way of discharging domestic sewage into the rivers/lakes/ponds and dumping solid waste in water bodies. In addition, the rapid growth of industries has also played a significant role in polluting water bodies by disposing the industrial effluents into the water bodies. The main objectives of this study are to remove the contaminants so that the quality of discharged water is improved to reach the permissible level of chemicals in discharged water. To remove enough solid wastes from (organic and inorganic) the Wastewater and Discharge treated water without harm to public health or when reused again. This paper explains the PAP basin along with its significant points of pollution, and also the pollution of water is proved by the test results and based on the test results two methods are suggested for removal of contaminants in water so that the wastewater can be reused for irrigation purposes.

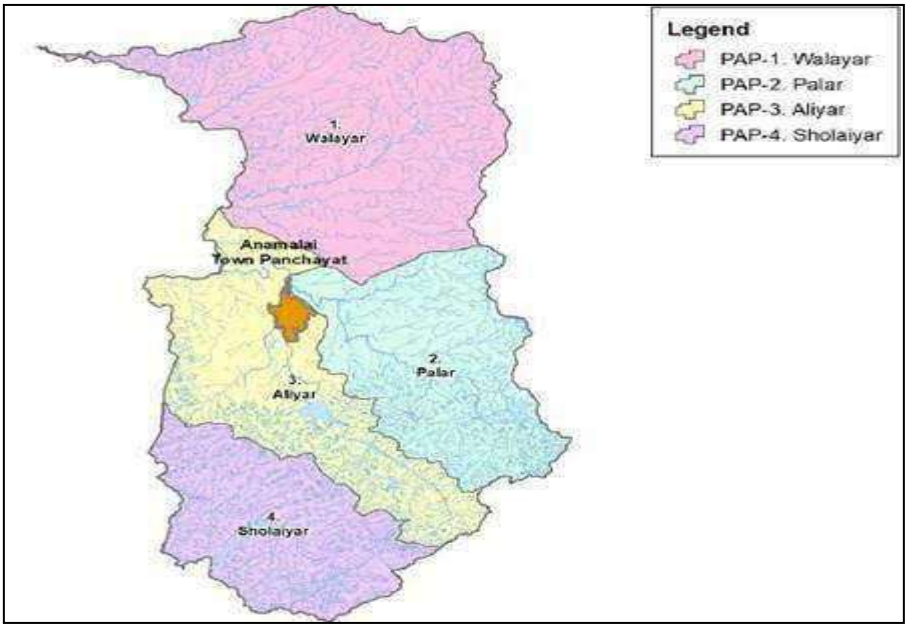

Fig 1 PAP Basin & Sub Basin

PAP BASIN

The PAP River covers an area in Kerala and the Tamil Nadu States, and it is located in the southwestern part of Peninsular India. Aliyar river originates in the eastern slopes of Anaimalai hills in Coimbatore district at an elevation of 2250 m above Mean Sea Level and flows in the north-westerly direction from its origin for 45 Kms; it is joined by a tributary, namely the Palar river on its right bank traversing by another 15km westwards, it enters the Palghat district of Kerala State through Palghat gap. Parambikulam-Aliyar river basin has a rippling topography, with the maximum spot height in the plain being 385m above MSL. The basin area (822.73 sq. km) is covered with hills and dense forest cover by one-third of its area. PAP basin covers around 2388.72 sq. km. This basin area is located in North latitude between 10°10’00” to 10°57’20” and East longitudes 76°43’00” to 77°12’30”. Map of the Parambikulam-Aliyar basin is shown in Figure 2.

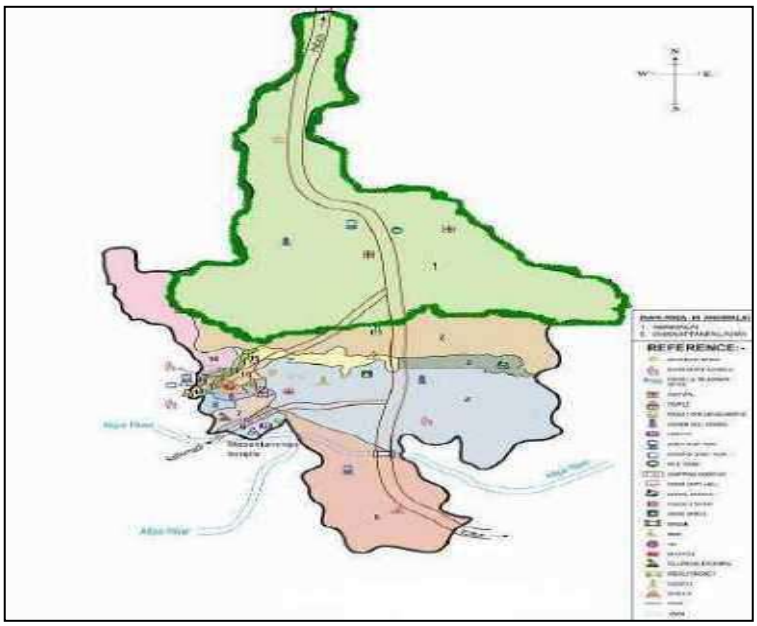

Fig 2 Anamalai Town Panchayat map

Anaimalai Town Panchayat, given by Fig 2, is situated in Coimbatore District, Pollachi Taluk. Its area is 10.50 sq.Km. As per the 2011 Census, the population is 17208. Agriculture is the Major Work in the Anaimalai area. The famous Arulmigu Masani Amman Temple is situated. Anaimalai Town Panchayat is located on the Banks of River Aliyar.

EXISTING CONDITION

The poultry forms seem an excellent development for the past few years for chicken and eggs. Ordinary soil will be suitable for coconut and sugarcane. The people are cultivating Vegetables also. The entire Anaimalai area is within the Aliyar river sub-basin, and several small streams originate from the hills located in the Anaimalai. Only seasonal floods inundate lower parts of the sub-basins. Sub-Basin subsoil water is used to irrigate the lands. Currently, Under Ground Sewerage System (UGSS) and Sewage Treatment Plant (STP) is not implemented in Anaimalai Town Panchayat. The untreated sewerage is being let out to the River Aliyar, Upper and PWD Channel.

In the Aliyar river, pollution is mainly caused by domestic wastewater discharge, as shown by Figure 3, by the Anaimalai town panchayat and some of the reasons for pollution are consideration of used water is wastewater. The wastewater is due to commercial, industrial, and agricultural activities. This also includes stormwater runoff, when the salts, oil, grease, chemicals, and debris from the road and impermeable surfaces mix with the rainwater and flow into waterways. It is seen that 80 per cent of the world's wastewater is not treated or reused. It is estimated that sewage treatment systems release more than 850 billion gallons of untreated wastewater every year.

Fig 3 Pollution in Aliyar River

PROPOSED METHODOLOGY

The proposed system gives a step-by-step approach for reducing and eliminating the contamination of the Aliyar river based on the wastewater from domestic use. The Aliyar river stretch flows within the Anaimalai Town Panchayat limit. The river flows in the middle area from West to East within the Anaimalai Town Panchayat is shown in Figure 4. The untreated sewer and domestic wastewater are being discharged in River Aliyar, Upper and the PWD Channel. In the above area, a thorough walk survey has been carried out. Field Work was done to collect the location of wastewater outfall location and its flow. Also, the location of the proposed STP and solid waste dumpsite has been collected.

Field activity was conducted along the River stretch, and it was done to collect the location of wastewater outfall and its flow. Collection of secondary data from different line departments such as local bodies, Public Works Department (PWD), Tamil Nadu Pollution Control Board (TNPCB).

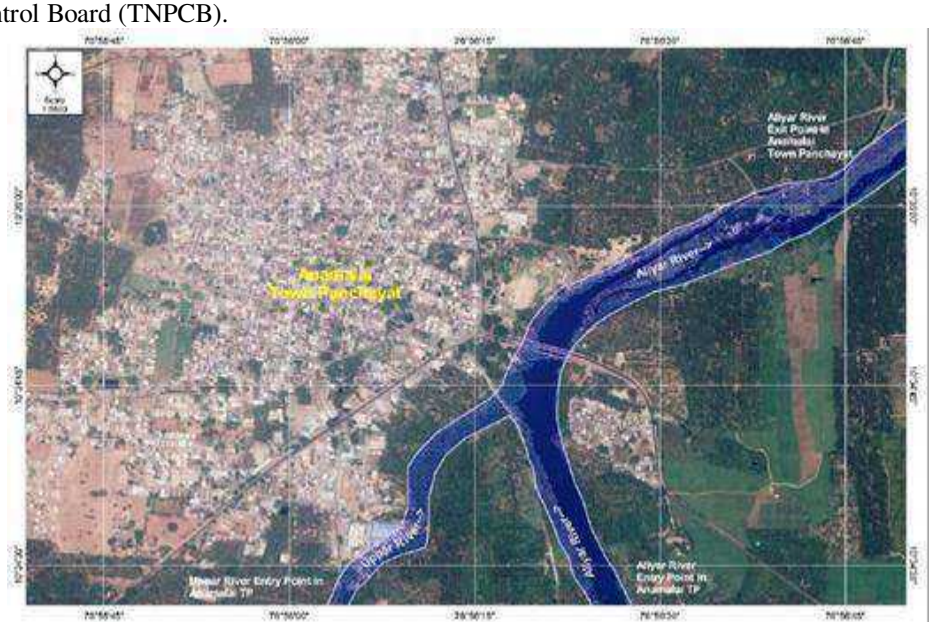

Fig 4 Walkthrough Survey - Anamalai Town Panchayat

A complete reconnaissance survey was carried out in the river stretch to study the outfall points by collecting and quantifying the sewage. Flow of sewage was measured is shown in table 1. In order to map the outfall points, a walkthrough survey was conducted on either side of the river bank. The sewage outfalls were noted and recorded precisely using GPS; the outfall photographs were taken with the stamps of its Geo Coordinates.

Table 1 Waste Water Collection Locations

S.No	Name of River	Location Name	Latitude	Longitude
1	Upper River	Outfall Indira Nagar Street	N 10° 34' 41.502"	E 76° 56' 22.182"
2	Aliyar River	Outfall Masaniamman Temple	N 10°34' 30.474."	E 76° 56' 3.696"
3	Aliyar River	Outfall Vepparai Road	N 10° 34' 45.09"	E 76° 56' 16.692"
4	Aliyar River	Outfall Kottur Main Road	N 10°34' 47.544."	E 76° 56' 18.522"
5	Aliyar River	Someshwaram Kovil Street Outfall	N 10°34' 57.498."	E 76° 56' 17.94"
6	Aliyar River	Outfall Haj Layout End of the Street South	N 10° 35' 6.894"	E 76° 56' 14.376"
7	Aliyar River	Upstream side Aliyar River	N 10° 34' 45.09"	E 76° 56' 16.692"
8	Aliyar River	Downstream side Aliyar River	N 10° 34' 47.544"	E 76° 56' 18.522"

Eight Outfall locations of wastewater discharge have been identified within the Town Panchayat limits, and the details are furnished in Table 2. The outfall location map is given in Fig 5.

Fig 5 Waste Water Outfall Location - Aliyar River

The wastewater samples are collected from 8 outfall points, and these points are selected based on the geological survey and at locations of wastewater outfall.

TABLE 2 Location of Sewage water mixing along Aliyar River

S No.	Location of Sewage Water Mixing Point	Town Panchayats – HH / Population			Wastewater generated in Lakhs Litres (80% Supply)
		Anaimalai			
		Ward (Noes)	House Hold (No)	Population (No's)	
1	Indira Nagar	5	613	1939	1.38
2	Near Masaniamman Temple	6	945	2835	2.02
3	Vepparai Road	6	1275	3825	2.72
4	Kottur Road (Near TP Office)	4,9,12,13 & 15	1725	5275	3.76
5	Near Someshwar Temple	3	644	2412	1.72
6	Haj Layout	2,18	625	1964	1.40

WATER SAMPLE TEST

Analyse the samples in National Accreditation Board for testing and calibration Laboratories (NABL) laboratory for its characteristics and composition, and based on the test, the water parameters are compared with the standard values. The test results are given in Tables 3 & 4. Based on the test results, it can be seen that the physiochemical values of the water collected from the outfall locations values it is seen that the values are more significant than the maximum permissible limits.

TABLE 3 Water Sample Results – I

Quality	Indira Nagar	Near Masani Amman Temple	Vepparai road	Kottur road	Standard values (IS: 10500 – 2012)
Appearance	Colourless	Colourless	Colourless	Colourless	Colourless
Odour	Sulphide	Slightly Sulphide	Slightly Sulphide	None	Agreeable
Turbidity	No	No	No	No	1
pH	7	7	8	8	6.5 to 8.5
Alkalinity	480	780	580	620	200
Hardness	>600	440	380	440	200

Chloride	300	320	160	160	250
TDS	1836	1848	1344	1464	500
Fluorides	1.5	1.5	1.5	1.5	1
Iron	2	0	0	0	0.3
Ammonia	>5	>5	2	5	0.5
Nitrite	0.05	0.1	0.2	0.1	1
Nitrate	40	45	45	20	45
Phosphate	0.5	0.5	0.5	0	0.1
Residual Chloride	0.2	0.2	0.2	0.1	0.2

TABLE 4 Water Sample Results – II

Quality	**Someswaran temple**	**Annamalai haj layout**	**Aliyar river upstream side**	**Aliyar river down stream side**	**Standard values (IS: 10500 – 2012)**
Appearance	Colourless	Colourless	Colourless	Colourless	Colourless
Odour	Strong Sulphide	Sulphide	None	None	Agreeable
Turbidity	No	No	No	No	1
pH	8	7	7	7	6.5 to 8.5
Alkalinity	600	560	40	60	200
Hardness	400	520	40	80	200
Chloride	340	260	80	60	250
TDS	1608	1608	192	1608	500
Fluorides	1.5	1	0.5	0.5	1
Iron	1	0	0	0	0.3
Ammonia	>5	5	0.4	0.5	0.5
Nitrite	0.1	0.2	0.1	0.5	1
Nitrate	35	75	45	45	45

Phosphate	0.5	0	0	0.1	0.1
Residual Chloride	0.2	0.2	0.2	0.3	0.2

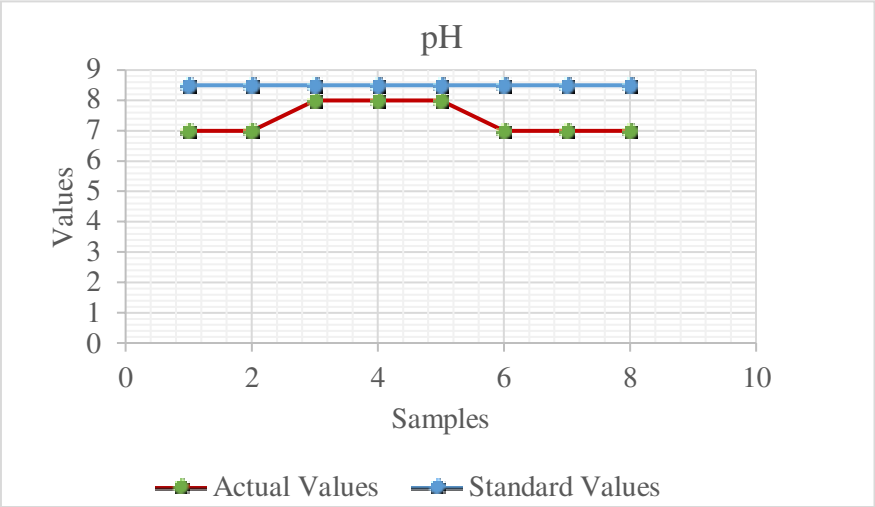

Fig 6 pH value

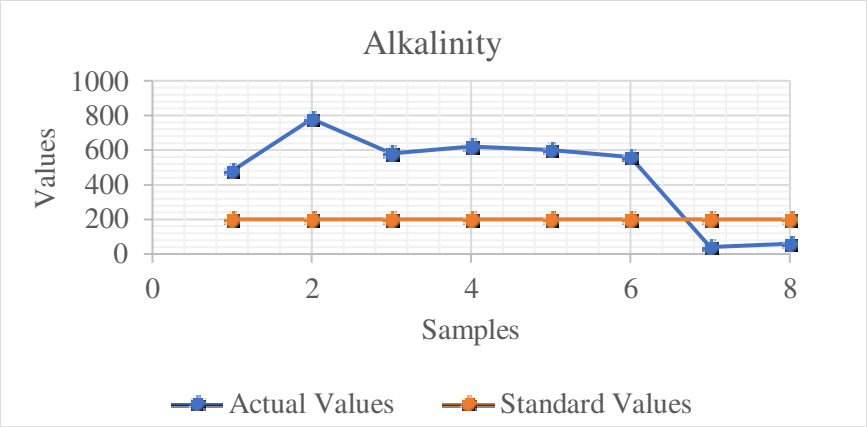

Fig 7 Alkalinity Value

Fig 8 Hardness Value

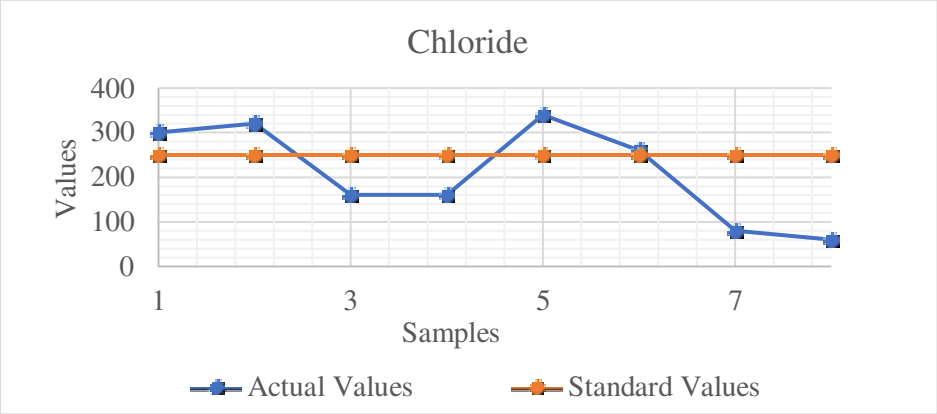

Fig 9 Chloride Values

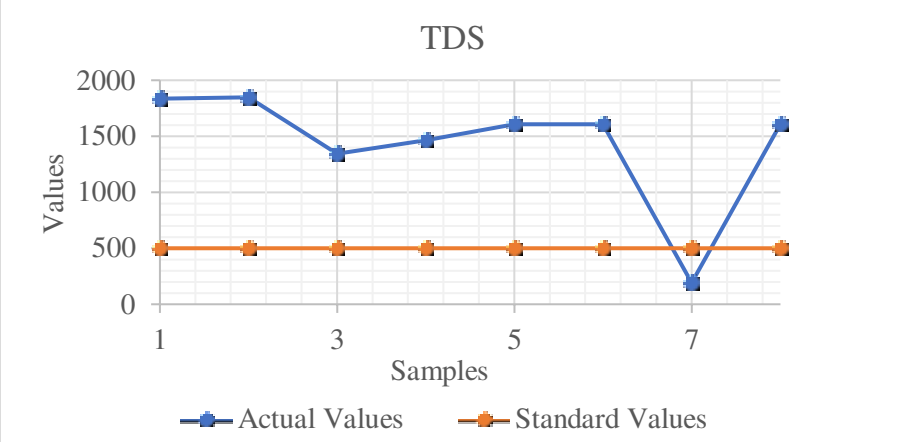

Fig 10 TDS Values

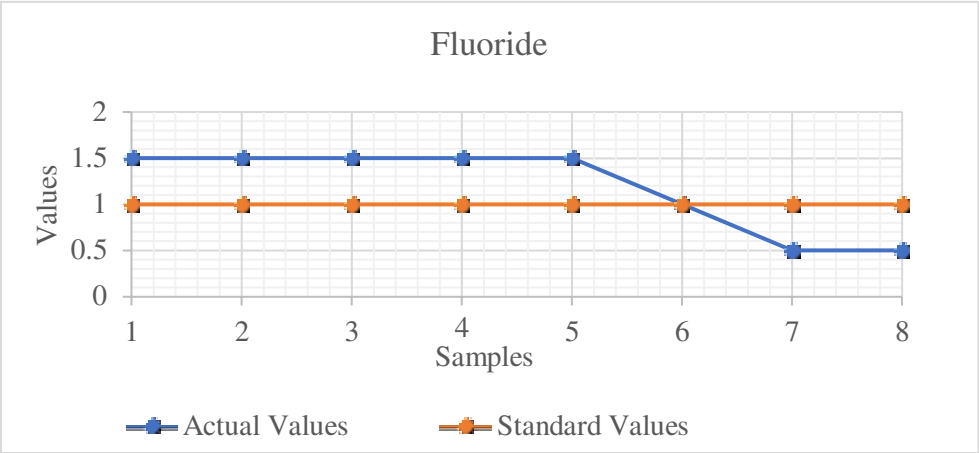

Fig 11 Fluoride Values

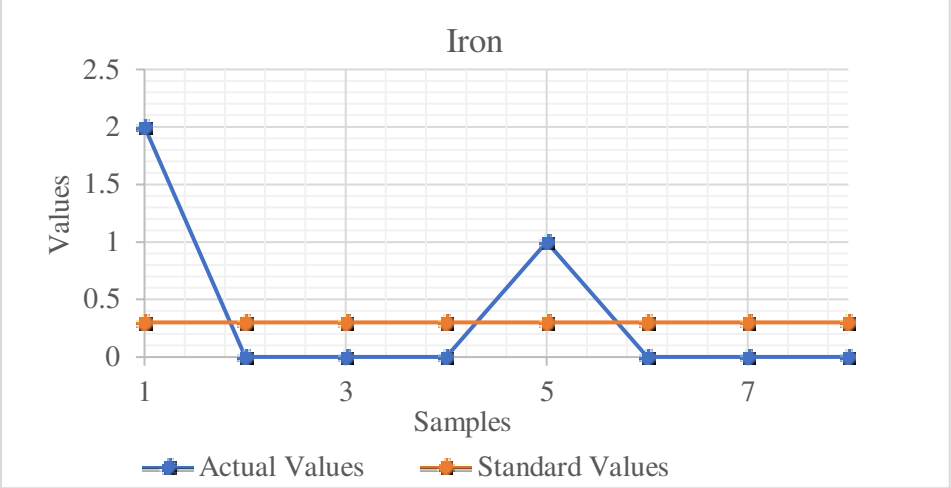

Fig 12 Iron Values

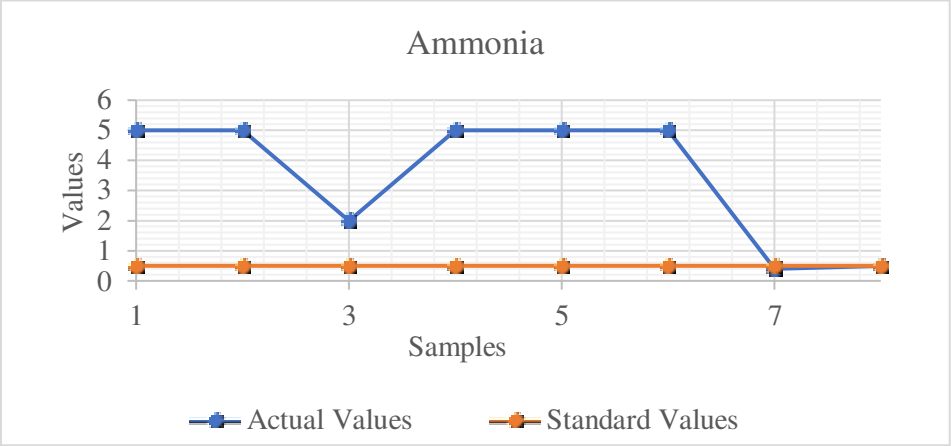

Fig 13 Ammonia Values

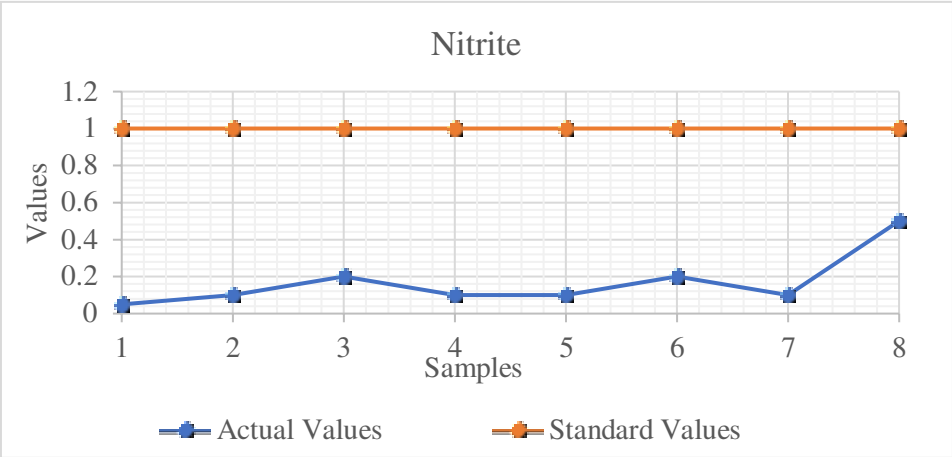

Fig 14 Nitrate Values

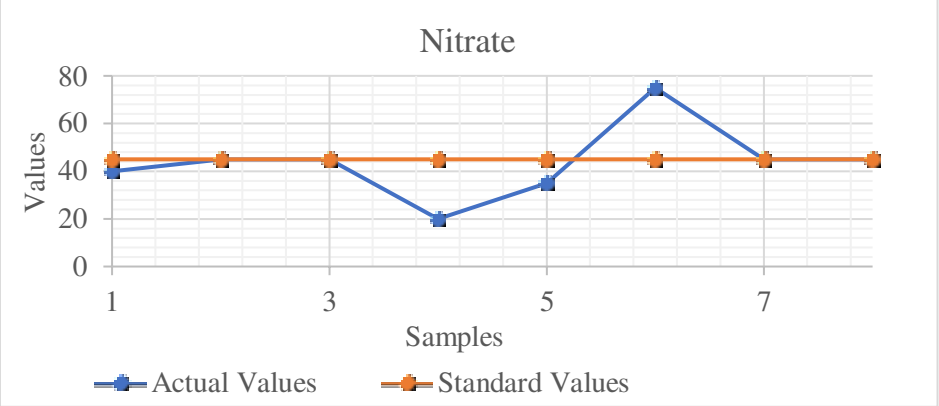

Fig 15 Nitrate Values

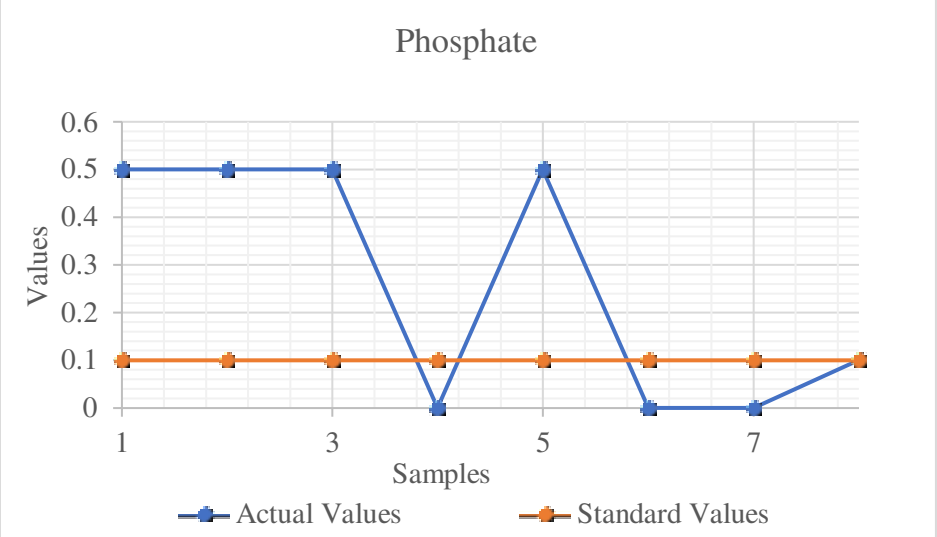

Fig 16 Phosphate Values

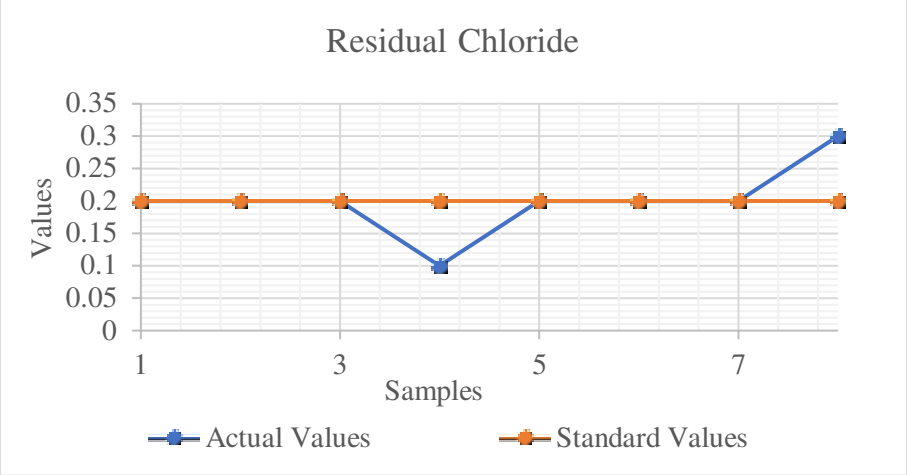

Fig 17 Residual Chloride Values

WATER SAMPLE TEST ANALYSIS

From the sample results, it is inferred that the chemical properties of the Aliyar River water have exceeded the maximum permissible values,

- The maximum permissible limit of alkalinity of water is 780 mg/l; at six places outfall locations, the value is higher. (Indira Nagar, Near Masaniamman Temple, Vepparai Road, Kottur Road (Near Annamalai TP Office), Someshwarar Temple, Annamalai Haj Layout)
- The hardness of the water must be 600mg/l, but the value is exceeded at six places ((Indira Nagar, Near Masaniamman Temple, Vepparai Road, Kottur Road (Near Annamalai TP Office), Someshwarar Temple, Annamalai Haj Layout)
- The maximum permissible limit of chloride is 340 mg/l, and it is exceeded at four places (Indira Nagar, Near Masaniamman Temple, Someshwarar Temple, Annamalai Haj Layout)
- The maximum permissible limit of TDS is 1848 mg/l, and it is exceeded at seven places (Indira Nagar, Near Masaniamman Temple, Vepparai Road, Kottur Road (Near Annamalai TP Office), Someshwarar Temple, Annamalai Haj Layout, Aliyar River Down Stream Side)
- The maximum permissible limit of fluoride is 1.5 mg/l, and it is exceeded at five places (Indira Nagar, Near Masaniamman Temple, Vepparai Road, Kottur Road (Near Annamalai TP Office), Someshwarar Temple)
- The maximum permissible limit of iron is two mg/l, and it is exceeded at two places (Indira Nagar, Someshwarar Temple)
- The maximum permissible limit of ammonia is 50 mg/l, and it is exceeded at six places (Indira Nagar, Near Masaniamman Temple, Vepparai Road, Kottur Road (Near Annamalai TP Office), Someshwarar Temple, Annamalai Haj Layout)
- The maximum permissible limit of nitrate is 75 mg/l, and it is exceeded at one place (Annamalai Haj Layout)

WATER TREATMENT METHODS

Based on these values, the appropriate method of water treatment must be selected. The activated sludge process is selected as it is an effective water treatment method that can reduce the values mentioned above, and the DEWATS method is also adopted.

- The location of the Activated sludge process is selected where the wastewater generated is greater than 2 Lakh litres, i.e., Near Masani Amman Temple (2.02 LL), Vepparai Road (2.72 LL) and Kottur Road (Near Town Panchayat Office) (3.76).
- The location of DEWATS is used in other locations Indira Nagar (1,36 LL), Haj Layout (1.40 LL), and near Someshwarar Temple (1.72 LL).
- Post-treatment – in aerobic polishing ponds

The test results revealed that the amount of Alkalinity, Hardness, Chloride, TDS, Fluorides, Iron, Ammonia, Nitrate and BOD are higher than the permissible limits. And also found that TDS has polluted the Aliyar river downstream side. Hence, it is necessary to establish a new treatment system to minimise or nullify the values, safeguard the river, and maintain an environment in that locality. The three places such as near Masani Amman temple, Vepparai road, Kottur road (near town panchayat office) having wastewater discharge more than 2lakhs litter per day will have Activated sludge process method and below 2lakhs litter discharging places like Indira Nagar, Someswarar temple, Haj layout will have DEWATS treatment method. If the treatment methods are implemented with Government financial assistance, it will help maintain the ecosystem in and around Anamalai town.

CONCLUSION

The Parambikulam Aliyar Project (PAP) basin consists of eight water outfalls from Anamalai town, which allows the flow of untreated wastewater into river Aliyar, and due to the mixing of the wastewater, the river gets contaminated. The value of physical and chemical quantities such as alkalinity, Ammonia, Fluorides, TDS and hardness values rise beyond the permissible limits. So, based on the test results conducted and study, the Activated Sludge process treatment method and DEWATS are suggested. This treatment method will improve the water quality and maintain the values of parameters within the permissible limit. The treated water can be reused for agriculture purposes and let into the Aliyar River. The main problem associated with wastewater reuse in developing countries will be due to the lack of treatment. So, the challenge is to find such low-cost, low-tech, user-friendly methods, which avoids threatening our substantial Wastewater dependent livelihoods and, on the other hand, protect degradation of our valuable natural resources. Activated Sludge based treatment and DEWATS are suggested based on the excessive chemicals found on the test samples, and the treatment is mainly focused on reducing Alkalinity, Hardness, TDS, Ammonia and Fluoride. DEWATS is suggested as a water treatment method where the discharged water flow is low. Discharge standards should be looked after overtime to achieve the required targets for receiving water bodies. These systems adopted will open doors for community participation and engagement that would eventually lead to a sustainable model.

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Textile Sludge Management by Vermi-Technology

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Abstract. All living organisms on the planet require nutrients for survival and growth, which food provides. Food production has significantly contributed to the development of solid waste. This trash was disposed of using destructive processes such as landfilling and incineration. The non-toxic component of solid wastes can be used in various biological processes to recover or manufacture value-added products from solid waste. Vermicomposting is the most cost-effective and time-efficient method of professional solid waste management. This research aims to use the eco-biological method of vermicomposting to manage Textile Sludge Waste (TSW) and Tea Leaf Residues (TLR). On the 0th, 15th, and 45th days, vermicompost samples are collected and evaluated for physicochemical parameters. By the conclusion of the 45th day, the vermicompost had transformed into nutrient-rich manure. The simple approach of employing appropriate earthworms and combining them with other organic waste made them acceptable for earthworms to reduce pollution. It is critical to establish the characteristics that will indicate the maturity of vermicompost and ensure the safety precautions for its usage as a healthy soil supplement.
Keywords: *Food Industry, Population Increase, Solid Wastes, Pollution, Earthworm, Vermi compost.*

INTRODUCTION

In 2013, India was the seventh most rich country globally; it is a developing and evolving country in southern Asia. As of 2025, India is expected to be the fifth-largest economy globally and the third-largest after China and the United States. As much as 88% of the raw materials used in India's industries are transformed into the garbage and discharged into nearby waterways, making the industry a significant cause of pollution. More than 1900 clothing manufacturers are located throughout India. Toxic sludge waste is the principal water and air pollution source at these factories.

On the other hand, tea is the most popular beverage, with global consumption of 3.5 million metric tones per year. Everyday tea use, fast tea extraction, and ready-to-drink teas all result in significant emissions of tea leaf waste into the environment. Around seven million hectares of tea and vegetable plantations produce 80 Mt of tea and vegetables annually, critical to the world's food supply.

Indians are the world's second-largest tea producers because of high consumption rates. Tea Leaf Residue (TLR) is a waste product frequently dumped in landfills after being consumed. The tannin concentration in raw green tea leaves is minimal, according to TLR. Tannins are oxidized to tannic acid, which is then removed from tea. However, TLR may leak lignin at high levels into the water during the rainy season, contaminating the ecosystem. This trash necessitates the use of a well-known recycling process. Since the lignin content of tea factory products is high and organic carbon content is low, it is preferable to recycle tea factory waste and other carbonaceous materials. As a result, industrial sludge and carbonaceous waste were added to the TLR to replace organic carbon.

It has been shown that earthworms play an important role in worldwide agriculture, as Archana Singh et al. (2020) described. Researchers Pellejero and colleagues (2020) recommend testing the viability of vermicomposting onion waste. Vaibhav Srivastava and co-authors (2020) Vermicomposting may be a viable option for waste management if the composition and characteristics of the waste allow it; Soubam Indrakumar Singh et al. (2020) focus on vermicomposting and term filtration for composting a variety of solid and liquid wastes, including industrial sludge, food waste, and animal waste among others. As compost for worms (nutrient-rich manure). Reusing organic wastes like vermicomposting can result in nutrient-rich organic fertilizers that are abundant sources of beneficial microorganisms, according to Abdullah Adil Ansari et al. (2020). Organic waste may be recycled by using vermicomposting, which is an environmentally benign method, according to Ali Mohd Yatoo et al. (2020).

Organic matter is maintained more quickly, and its physical and biochemical characteristics are altered by a bio-oxidation process involving earthworm detritivores and microorganisms.

The study's primary goal is to use vermicomposting to manage textile sludge waste (TSW) and tea leaf residues (TLR). The waste (TSW and TLR) will be recycled using vermicomposting in this project. Vermicomposting is becoming increasingly important to reduce the environmental impact of massive volumes of organic waste. It is the most suitable bioconversion technique for the disposal and recycling of agricultural waste. Cow dung, municipal solid waste, and industrial waste have all been the subject of numerous studies. TLR composting performance has not yet been investigated. As a result, Eisenia fetida was used in this work to recycle TSW and TLR. Vermicomposting is a viable option for dealing with waste disposal and pollution concerns. Using vermicomposting, organic waste may be turned into fertilizer at a fraction of the cost.

METHODS AND MATERIALS

Parameter Consideration-Abiotic

The primary abiotic parameters affecting the vermicomposting phase include moisture content, pH, temperature, aeration, feed uniformity, and light.

Moisture content should be between 60% and 80% in vermicomposting or vermiculture procedures. Water also functions as a conduit for different chemical processes and nutrient transfer during operation. For earthworms and microbes, the ideal pH range is 5.5–8.5. The temperature range for earthworms during vermicomposting is 12–28oC. Due to the aerobic nature of earthworms, oxygen is required for vermicomposting. Appropriate earthworm feed is a significant need for vermicomposting. Earthworms can consume practically any edible material on the planet; this small particle size allows for adequate oxygenation throughout the waste material pile and makes it accessible to worms. Earthworms are photophobic by nature. They should, however, be kept away from direct sunlight. The carbon: nitrogen ratio of the diet affects the development and reproduction of earthworms. Waste degradation is slowed if the C: N ratio is too high or too low.

Parameters Biotic

Density storage earthworms, microbes, and enzymes are among the biotic elements that influence the vermicomposting mechanism. Different physiological functions, such as breathing rate, reproduction rate, eating rate, and burrowing behaviour, are influenced by the population of earthworms in the vermicomposting system. A worm storage density of 1,60 kg/m2 and a vermicomposting feed rate of 0,75 kg/kg-worm/day were found to be ideal. The interaction between earthworms and microbes during vermicomposting stabilizes organic materials. In their gizzard and gut, the worms produce enzymes that cause fast biochemical conversion of cellulose and protein components in organic waste. Enzymes act as catalysts in various metabolic activities, including pollutant breakdown and detoxification. There are around 3,320 earthworm creatures on the planet. Earthworms are classified into three classes based on their morpho-ecological characteristics. Epigenic, Endogenic, and Anecic are the three types.

Epigenic earthworms are microscopic worms that eat decomposing organic materials and thrive naturally. Moderate endogenic earthworms feed on organic soil and reside under the surface. Anecic earthworms are enormous worms that reside in the deep soil and eat decomposed trash and other organic waste. For quick development rates, the worm species appropriate for vermicomposting should convert plant litter or animal waste into body proteins. Eisenia fetida, as illustrated in Figure 1, may be cultivated at both high and low temperatures (up to 43 degrees Celsius).

Fig 1. Eisenia fetida

Materials Required

Below are the experiment descriptions, materials used, and analytical techniques.

TSW-TLR Set

The solid materials were collected for solid waste management studies. They are cow dung, textile sludge and tea leaf residue from a tea shop. Cow dung was collected in the vadavalli area Coimbatore district. The sludge was collected from the Pallipalayam spinning Mills at Erode. The TLR was collected from the tea shop Coimbatore district. Until application, all raw materials were dried as shown in Fig 2. and analyzed.

Fig 2. Shade Drying of Sludge

The combination of TSW and TLR was achieved as follows, making up 20 kg of the final mixture.

- I (E1) TSW+CD Treatment (1:1)
- TSW+TLR+CD Treatment II(E2) (1:2:1)
- Therapy III (E3) TSW+TLR+CD (2:2:1)

TSW and TLR were cleaned, powdered, and sieved with 2 mm mesh. Then they were weighed and placed in alternating layers as a heap spread on a plain stroke floor. Cow dung mixed in portable water was used as inoculum, scattered between each layer. In a heap, 50 percent of moisture was preserved, and coconut leaves were mulched. Partial deterioration lasted 40 days. Once a week, waste was turned over with a spade. The microorganisms in cow dung begin to degrade solid waste. After 40 days, the partly decomposed TSW and TLR given in Fig 3. were retrieved and used for vermin.

Fig 3. Earthworm Safeguard

Vermicompost Preparation

Plastic bins (45 cm high, 40 cm long, and 25 cm wide) were chosen for vermicomposting. They were chosen because they were the best size for the job. Some of the TSW and TLR were damaged (various ratios). It took 40 days of vermicomposting in three replicates to get just 15.35 kilograms of TSW and TLR from 20 kilograms of TSW and TLR. The work on the roof of the house is done. Around ten young, non-clitellate E. fetida added to the vermis. They each weighed between 200 and 250 mg. Sprinkling water kept the container's moisture level about 35% to 40% during the study.

Fig 5 shows how the two containers were kept at room temperature, humid and dark, and not disturbed to make vermicast. They were covered in nylon net to keep bugs and worms from getting out. 40 to 50 percent of the moisture should be kept. If there is too much water in the soil, the earthworms' activity will slow down. Worms should not hurt while being handled. Centipedes, toads, lizards, white ants, red ants, and rats are some of the things that can eat worms. They need to protect themselves from things like that. The mix for collecting and feeding the worms must check at regular intervals. Otherwise, the vermicomposting and reproduction of the worms would not be as good. A shelter must be put over the pit when it rains, and there must be proper drainage around it will make sure that water does not get inside the pit. There is much semi-decomposed material that helps the Vermicompost grow faster.

Analysis of Initial Sample Values

Vermicompost samples were analyzed using the following basic procedures. In sample water suspension at 1:10 ratio, pH and EC were analyzed by pH meter given by Fig 3, and conductivity meter. Table 1 gives the initial Physio-chemical parameters of TSW, cow dung (CD) and TLR. The key parameters to remember were the TSW/TLR TOC. TOC's value was powerful in TSW, causing an environmental odour epidemic.

TABLE 1. Physic-chemical values of raw TSW, CD and TLR

Physic-chemical values	TSW	CD	TLR
pH	5.47	7.62	5.71
EC (dS m^{-1})	0.71 ± 0.09	3.80 ± 1.53	0.12 ± 0.03
TOC (%)	62.4 ± 2.2	34.3 ± 1.9	3.9 ± 0.5
TN (%)	0.12 ± 0.03	2.30 ± 0.14	0.09 ± 0.01
TP (%)	5.63 ± 0.24	0.42 ± 0.06	1.62 ± 0.03
TK (%)	0.98 ± 0.02	0.49 ± 0.03	0.81 ± 0.06
AN (%)	0.12 ± 0.01	1.15 ± 0.06	0.09 ± 0.03
AP (%)	5.0 ± 1.0	3.7 ± 1.0	1.1 ± 0.3
AK (%)	0.08 ± 0.03	0.12 ± 0.08	4.03 ± 1.06
C/N Ratio	520	15	43
TCa (%)	0.62 ± 0.08	0.47 ± 0.02	0.21 ± 0.07
TMg (%)	0.41 ± 0.05	0.39 ± 0.23	0.38 ± 0.08
Lignin (%)	0.03 ± 0.09	1.32 ± 0.91	16.34 ± 2.45
P-Value	0.001*	0.001*	0.001*

Analysis of Vermi Compost Results

E.fetida casting was found to get better with more TLR in it, like in treatment I (E1), II (E2), and III (E3) (E3). The TSW 1:2:1 unit had the best casting behaviour, meaning earthworms preferred less TSW material with more TLR material. It could be because the 1:2:1 ratio has a better C/N ratio than other ratios. A lot of TOC makes the odour more unpleasant. The assimilation mechanism mainly was shown on a 1:2:1 scale. The TLR TSW (2:2:1) ratio had a lower rate of assimilation and casting. Thus, on the 45th day, their physical and chemical characteristics were limited compared to the two other days they had.

Tables 2 to 7 showed the physics and chemical values of vermicompost TSW and TLR when they were mixed. It shows pH, EC, TOC, and TN; Table 2 also shows TN, TP, TK, and TP values. The table is called Table 2. The results were the same in all three different ways. At first, the pH was acidic. On the 15th day, the pH was equal to before. It was the 45th day, and the pH was the same in all three treatments. EC went down steadily from 0 to 45 days (Table 2 and 4). When they cast at 45 days, the EC dropped by about half. This neutral pH and lower vermicompost EC make it easier for plants to grow when used as manure.

TABLE 2. pH, EC, TOC, TN, TP and TK on 0^{th} day

Samples	pH	EC (ds $^{m-1}$)	TOC (%)	TN (%)	TP (%)	TK (%)
E1	6.59	0.67 ± 0.11	42 ± 1	1.5 ± 0.2	3.7 ± .0	0.6 ± 0.1
E2	6.44	0.66 ± 0.06	44 ± 1	1.3 ± 0.1	3.8 ± .0	0.8 ± 0.1
E3	6.52	0.68 ± 0.12	45 ± .5	1.1 ± 0.2	4.2 ± .1	1.2 ± 0.2

TABLE 3. AN, AP, and AK, C/N ratio, Ca and Mg on 0^{th} day

Sample	AN (%)	AP (%)	AK (%)	C/N ratio	Ca(%)	Mg (%)
E1	0.37±0.10	2.24±0.02	0.15±0.11	29±0	1.0±0.1	0.9±0.3
E2	0.24±0.03	3.14±0.09	0.12±0.42	32±1	0.7±0.0	0.5±0.2
E3	0.19±0.12	4.08±0.01	0.11±0.13	42±1	0.8±0.0	0.3±0.1

TABLE 4. pH, EC and TOC on 15th day and 45th day

Sample	pH		EC (ds $^{m-1}$)		TOC (%)	
	15th day	45th day	15th day	45th day	15th day	45th day
E1	6.82	7.09	0.54±0.14	0.39 ± 0.06	40 ± 1	35 ± 0.5
E2	6.88	7.3	0.56±0.13	0.39 ± 0.06	42 ± 2	37 ± 1
E3	6.81	7.09	0.56±0.11	0.39 ± 0.11	44 ± 1	39 ± 0.5

TABLE 5. TN, TP and TK on 15th day and 45th day

Sample	TN (%)		TP (%)		TK (%)	
	15th day	45th day	15th day	45th day	15th day	45th day
E1	1.6 ± 0.1	2.2 ± 0.1	2.9 ± 0.0	2.9 ± 0.0	0.9 ± 0.0	1.3 ± 0.1
E2	1.5 ± 0.1	1.7 ± 0.0	3.7 ± 0.0	3.8 ± 0.0	1.2 ± 0.0	1.5 ± 0.1
E3	1.3 ± 0.1	2.1 ± 0.0	4.6 ± 0.0	4.9 ± 0.0	1.4 ± 0.0	1.7 ± 0.1

TABLE 6. AN, AP and AK on 15th day and 45th day

Samples	AN (%)		AP (%)		AK (%)	
	15th day	45th day	15th day	45th day	15th day	45th day
E1	0.42±0.09	0.52±.01	2.8±.01	2.9±.01	0.18±.52	0.26±.63
E2	0.31±0.06	0.41±.01	3.15±.01	3.19±.09	0.16±.90	0.28±.82
E3	0.23±0.10	0.38±.08	4.10±.01	4.18±.03	0.29±.81	0.30±.92

TABLE 7. C/N, TCa and TMg on 15th day and 45th day

Samples	C/N ratio		TCa(%)		TMg (%)	
	15th day	45th day	15th day	45th day	15th day	45th day
E1	40 ± 1	17 ± 1	1.4 ± 0.1	2.0 ± 0.1	1.2 ± 0.1	1.4 ± 0.2
E2	42 ± 2	21 ± 1	1.2 ± 0.1	1.9 ± 0.1	1.1 ± 0.1	1.4 ± 0.0
E3	44 ± 0	25 ± 1	1.0 ± 0.1	1.6 ± 0.1	1.0 ± 0.1	1.3 ± 0.0

Table 6 shows the primary nutrients, i.e., total and AN, AP, and AK material, as well as their TSW and TLR variations. After vermicomposting, all three ratios had higher nutritional content. As the days passed, the ascent became more gradual. Increases of around 28% were found in TSW combinations of 1:1, 1:2:1, and 2:2:1. AN variety was identified in ratios of 0.37 to 0.52 in a 1:1:1 ratio, 0.24 to 0.41 in a 1:2:1 ratio, and 0.19 to 0.38 in a 2:1:1 TSW mixed ratio (Table 6). As a result, the nitrogen levels rise was regarded as unavoidable regardless of the ratios. The key plant nutrients, NPK, rose in the vermicompost TSW and TLR.

Tables 3 and 7 show the additional micronutrients investigated and the C/N ratio. TCA and TMg levels rise throughout time. Because the TSW already had a greater TCA level, the last day's total was more significant than the previous two. Thus, the vermicompost TSW and TLR are likewise rich in micronutrients, implying that a better grade vermicomposting may make from solid waste TSW and TLR.

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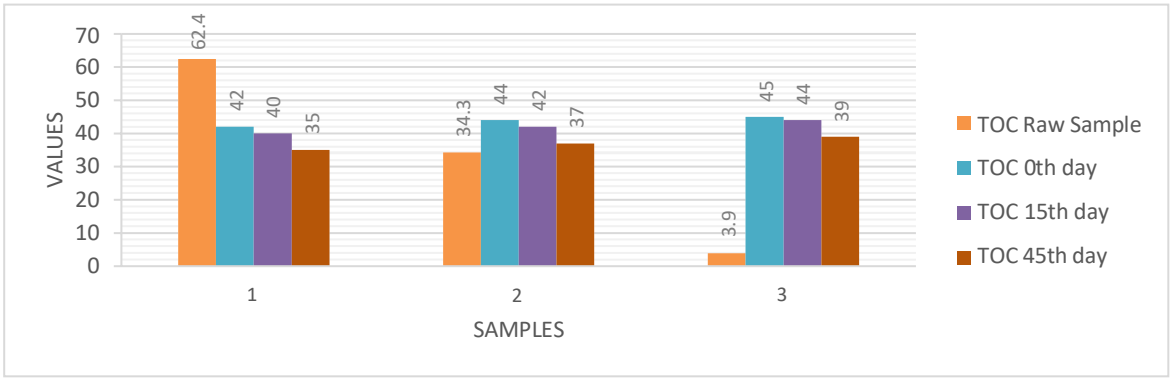
RESULTS AND DISCUSSION

Vermicomposting considerably changed the physical-chemical properties of various carbonaceous mixtures studied. The final Manure obtained is given by the following Fig 4.

Fig 4. Final Manure Obtained

The pH all the samples were almost neutral and stabilized at the mature stage (45 days), owing to humic compounds' buffering nature. Similar tests on TSW vermicomposting of urban waste found that the decomposition phase eliminated the unwanted odour and significantly increased the number of earthworms. A substantial decrease in EC from its initial day was observed in all vermicompost ratios. EC declination may be attributed to soluble salts' use by microorganisms to synthesize microbial biomass and absorb soluble salts by earthworms and enhanced microbial activity.

All the values are recorded in tables with a period separation of $0^{th\ day,}$ 15^{th} and 45^{th} day. The graphical representation of all the measured values is shown in the Fig 5 (a to l).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50
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30
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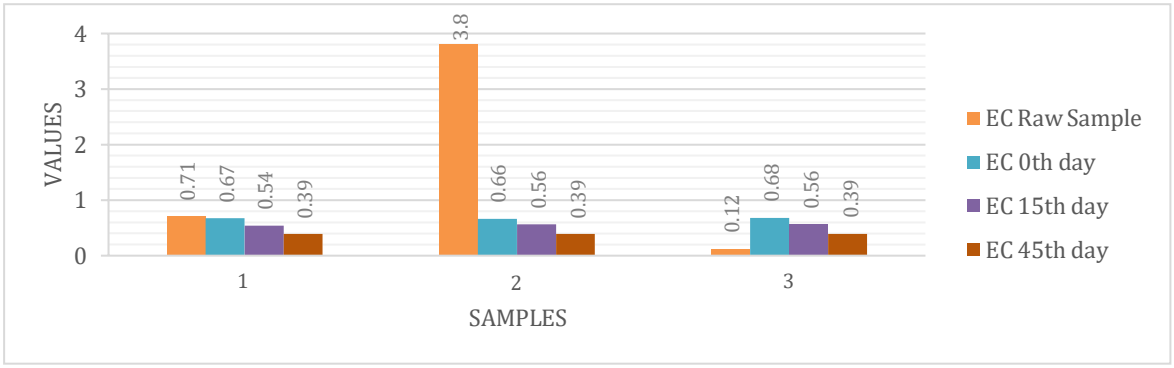
10
0
VALUES
62.4
42
40
35
34.3
44
42
37
3.9
45
44
39
1
2
3
SAMPLES
TOC Raw Sample
TOC 0th day
TOC 15th day
TOC 45th day

(a)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2
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0
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0.56
0.39
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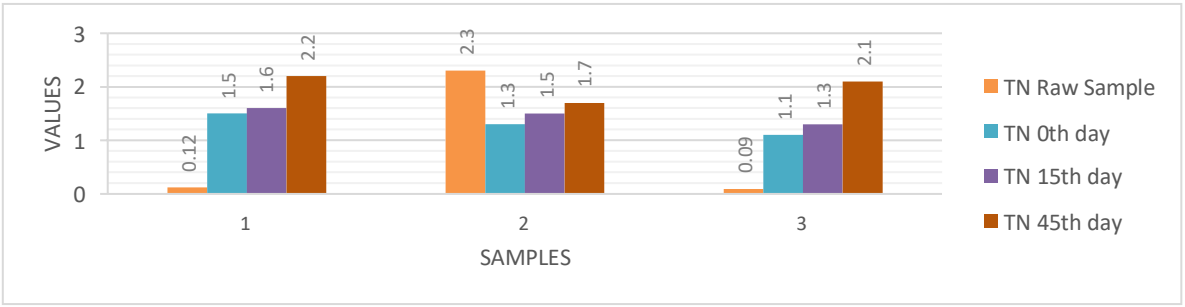
0.39
1
2
3
SAMPLES
EC Raw Sample
EC 0th day
EC 15th day
EC 45th day

(b)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2.3
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1.5
1.7
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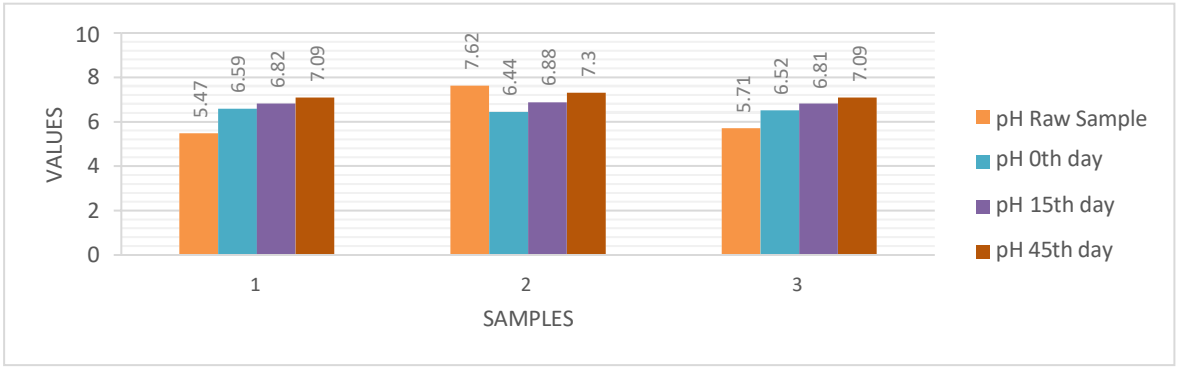
1.1
1.3
2.1
1
2
3
SAMPLES
TN Raw Sample
TN 0th day
TN 15th day
TN 45th day

(c)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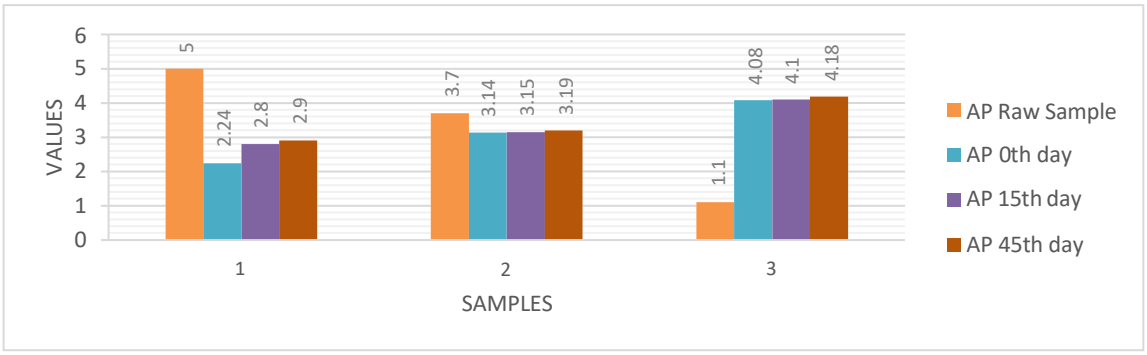
pH 0th day
pH 15th day
pH 45th day

(d)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AP 45th day
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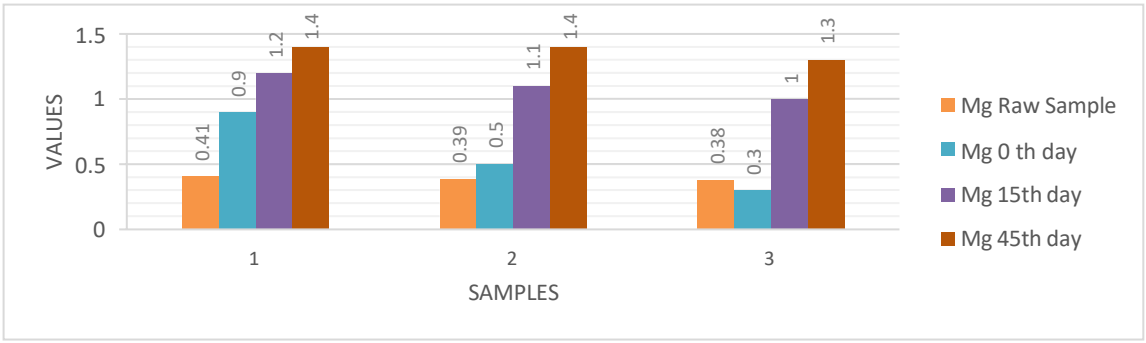
4.18

(e)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1.4
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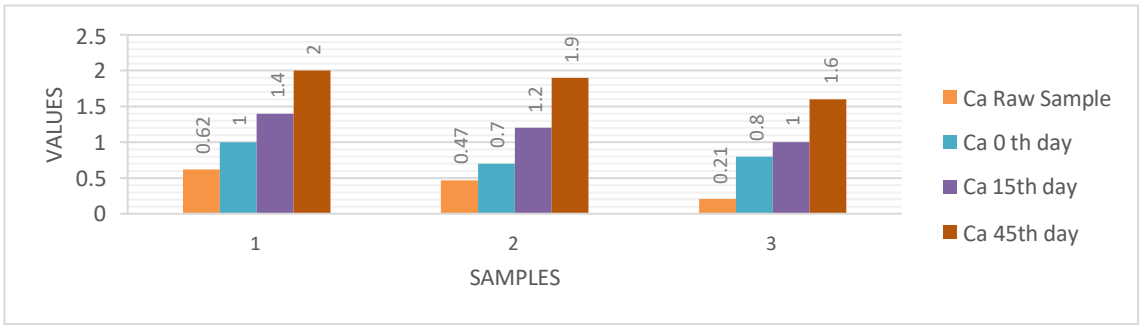
1
1.3

(f)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Ca 0 th day
Ca 15th day
Ca 45th day
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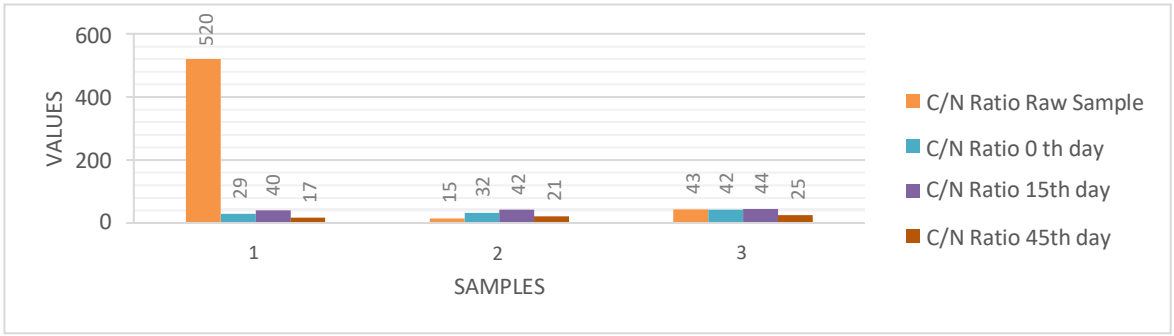
0.8
1
1.6

(g)


VALUES
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C/N Ratio 0 th day
C/N Ratio 15th day
C/N Ratio 45th day
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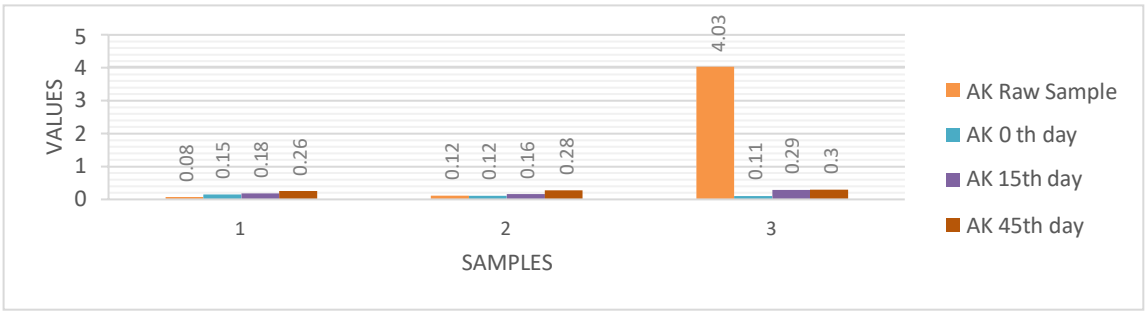
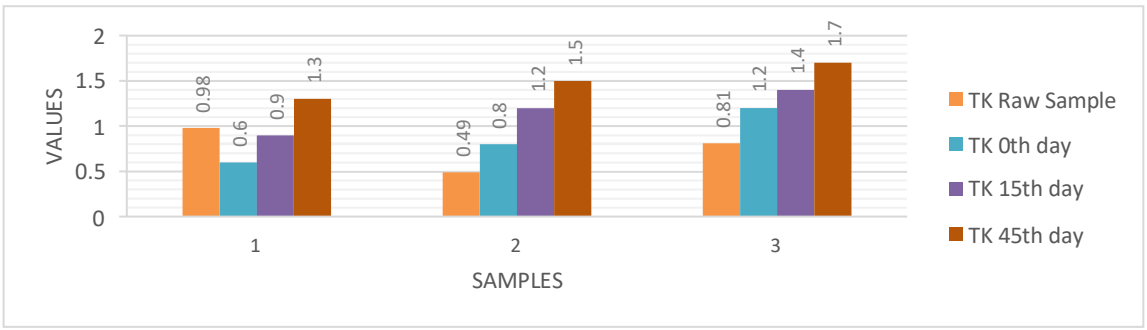
32
42
21
43
42
44
25

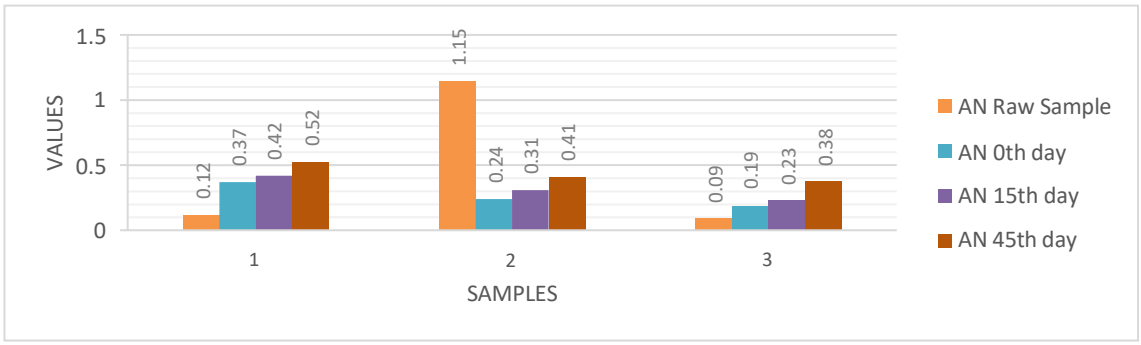
(h)



(i)



(j)



(k)

(l)

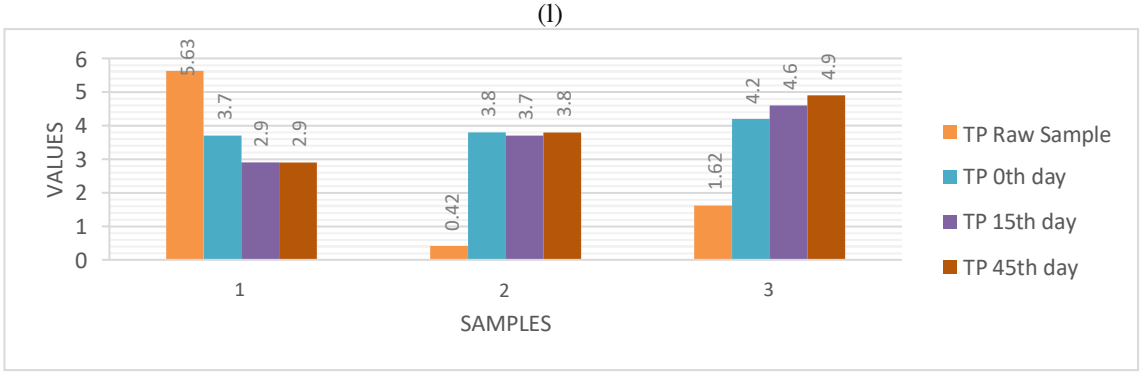


Fig 5. Values on 0th,15th and 45th day for (a) TOC, (b)EC, (c) TN, (d) pH, (e)AP, (f)Mg, (g)Ca, (h)C/N, (i)AK, (j)TK, (k)AN, (l) TP

From Fig. 5 (d) it is inferred that the value of pH remains in the neutral region after 45 days. TOC shown by Fig. 5 (a), in depletion could be attributed to CO_2 conversion by microbial respiration and organic matter mineralization, triggering a rise in total nitrogen. Microorganisms use carbon as an energy source to decompose organic matter. Generally, C/N ratio given by Fig. 5(h) vermicomposting varies from 17 to 25 throughout the 45th day. In the present data, the C/N ratio is inside this range except for 15th-day industrial sludge with tea leaf residue mixture. Generally, vermicomposting TN material ranges from 1.6% to 2.1% given by Fig. 5(c). When monitoring the micronutrient stage, higher TCA given by Fig 5(g) and TMg denoted by Fig. 5(f) content was observed in E. fetida's mature vermicompost.

CONCLUSION

Modernization, urbanization, and technical advancement have all helped progress, but they have also contributed significantly to the creation of solid waste. There is a significant influence on the deterioration of the global environment caused by the high quantity of solid waste generated in emerging countries. Solid waste management has emerged as one of the most pressing issues facing the world today, necessitating adopting a more sustainable and environmentally friendly strategy for its management. TSW and TLR in different earthworm combinations were established for solid waste disposal, and E. fetida was the first earthworm used in this process. We conducted systematic physicochemical research on various vermicompost combinations on three different days (0, 15, and 45th).PH, total N, P, and K, available N, P, and K, TCA, and TMg were increasing in trend from their original vermicomposting days, whilst EC, TOC, and C/N were observed to be falling in trend from the same days. The study finds that the vermicomposting TSW and TLR is viable due to the bioconversion of these organic wastes into manure, which is likely to reduce the pollution caused by their disposal. The use of vermicompost as organic manure is an excellent alternative to chemical fertilizers since it promotes microbial biodiversity while also improving soil structure and fertility and crop productivity and yield.

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Determining The Quality Of Ground Water In Erode District By Statistical Analysis

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Abstract Water is the basic requirement of all living organisms in the world. Every living organism requires particular quality of water for their survival. In this work, the qualities of water for human beings are predicted from water samples collected in and around Erode district, Tamil Nadu. The water samples are collected from the public bore wells in 1444 locations and 14 parameters viz., Turbidity, pH, TDS, TH, EC, Na^+, K^+, Ca^+,Mg^{2+}, $HCO3^-$, $NO3^-$, $SO4^{2-}$, Cl^- and F are determined for pre and post monsoon samples. The ground water quality is assessed using statistical analysis, descriptive analysis, correlation analysis and factor analysis.
Keywords: Water quality, Parameters. Pre monsoon, Post monsoon, Analysis.

INTRODUCTION

Statistical Analysis is the collection of methods to process large amount of data and reporting the same to overall trends. It is a numerical measure describing the characteristics of samples. The characteristics of data set can be arrived to study the wholesome nature of a data set of matrix size 144 x 14.

DESCRIPTIVE STATISTICS

Descriptive statistics is the numerical summaries of samples with maximum and minimum values, mean and standard deviation. The mean and standard deviation are determined for different parameters in pre and post monsoon samples, compared with prescribed limits by IS10500.

From Table 1. Lower values of standard deviation are found in pH and F in both monsoons. The values of TDS in pre monsoon is found to be 913.28 mg/l and post monsoon is found to be 816.55 mg/l and are above the prescribed limits.

Table 1 Descriptive Statistics for Pre monsoon and Post monsoon Samples

Water Quality Parameters	Unit	Pre Monson				Post Monson			
		Max Value	Min Value	Ang	SD	Max Value	Min Value	Avg	SD
PH		9.10	7.22	7.88	0.34	9.90	7.28	7.92	0.32
Tur	**NTU**	230.00	1.00	9.04	21.26	30.00	1.00	6.44	3.39
TDS	**mg/l**	7420.94	189.74	1147.34	875.42	5969.30	220.51	1246.23	1119.87
TH	**mg/l**	1226.83	33.91	419.10	273.01	1422.94	102.10	484.22	292.11
EC	**µmho/cm**	7376.46	296.47	1792.72	1367.85	9327.03	344.54	1947.24	1749.79

Na	**mg/l**	1188.00	7.00	191.58	191.02	1410.00	8.00	194.33	274.43
K	**mg/l**	252.00	1.00	47.52	43.84	291.00	2.00	52.64	59.11
Ca	**mg/l**	378.00	7.00	104.56	78.46	398.00	30.00	111.35	71.75
Mg	**mg/l**	126.00	3.00	38.48	25.40	168.00	5.00	50.11	31.65
$HCO3^-$	**mg/l**	1238.00	84.00	445.56	239.41	1432.00	92.00	448.47	257.51
$NO3^-$	**mg/l**	124.00	2.00	40.33	26.11	305.00	5.00	53.22	49.81
$SO4^{2-}$	**mg/l**	852.00	6.42	104.66	137.53	916.00	6.00	123.14	166.45
Cl	**mg/l**	1656.00	10.00	289.42	319.22	1860.00	12.00	313.72	386.61
F	**mg/l**	2.00	0.10	0.50	0.40	2.00	0.10	0.62	0.35

CORRELATION ANALYSIS

It is the measure of strength of the linear relationship between the numerical variables. The correlation analysis has been conducted between the values of groundwater quality parameters in the area of study and is given in table 2 and table 3. The positive correlation indicates close association with the properties of array and negative correlation indicates the parameters in one array are independent of the parameters of another array.

Table 2 Correlation Matrix for Pre monsoon Samples

	Tur	**PH**	**TDS**	**TH**	**EC**	**Na**	**K**	**Ca**	**Mg**	**$HCO3^-$**	**$NO3^-$**	**$SO4^{2-}$**	**Cl**	**F**
Tur	1.00	-0.14	-0.04	0.02	-0.04	-.06	-0.1	0.03	-0	0.01	0.04	0.01	-.07	-0.02
PH		1.00	-0.23	-0.4	-0.23	-.11	-0.1	-0.3	-0.4	-0.4	-0.29	-0.12	-.14	-0.11
TDS			1.00	0.89	0.98	0.96	0.76	0.84	0.76	0.85	0.53	0.82	0.95	0.04
TH				1.00	0.59	0.73	0.57	0.95	0.83	0.9	0.58	0.67	0.79	0.03
EC					1.00	0.96	0.76	0.84	0.76	0.85	0.53	0.82	0.95	0.04
Na						1.00	0.74	0.68	0.63	0.72	0.42	0.83	0.95	0.02
K							1.00	0.5	0.55	0.6	0.5	0.58	0.75	0.2
Ca								1.00	0.62	0.85	0.48	0.69	0.73	0.04
Mg									1.00	0.76	0.62	0.47	0.71	0.02
$HCO3^-$										1.00	0.55	0.69	0.68	0.04
$NO3^-$											1.00	0.31	0.44	0.19
$SO4^{2-}$												1.00	0.71	0.04
Cl													1.00	0.02

A pair of parameters having correlation coefficient up to 0.5 does not have any significant correlation between them, $\geq \pm 0.5$ have significant correlation between them and $\geq \pm 0.8$ is having very strong linear correlation between them. From table 2 and table 3, it is found that the parameters like Turbidity, pH, TH, EC, NA^+, K^+, Ca^+, Mg^{2+}, $HCO3^-$, $NO3^-$, $SO4^{2-}$, Cl^- and F has significant correlation with each other in both monsoons.

Turbidity has positive correlation and negative correlation in pre monsoon samples, with low positive correlation in post monsoon samples. pH has negative correlation with all parameters in pre monsoon for all parameters and having negative correlation with all parameters in post monsoon expect F & pH, this shows pH is independent of all other parameters. TDS has

low correlation of 0.04 and 0.19 with F in pre and post monsoon respectively. TH has low correlation of 0.03 and 0.06 with F in pre and post monsoon respectively. EC has low correlation of 0.04 and 0.002 with F in pre and post monsoon respectively. Na has low correlation with $NO3^-$ in both monsoon. Ca has negative correlation of -0.03 with F in pre monsoon. $NO3^-$ has low correlation with $SO4^{2-}$ and Cl with 0.31 & 0.24 and 0.44 & 0.27 in pre and post monsoon respectively. $SO4^{2-}$ has 0.71 & 0.87 with Cl in pre and post monsoon respectively. It can be stated that this increase and decrease in the composition of iron found in water is predominantly due to the precipitation reaction/ dissolution and concentration effects.

Table 3 Correlation Matrix for Post monsoon Samples

	Tur	**PH**	**TDS**	**TH**	**EC**	**Na**	**K**	**Ca**	**Mg**	**$HCO3^-$**	**$NO3^-$**	**$SO4^{2-}$**	**Cl**	**F**
Tur	1.00	0.11	0.23	0.15	0.23	0.23	0.26	0.1	0.21	0.2	0.14	0.22	0.22	0.18
PH		1.00	-0.15	-0.3	-0.15	-.06	-0.2	-0.3	-0.3	-0.33	-0.24	-0.03	-.09	0.09
TDS			1.00	0.8	0.99	0.96	0.92	0.72	0.8	0.84	0.36	0.91	0.97	0.002
TH				1.00	0.8	0.6	0.67	0.96	0.92	0.91	0.45	0.63	0.71	0.06
EC					1.00	0.96	0.92	0.72	0.8	0.84	0.36	0.91	0.97	0.002
Na						1.00	0.9	0.51	0.64	0.69	0.25	0.93	0.97	-0.03
K							1.00	0.6	0.68	0.75	0.39	0.82	0.91	0.03
Ca								1.00	0.78	0.81	0.42	0.54	0.65	0.02
C									1.00	0.92	0.44	0.65	0.7	0.11
$HCO3^-$										1.00	0.44	0.69	0.72	0.08
$NO3^-$											1.00	0.24	0.27	0.06
$SO4^{2-}$												1.00	0.87	-0.06
Cl													1.00	-0.01
F														1.00

FACTOR ANALYSIS

It is a method of data reduction. FA can effectively reduce numerous hydro chemical data into few major factors whose values exceed one, explain more total variance in the data than individual effluent characteristics. FA is performed using SPSS 17.0 package on a data matrix of sixe 144 x 10 for both monsoons. FA of Pre and Post monsoon were given in table 4 and table 5 respectively.

Table 4 FA For Pre-Monsoon Samples

Factors	**Eigen Values**	**Percentage of Variance**	**Cumulative Percentage of Variance**
1	6.469	64.689	64.689
2	1.117	11.174	75.863
3	0.853	8.534	84.397
4	0.584	5.841	90.239

5	0.361	3.614	93.853
6	0.265	2.651	96.504
7	0.239	2.395	98.899
8	0.105	1.049	99.948
9	0.005	0.052	100

Table 5 FA For Post Monsoon Samples

Factors	Eigen Values	Percentage of Variance	Cumulative Percentage of Variance
1	6.664	66.637	66.637
2	1.194	11.937	78.575
3	0.933	9.332	87.906
4	0.633	6.328	94.234
5	0.251	2.508	96.742
6	0.163	1.633	98.375
7	0.099	0.988	99.363
8	0.063	0.626	99.99
9	0.001	0.01	100

The Eigen values of first two factors exceed one in pre and post monsoon & explain 75.863% & 78.575% respectively of total variance. Factor 1 of pre monsoon and post monsoon has high loading of TDS, Na, Cl, $HCO3^-$, Ca, $SO4^{2-}$, Mg & K which reflects major cations and anions. Hence these parameters may be considered as important chemical parameters influencing hydrochemistry of ground water samples in both monsoons. Factor 2 has high loading of F involving 11.174% & 11.937% of total variance in both monsoons. Hence TDS, Na, Cl, $HCO3^-$, Ca, $SO4^{2-}$, Mg & K are found to be significant water quality parameter in pre monsoon and post monsoon. Rotated Factor Loading Matrix of Pre and Post monsoon were given in table 6 and table 7 respectively.

Table 6 Rotated Factor Loading Matrix for Pre-Monsoon Samples

Chemical Parameters	Factor	
	1	2
TDS	0.975	0.203
Na	0.967	-0.01
Cl	0.909	0.185
$HCO3^-$	0.637	0.543
Ca	0.719	0.557
$SO4^{2-}$	0.763	0.53
Mg	0.242	0.669
K	0.936	0
F	0.963	0.084
$NO3^-$	-0.168	0.578

Table 7 Rotated Factor Loading Matrix for Post monsoon Samples

Chemical Parameters	Factors	
	1	2
TDS	0.975	0.203
Na	0.967	-0.01
Cl	0.909	0.185
$HCO3^-$	0.637	0.543
Ca	0.719	0.557
$SO4^{2-}$	0.763	0.53
Mg	0.242	0.669
K	0.936	0
F	0.963	0.084
$NO3^-$	-0.168	0.578

CONCLUSION

Based on the statistical analysis, it is found that groundwater in most of the area is unsuitable for drinking purpose. Groundwater in few parts in the area of study is unsuitable for irrigation purpose. From the statistical analysis, it is found that the correlation in both the monsoon does not change considerably. Some of the parameters are having high standard deviation during both monsoons. It can be concluded that the factors controlling the concentration of these parameters are not uniform at all the sample locations of the study area.

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A Study Of Impacts On Water Shed Development At Kurichi Lake In Coimbatore

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Abstract. With growing population rates and rapid urbanization, preservation and conservation of water as a precious resource becomes vital. India's water availability forecasted in the future will be miserable if correct steps are not undertaken to manage the available water resources in the country. Besides water shortage, the poor availability of water resources may exacerbate the situation. Improvement of the watershed will recover the quality of the water and other natural resources around the watershed, enriching the ecosystem. Coimbatore is the second-largest city in Tamil Nadu which consists of nine water bodies, in which Kurichi Lake is the biggest one in Coimbatore Corporation boundary. Kurichi Lake water quality degradation has been evident for decades, especially in the vicinity of cities with anthropogenic activities. The present investigation work was carried out for determining the various physical-chemical characteristics of the surface water quality of Kurichi Lake at Coimbatore. After the experimental observation, many water characteristic values exceeded their permissible limits. So based on the results, suitable methods are suggested to improve the watershed, and it provides an opportunity for maintaining a sustainable environment in and around the lake.

Keywords: Population, Urbanization, Coimbatore, Watershed, Kurichi Lake Water quality.

INTRODUCTION

Groundwater is the most critical natural resource and a vital component of the ecological system. The physical, chemical, and bacteriological properties of groundwater must be determined before being used for various purposes. Technology may help with watershed development since it has been discovered that the Geographic Information System and Geospatial Data Management can be utilized effectively in watershed management and rural development [1]. The information may be used to assess the appropriateness of soil and water conservation buildings in locations prone to erosion and flooding. Excessive cattle in a limited area will degrade the ground; hence in agricultural regions, land use policies must include adequate soil management practices as a prerequisite for cultivation and grazing growth. The findings reveal that extended livestock exposure to soil degrades it and is the primary cause of soil deterioration. Landforms become extremely brittle due to high terrain morphogenetic processes [2]. The usage of pesticides will deplete the soil's fertility and render the watershed unusable for both animals and humans. Excessive use of agrochemicals that leached into the groundwater resulted in nitrate concentrations that were significantly higher than the irrigation water quality guideline levels. Phosphate levels were found in three wells [3]. Based on sedimentation, the existence of a pond as a watershed structure will benefit the ecosystem. The discharge and sediment flow were calculated daily and monthly using the Soil and Water Assessment Tool, using two case scenarios with and without ponds as a conservation structure. The pond's yearly discharge and sediment flow parameters have been lowered [4]. The overall sediment production of the study region has grown due to changes in land use/cover. In the deforested zone, where forest/orchard was converted to infrastructure and wasteland, soil erosion increased [6].

The study's primary goal will be to investigate potential ideas for improving the lake's ecological condition and compile a full report on the various processes involved in the watershed's regeneration. This work uses graphical representations and multivariate statistics to explain better water quality variations owing to anthropogenic effects in urban settlements, industrial

zones, and irrigational zones. Furthermore, the proper treatment of Kurichi Lake's watershed was presented using a devised technique. The study is structured to explain the recommended strategy and technologies for improving watersheds.

EXISTING CONDITION

Groundwater contamination in metropolitan areas is a significant problem, particularly in industrialized regions. The city of Coimbatore is home to many of South India's textile factories, making it a central industrial hub. Sewage is thrown into the river in Coimbatore since there is no proper drainage or sewerage infrastructure. Consequently, the dirty water flows to several tanks that make up the Noyyal river network. Wastewater discharge from point sources such as small-scale industries and crowded residential areas with unrestricted domestic sewage runoffs flows into Kurichi Lake. The higher pollution load discharged into the stream is carried out to a tank, resulting in surface water and groundwater degradation in an aquatic environment.

One of the primary goals of the research is to examine alternative ideas for lake ecological redevelopment and provide an in-depth report on various processes involved in watershed rejuvenation. Anthropogenic impacts on water quality are depicted graphically and statistically in this article, examining metropolitan areas, industrial zones, and irrigational zones. Furthermore, a new strategy for improving the watershed around Kurichi Lake discuss. A watershed improvement approach and technology are described in detail in this publication.

Because Coimbatore lacks adequate drainage or sewerage infrastructure, sewage is spilt into the river. As a result, dirty water flows to other tanks part of the Noyyal river system. Kurichi Lake, as shown in figure 1, receives wastewater discharge from point sources such as small-scale industries and densely populated

Fig 1 Satellite View of Kurichi Lake

residential areas with unrestricted domestic sewage runoffs, and the higher pollution load discharged into the stream was carried out to the tank, resulting in deterioration of surface and groundwater in an aquatic environment.

Domestic and untreated industrial wastes pour into Kurichi Lake, as seen in figure 2, and are responsible for the high concentrations of electrical conductivity, COD, alkalinity, and turbidity. Previous studies offered a cursory and superficial assessment of groundwater quality without characterizing the distinct elements influencing water quality.

Fig 2 Solid Waste Dumping On The Sides

Table 1 contains information on Kurichi Lake, located near Athuppalam in Coimbatore, Tamil Nadu, India. Kurichi Lake locates on the north side of Athuppalam and Palghat roads and the east side of Pollachi Road. Kurichi town surrounds the lake on the south and Kuniyamuthur on the west. This area lies in SF. No. 131 of Coimbatore South Taluk, an entrance of the lake, is accessed by the Kurichi canal from the Noyyal River. Kurichi canal is 4.81 kilometers long.

TABLE 1 Geographical Details Of Kurichi Lake

Taluk	Coimbatore South
Village	Kuruchi
Latitude & Longitude	10° 57'56" N and 76° 57'54" E
length	4.81 kilometres
Catchment area	4014 Acres (6.272 Sq.miles)
Water Spread area	334 Acres (1.352 Sq.km)
Capacity	60.00 M.cft
Full Tank Level	3.28 m
Max Water Level	3.83 m
Top Bund Level	24.74 m
Depth	3.277 m (10.75 Feet)
Length of the Bund	2400.00 m
No of Inlets	1
No of outlets	6
Length of Surplus escape	27.44m
No. of Sluices	5

These steps are vital for restoring and rehabilitating a degraded land area around the watershed. When an ecosystem recovers sufficient biotic and abiotic resources in its structure with negligible external support, the system is restored. The ecosystem that demonstrates resilience for normal ranges of environmental stress and disturbance interact with neighboring ecosystems through social and economic linkages between biotic and abiotic fluxes. Figure 4 depicts the proposed plan's process as a flowchart. Each phase illustrates a bottom-up method to restore Kurichi Lake's watershed. The water samples are gathered from various sites of inlets in Kurichi Lake, as shown in Figure 5, and the testing report is displayed in Table form, as shown in Table 2, and in graphical form, as shown in Figure 6. (a-m). As a result of the graphs, the water quality in Kurichi Lake determines and suitable water treatment procedures for preserving traditional water values offered.

TABLE 2 Water Sample-Result

	Sample 1 Inlet Entry (North west corner of lake)	Sample 2 Western Bund at Gandhi Nagar	Sample 3 North East (Pothanur Pirivu)	Sample 4 South Side of Kuruchi lake	Standard Values
pH	7	7	7	7	7
Alkalinity	170	300	110	110	200
Hardness	180	140	140	120	300
Chloride	140	100	100	110	250
TDS	588	648	408	408	500
Fluorides	0.5	1	1.5	1	1
Iron	0	0	0	0	0.3
Ammonia	3	3	0.5	0.5	0.1
Nitrite	0.5	0.2	0.5	0.2	0.03
Nitrate	75	75	100	100	50
Phosphate	0	0.2	0	0.5	0.7
Residual Chloride	0	0.2	0.2	1	0.2

Removal of Encroachments

The exact Lake boundaries have to be ascertained by conducting a survey, and after removal, proper fencing must be provided. It is found that the encroachments surrounding Kurichi Lake are schools, huts, shops and temples located in the landfilled areas.

Desilting, Deweeding, Bioremediation, Aeration, Bio Manipulation

The building wastes are dumped into the lake. The depth of the lake was 3.277 m. Due to heavy silting, the depth has been decreased. So, a proper desilting of the lake at the center and along its shore line as shown in Figure 3, can be done so that the depth can be increased, which can help with drought mitigation and increase of groundwater table.

Water hyacinths must be removed so that sunlight may enter the lake to improve the life in and out of the lake, providing biodiversity in nature. Bioremediation can also be used to use living organisms, such as microbes and bacteria, to remove contaminants, pollutants, and toxins from soil, water, and other environments. It cleans up the contaminated groundwater.

Fig 3 Desilting Of Lake

Strengthening of Bund, Fencing of Water Body

To avoid soil erosion and bund breaching, a proper method of strengthening must be done, i.e., putting concrete walls or partly natural tree plantation along with turfing. The bottom portion of the bund area will have water uplift pressure, so proper toe wall provision with concrete bottom layer must be provided.

Removal of Obstructions from Inlet and Outlet

Kurichi Lake permits untreated sewage water to drain from its basin without further processing. The inlets are used to dispose of construction trash and household rubbish. So, the inlet blockages must eliminate. The inlet and outlet channels should be cleaned and maintained regularly to guarantee that rainwater may flow freely into the lake during the rainy season. The excess water can be discharged into other water bodies or recharged into the earth.

Catchment Area Treatment Afforestation, Storm Water Drainage Management

The Catchment area of the lake is varied by proposing the construction of Surplus arrangement in the lake. The trees are also planted on the bund of the lake so that it aids in bund strengthening. If the lake's catchment area is improved, then natural rainwater received with runoff water into the lake will increase. Afforestation helps with the natural filtration of runoff water and creates a well-balanced ecosystem that maintains biodiversity.

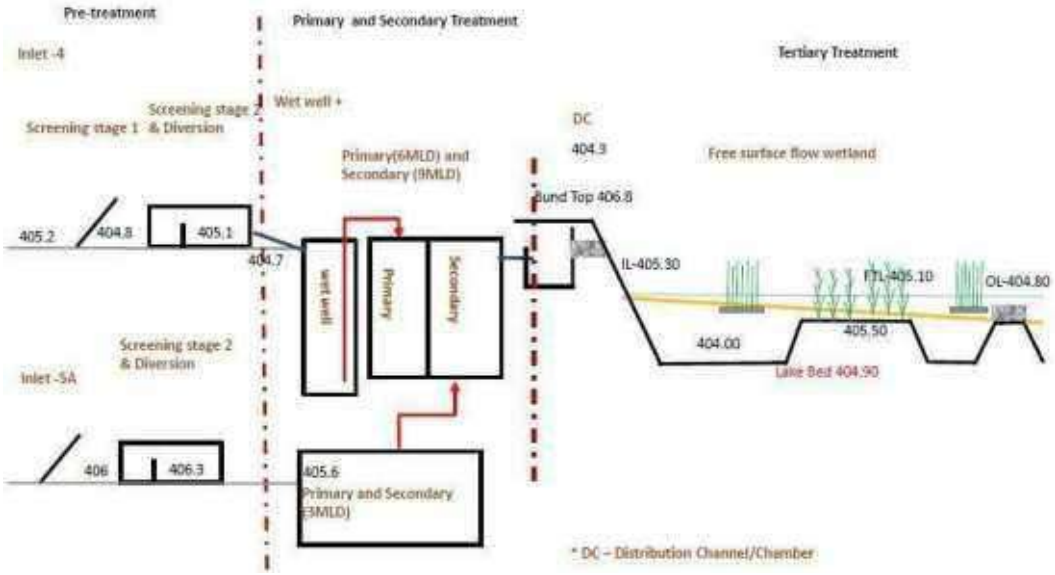

Fig 4 Water Treatment Plant

Entry of Sewage After Treatment

The sewage entering the lake must be treated and free from pollution. The water must have its physical and chemical quantities in the allowable range so that the aquatic organisms will increase and the biotic and abiotic life in the lake will improve. The treatment may be proposed based on the test sample results obtained, and reduction of specific chemicals in water can be made based on the treatment method selected. The water treatment plant consists of three stages, which can be seen in Figure 4. Water treatment methods like coagulation, sedimentation, filtration, disinfection, sludge drying, fluoridation and pH correction will be suitably followed based on the needs and availability.

Man-Made Islands with Tree Plantations

Providing sufficient artificial islands in the lake area will improve the habitat for living organisms and non-living organisms with balanced flora, fauna given by Figure 5. There are 81 species of mammal, 38 species of birds and 18 species of amphibians and reptiles that are endangered, and they can be eliminated through tree plantation.

Fig 5 Man-Made Islands

Create Wetland Plantations Near the Inlet (Natural Filtration)

Construction of wetlands given by Figure 6, along the inlets uses the natural purification process of vegetation, soils and microbes and removes contaminants from discharge.

Fig 6 Construction Of Wetlands

Industrial wastewater, municipal wastewater, and stormwater treatment all employ this form of water purification. In addition, it prevents runoff water from evaporating away. Adaptation to climate change is impossible without this low-cost water security-improving device. Wetland-created green areas also provide habitat for animals and can enhance their recreational value.

Recreational Activities

It is proposed to create a recreational space for the public with a cycling track and walkers track shown by Figure 7, around the lake for 5.50 kilometers. Shops can also be set up near the lake. To construct walkable pathways that reduce overcrowding and air pollution, boost the local economy, promote interactions among the general public, and confirm security. The roadways and pathways are created or renovated for public transport, pedestrians and cyclists, and essential government services are offered within walking or cycling distance. To enhance citizens' quality of life, reduce the urban heat effects in the area and promote eco-balance by developing open spaces with parks and playgrounds.

Fig 7 Pathway

Awareness and Community Participation

Making administration more citizen-friendly and cost-effective encourages online services to ensure accountability and transparency, providing services without requiring individuals to visit the local municipal office physically. Forming e-groups to listen to people and solicit input and conducting online monitoring of programmes and activities via cyber tours of lakeshores will boost community knowledge and engagement in recreational activities.

DISCUSSION & CONCLUSION

Healthy ecosystems are essential for humans, animals, and plants. For living creatures to survive, they require a stable and healthy ecosystem to thrive. Many authors and ecologists have stated that humans misuse the land because they perceive it as a commodity traded for money. When people perceive land as a part of a larger community to which they belong, they will begin to treat it with kindness and reverence. Restoration enables us to enhance our connection with the ecosystems on which people's lives are dependent, and it enables them to become a constructive part of the communities that work together to create a better environment for everyone. As a result, implementing some of the novel ecological restoration techniques described in the research would restore the biological balances of the lake and groundwater table while also increasing the storage capacity of both. Further ecological restoration can also contribute to maintaining a sustainable environment in the immediate vicinity. Apart from that, when the ecological restoration is well established in the research region indicated above, an ecosystem restored by bio-diversity conservation becomes affluent.

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Smart Parking System Using Raspberry Pi

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Abstract: This paper presents a new method for the people who want to park their vehicle in the modern city, and also an algorithm was implemented for the current cloud-based smart parking system using raspberry pi dependent on the Internet-of-Thing's innovation. The framework that helps people to go through the web site and he can check the free slots to park the vehicle and the client can also check complete number of free places, with this smart parking system the client can save his time, fuel and also he can relief from the mental tension to park his vehicle. Parking vehicle issue became one of significant task in the city transportation the executives since the relating to or occupying space asset of a city is restricted and the stopping cost is costly. Bunches of vehicles out and about ought to invest superfluous time and devour energy during looking for leaving because of restricted parking spot. To adapt to these constraints and give more savvy answers for drivers in the determination of stopping office, this examination proposes a brilliant stopping direction calculation. The proposed calculation upholds drivers to track down the most suitable stopping office thinking about constant status of stopping offices in a city. To recommend the most appropriate stopping office, a few factors like driving distance to the directed stopping office, strolling distance from the directed stopping office to objective, anticipated stopping costs, and gridlock because of stopping direction, are having been thought about carefully in the projected calculation. The projected calculation assists with augmenting the use of room assets of a metropolitan city, and diminishes superfluous energy utilization and Carbon dioxide (CO_2) emanation of meandering vehicles since it is intended to manage the usage of leaving office effectively and lessen gridlock because of parking spot explore.

Keywords: Smart Parking System (SPS), City transportation management, smart parking guidance, parking guidance algorithm.

INTRODUCTION

In the improvement of traffic the board frameworks, an insightful leaving framework was made to diminish the expense of employing individuals and for ideal utilization of assets for vehicle leave proprietors. Right now, the normal strategy for discovering a parking spot is manual where the driver for the most part discovers a space in the road through fate and experience. This cycle requires some investment and exertion and may prompt the most pessimistic scenario of neglecting to discover any park space if the driver is driving in a city with high vehicle thickness. The option is toward discover a predefined vehicle leave through high-limit. Nonetheless, this is certifiably not an ideal arrangement in light of the fact that the vehicle park could typically be far away from the client objective. Past study has utilized vehicle-to-vehicle (V to V) [2] and vehicle-to foundation (V to F)[1] connection with the help of different remote organization advancements, for example, radio recurrence recognizable proof (Radio Frequency Identification), Zigbee, remote wreck network [2], and the Internet. This examination meant to give data about close by parking spots for the driver and to reserve a spot minutes sooner utilizing upheld gadgets, for example, cell phones or tablet Personal Computers. Besides, the administrator identifies the users and helps the users to book their parking spot. Notwithstanding, the present savvy leaving framework doesn't give an in general ideal arrangement in tracking down an accessible parking spot, doesn't take care of the issue of burden adjusting, doesn't give monetary advantage, and doesn't get ready for vehicle-refusal administration. To determine the previously mentioned issues and exploit the huge advancement in innovation, the Internet of Things (IoT) innovation has made a transformation in numerous fields in life just as in brilliant stopping framework Smart Parking System innovation [2]. The current investigation proposes and fosters a powerful cloud-put together Smart Parking System arrangement based with respect to the Internet of Things. Our framework builds every vehicle

leave as an Internet of Things organization, and the information that incorporates the motor vehicle GPS area, distance between vehicle leaving regions and number of free slots in vehicle leave regions will be moved to the server.

The cloud server helps to determine the free parking slots and charge for the parking based on time stamp, and these free parking slots and the parking costs are repeatedly updated and are available any cost of time by the motor vehicles in the system. The Smart Parking System is a new technology, with this technology we can automatically supervise and manage the car parking system and each car parking system can function separately as a traditional smart car parking system.

Initially, a car (from this point forward a vehicle) was developed to expand accommodation and support in regular day to day existence. even so, the vehicle clog in a major city messes unfortunate up like natural issues, energy utilization, parking spot deficiency, gridlocks, clamor, air contamination, and surprisingly minor mental harm to certain individuals. Due to huge traffic and issues like lack of parking spots, lack of prior knowledge on parking system. Thus, numerous vehicles out and about ought to invest pointless time and burn-through unessential energy during looking for parking spots. As indicated by the new examination work [4] managing the meaning of stopping issue, the traffic stream top brought about via looking through stopping offices can increment as much as around 25–40%. [3] Referenced that about 30% of vehicles out and about in the midtown space of significant urban communities appeared to journey for parking spaces, which took a normal of 7.8 min. The other examination tracked down that the meandering of vehicles to discover a leaving office is liable for about 30% of the whole traffic in a city [5] referred to from an investigation of stopping circumstance in Schwabing (an area of Germany) that a yearly complete economy harm had been assessed as 20 million euro, caused simply by the traffic looking with the expectation of complimentary parking garages [19, 20].

RELATED WORK

In certain examinations, the creators anticipated a new algorithm for smart parking system for vehicles. In the first part, they utilized a calculation to plan the online issue of a stopping framework into a disconnected issue. In second part, they set up a numerical model depicting the disconnected issue as a straight issue. In third part, they planned a calculation to tackle this straight issue. At long last, they assessed the proposed calculation utilizing exploratory reenactments of the framework. The test results demonstrated opportune and effective execution. Nonetheless, these papers don't specify the asset reservation instrument (all leaving prerequisites are inferred promptly and are put in the line), the component for surveying the assets framework, the instrument to direct vehicles to the parking spot, the system for taking care of circumstances when the solicitation for administration is denied and don't figure the normal holding up time and normal complete time that every motor vehicle spends on the framework. In another examination [4], the creators propose a Smart Parking System dependent on the combination of UHF recurrence, Wireless Sensor Network innovations, IEEE 802.15.4 and Radio Frequency Identification (RFID). This framework can gather data about the condition of inhabitance of the vehicle leaves, and can guide drivers to the closest empty parking space by utilizing a product application. Be that as it may, in this work, the creators have no numerical conditions for the framework design and don't make a huge scope stopping framework. The consequences of this paper just carry out the proposed engineering; they don't make reference to the presentation of the Smart Parking System framework [5]. Proposed an imaginative framework including the stopping direction administration. A parking spot can be held by a cell phone through Internet access. After entering the vehicle leave, the saved parking spot will be shown on a little guide utilizing remote transmission for vehicles under the committed short-range correspondence convention. An inertial route framework is carried out to direct the vehicle to the held space. The framework will occasionally refresh the situation with the parking spot continuously to assist with guaranteeing framework precision. Framework execution is estimated through the exactness of the inertial route frameworks run in an indoor climate, and the framework execution is assessed by thinking about the precision of the Global Positioning System. In this research, the creators have not assessed the presentation of the leaving administrations; they don't give any numerical model of the framework, and don't think about the hanging tight season of every vehicle for administration. Different specialists have planned engineering for stopping the executives in brilliant urban areas [6]. They proposed smart stopping collaborator (IPA) engineering pointed toward defeating current public stopping the board arrangements. This engineering gives drivers data about on-road stopping slow down accessibility and permit drivers to save the most advantageous stopping slow down at their objective before their takeoff. They use Radio Frequency ID innovation in this framework. At the point when no a vehicle stops or leaves the IPA parking space, the Radio Frequency ID Authorized person and the attractive circle distinguish the activity and send this data to the unit regulator to refresh the data on the vehicle leave status [21]. This examination utilizes just some straightforward numerical conditions for the framework design and doesn't make a large-scale stopping framework. In different works, creators have planned and carried out a Smart Parking System [7] to take care of the stopping issue. A piece of this framework is carried out in the Zigbee network which sends pressing data to a personal computer through an organizer and afterward refreshes the data set. The application layer can rapidly ignore the stopping data the Internet, and utilize the upsides of a web administration to accumulate all the dispersed stopping data for the accommodation

of the individuals who need to discover a parking spot. This paper essentially reports the plan and execution of a Smart Parking System and doesn't assess the framework execution [8]. Expected to mechanize the vehicle and the vehicle leaving. The paper examines a venture which presents a smaller than normal model of a computerized vehicle leaving framework that can direct and deal with the quantity of vehicles that can be left in a given region at some random time dependent on the accessibility of parking spots. The mechanized leaving strategy permits the leaving and leaving of vehicles utilizing detecting gadgets. Section to or exit from the vehicle leave is instructed by an web based application. The contrast between the Bonde framework and the other existing frameworks is that the creators were planning to make the framework as minimal human reliant as conceivable via computerizing the vehicles just as the whole vehicle leave; then again, most existing frameworks require human intercession (the vehicle proprietor or other) to leave the vehicle [9,16] Portrayed another Smart Parking System design dependent on the Internet of Things innovation. The design of this framework comprises of a Zigbee, (WSN) Wireless Sensor Network, a front-end layer and IoT middleware layer as the internal user interface that gives information answering to the client. Be that as it may, there is detriment as it doesn't utilize an appropriate application convention for the exchange of information from the Wireless Sensor Network to the worker, like the Constrained Application Protocol (CoAP), There are no framework for mathematical and execution assessment [17,18].

IMPLEMENTATION

Smart Parking System framework, first recognizes the vehicle left in quite a while and shows the situation with each opening through the web server. The people who want to park their vehicles can know the situation with the leaving opening through the website page, after that they need to show their Radio Frequency Identification (RFID) to the Authorized person (to read or examine with care) to get confirmed and note down the hour of that particular vehicle. Assuming the new guest is identified through another Radio Frequency Identification (RFID) Authorized person, it prompts to ask the username, secret phrase and Mail ID with their Radio Frequency Identification (RF-ID) and store those subtleties to the Raspberry Pi. Then, at that point while leaving, by showing the Frequency Identification (RF-ID) to the Authorized person it notes down the out time and computes the complete time with the cash for that time. Then, at that point it will be identified from the record balance and the implication will be shipped off their personal mail.

COMPONENTS REQUIRED

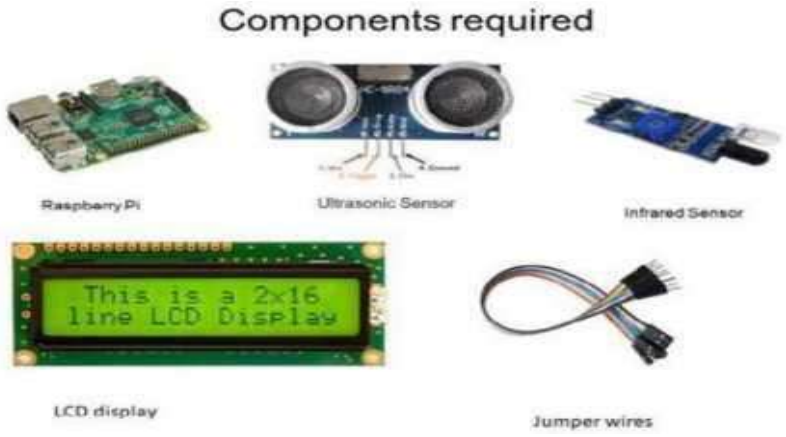

Fig. 1 Components Required

CIRCUIT DESIGN

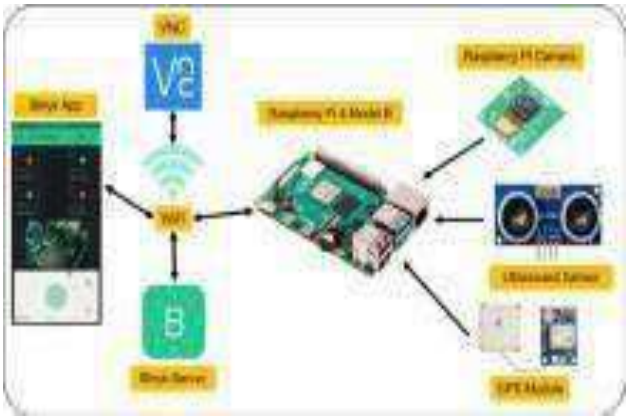

Fig.2 Circuit Design

RESULT

Slots	Slot 1	Slot 2	Slot 3	Slot 4
Vehicle	Filled by Vehicle	Filled by Vehicle	Filled by Vehicle	Filled by Vehicle

All the slots are filled with Vehicles,
No Empty Slot to park the vehicle

Slots	Slot 1	Slot 2	Slot 3	Slot 4
Vehicle	Empty	Filled by Vehicle	Filled by Vehicle	Filled by Vehicle

Slot 1 is empty, means a user can park the vehicle
slot 2,3 and 4 are filled with vehicles

Slots	Slot 1	Slot 2	Slot 3	Slot 4
Vehicle	Empty	Empty	Empty	Empty

Slot 1,2,3 and 4 are empty, means a users can park the vehicles

Slots	Slot 1	Slot 2	Slot 3	Slot 4
Vehicle	Empty	Filled by Vehicle	Empty	Filled by Vehicle

Slot 1,3 are empty, means a user can park the vehicles in 1 and 3 slots.
slot 2 and 4 are filled with vehicles

Fig.3 Results

CONCLUSIONS

The Parking framework turns out to be further developed than before which has the information base, Mail notices, Fees assessment, Auto-identification and so on.

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Vehicle Type Identification Using Machine Learning Tasks

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Abstract. This paper presents a method for vehicle type identification using machine learning algorithms. Machine learning allows the computer to imitate and adapt human like behavior by using algorithms and statistical models to analyze and draw inference from patterns in data. Machine learning as technology helps to analyze large amount of data, easing the tasks of data scientists in an automated process and is gaining a lot of prominence and recognition. The data required for the vehicle type identification are collected using Wi-Fi MAC Scanners (WMS) through which the vehicle traveled for a confined location. The data collected from the Wi-Fi MAC Scanners is a large data set. The method of machine learning tasks is adopted for analyzing the data set collected. The machine learning to task consists of numerous algorithms for analyzing different kind of data set. Machine learning also changed the way of data extraction and interpretation works by involving automatic sets of generic methods that have replaced traditional statistical techniques which will be more helpful to find the underlying pattern of the data collected. The machine learning algorithms are implemented with the help of python packages and the effective algorithm for the classification is also verified. The entire machine learning algorithms were coded using PYTHON 3.8.1, documentation released on 18 December 2019.

INTRODUCTION

Management of current roadways infrastructure and planning for maintenance and future growth are important projects for local and state governments. The maintenance and construction of new roads are large undertakings, requiring considerable dedication of resources and potential description of many users. Making decisions about these activities requires a good understanding of the pattern of usage for existing roadways and a means of planning and estimating the likely impact of future additions or modification of the existing network. The classification of mode of transport helps in identifying the characteristics of the road network and helps in implementing further improvements to the road structure. The reasons for classifying the mode of transport are as follows.

- Understanding the characteristics of road network.
- Providing necessary strategy for the improvement of road structure to avoid accidents or to find whether the road network has to be completely re-designed.

In Transportation, it is very important to monitor the vehicle movements on the roads in order to provide necessary improvements or to find the need for construction of new road structure. There are several methods to monitor the road user characteristics and the vehicle movements. In order to provide cost effective monitoring of road user characteristics, the installation of WMS on the roads are done. By using the data collected from the WMS, we can able get the road user characteristics and to predict whether the road needs improvement or replacement. This research aims to determine the mode of transport used by the road users by analyzing the data collected by the Wi-Fi MAC Scanners (WMS) through which the vehicle travelled through the confined location using machine learning algorithms and to find out the effective algorithm for the classification of mode of transport from the available clustering algorithms.

MACHINE LEARNING

Machine learning is the core subarea of artificial intelligence (AI). It helps computers get into a self-learning mode without explicit programming. When we fed new data, these computers learn, grow, change, and develop by them- selves. The machine learning field is continuously evolving [9]. And along with the evolution comes a rise in demand and importance. Data analysis has been used by the trial and error approach-one that is unable to use when there are significant and heterogeneous data sets in

question. For this reason, the big data was criticized for being over hyped [10]. The availability of more data is directly proportional to the difficulty in new predictive models that work accurately. Traditional statistical solution is focused on static analysis that is limited to the analysis of samples that are frozen in time. Enough, this could result in unreliable and inaccurate conclusions.

METHODOLOGY

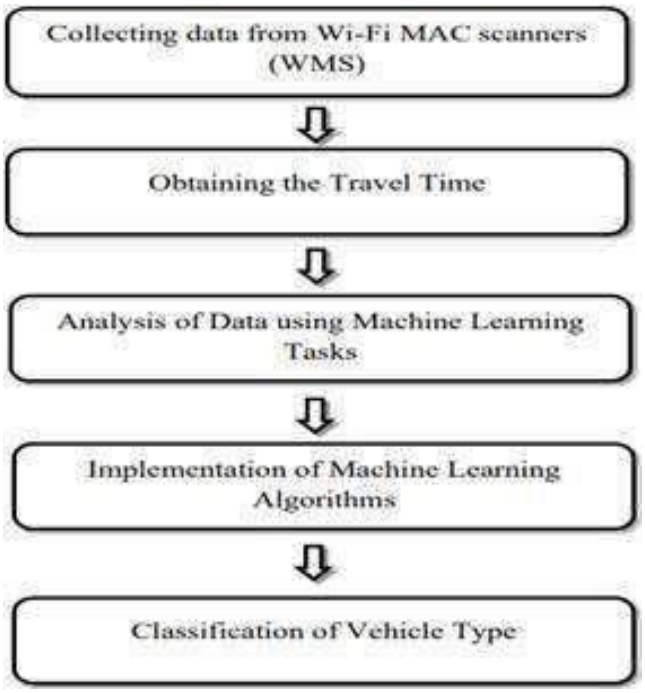

Fig 1 Methodology of the work

WI-FI MEDIA ACCESS CONTROL SCANNER (WMS)

Recent digitalization has led to a significant increase in data usage and Wi-Fi penetration rates across theglobe. Wi-Fi Media Access Control (MAC) data, allows for unannounced and non-participatory tracking of electronic de- vices. The Wi-Fi MAC scanner has attracted several transport researchers to use it in the estimation of traffic parameters such as travel time. However, the commercial sensors available for Wi-Fi MAC scanning are not affordable to be installed widely in a city.

COMPARISON OF VARIOUS SPATIAL SENSORS

Table 1. Comparison of various spatial sensors

Sensor	Cost	Accuracy	Privacy Concern
GPS	Moderate	High	High
GPS+RFID	High	High	High
ANPR	High	Low	Low
Bluetooth MAC	Low	High	Moderate
Wi-Fi MAC	Low	High	Moderate

GPS – Global Positioning System
RFID –Radio Frequency Identification
ANPR – Automatic Number Plate Recognition

WI-FI MAC SCANNER SPECIFICATION

- USB Wi-Fi adapter – TP-Link TL - WN82
- Operating Frequency – 2.4 GHz
- Range of Scanner – 80 meters
- Hardware –Raspberry pi 3B+ model.

LOCATION SELECTED FOR DATA COLLECTION

Fig 2. Location Selected

Origin: Latitude – 13.003915, Longitude -80.247516 (Foot over bridge I)
Destination: Latitude – 12.995195, Longitude -80.249517(Foot over bridge II)
Distance: 1 km

Description: The Wi-Fi MAC Scanners are placed in foot over bridge I and foot over bridge II. There is a continuous flow of traffic in the confined location (i.e no traffic signals are present) for the effective classification. The vehicles which pass through the location are scanned by the Wi-Fi MAC scanners within the range.

DATA COLLECTION FROM WI-FI MAC SCANNERS

Wi-Fi MAC Scanners helps to obtain the data about the vehicle passing through the confined location. One week data from the Wi-Fi MAC scanners is obtained for classifying the vehicle.

TRAVEL TIME ESTIMATION

- The data collected by the Wi-Fi MAC scanner also consist of duplicates as the vehicle consisting wireless network inbuilt such as cars or mobile phones used by the traveler travelling through the confined location can hit on the scanner for several time [3].
- For obtaining the travel time of the vehicle from foot over bridge I to foot over bridge II, the timestamp details from the scanner can be utilized.
- As the same wireless network can hit on the scanner for several times, the last hit of the wireless network is considered on both the scanners and the difference of the timestamps are calculated. Thus, the difference in their timestamp gives the travel time of the vehicle travelling through the distance between the Wi-Fi MAC scanners [7].

- As the same wireless network can hit on the scanner for several times, the last hit of the wireless network is considered on both the scanners and the difference of the timestamps are calculated. Thus, the difference in their timestamp gives the travel time of the vehicle travelling through the distance between the Wi-Fi MAC scanners [7].

ANALYSIS OF DATA USING MACHINE LEARNING TASKS

Method adopted for analysis of data

The data collected are unlabeled and neither classified. Hence, preferring the method of unsupervised learning for the analysis of the data. The term unsupervised learning can also be known as clustering. The unsupervised learning algorithm helps us to find the patterns in the data by clustering the data according to their similarities.

Application of Unsupervised machine learning

- Clustering automatically splits the dataset into groups based on their similarities.
- Anomaly detection can used to find out the unusual data points in your dataset. It is useful for finding fraudulent transactions.
- Latent variable models are widely used for data pre-processing. Like reducing the numbers of features in a dataset or decomposing the dataset into multiple components are used in unsupervised machine learning.

Types of Clustering algorithms in Unsupervised learning

- Hierarchical Clustering.
- K – means Clustering.
- Gaussian mixture models.
- Density based spatial clustering algorithms.
- Fuzzy C – means Clustering.
- K-neighbor search and radius search.
- Spectral Clustering.

CLUSTERING ALGORITHM FOR ANALYSIS OF DATA

For the analysis of data, preferring the algorithms of K-means Clustering algorithm and Fuzzy C–means clustering algorithm. The results of both the clustering algorithms are compared to find the better algorithm to suit the data collected.

K-Means Clustering Algorithm

K-means algorithm is an iterative algorithm that tries to group the dataset into K numbers of pre-defined distinct non-overlapping subgroups (clusters) in which each data point belongs to only one group [4]. K-means algorithm tries to make the intercluster data points as similar as possible while it also keeps the clusters as (far) as possible. It assigns data points to a cluster such that the sum of the squared distance between the data points and the cluster's centroid (arithmetic mean of all the data points that belong to that cluster) is always the minimum in this clustering algorithm. The less variation of difference we have within clusters, the more homogeneous (similar) the data points are within the same cluster [5]. The following are the reasons for selecting K-means clustering algorithm are the following.

- Clustering depends on the Euclidean distances (straight line distance between two points) between the data points.
- More suitable for large amount of data.
- Data can be clustered into specified numbers.
- Operates on actual observation rather than dissimilarity measures.

Steps in K-means algorithm

The K-means clustering algorithm aims at minimizing an objective function known as squared error function given by:

$$J(V)=\sum_{i=1}^{c}\sum_{j=1}^{ci}(||xi-vj||)^2$$

Where,

‖xi –vj‖' is the Euclidean distance of the data points between xi and vj. 'ci' is the number of data points present in i^{th} cluster. 'c' is the number of cluster centres.

Let X = {x1,x2,x3, ... ,xn} be the set of data points and V = {v1,v2,vc} be the set of centers.

1. Randomly select 'c' cluster centers.
2. Calculate the distance between each data point present in the cluster and cluster centres.
3. Assign the data point of the dataset to the cluster centre whose distance from the cluster centre is minimum of all the cluster centres.
4. Recalculate the new cluster centre using:

$$v_i=(1/c_i)\sum_{j=1}^{ci} xi$$

where, 'ci' represents the number of data points present in i^{th} cluster.

5. Recalculate the distance between each data point of the cluster and new obtained cluster centres.
6. If no data point was reassigned then stop the iteration of the algorithm, otherwise repeat from step 3.

Fuzzy C- Means Clustering Algorithm

Fuzzy C-means algorithm works by assigning membership to each data point of the data set corresponding to each cluster centre on the basis of the Mahalonobis (How standard deviation away from the mean) distance between the cluster centre and the data point [1]. More the data is near to the cluster centre more the membership value towards the particular cluster centre. Clearly the summation of membership of each data point should be equal to one. After each iteration, membership and cluster centres are updated [11].

Steps in Fuzzy C-means Clustering algorithm

Main objective of fuzzy c-means algorithm is to minimize:

$$J(U,V)=\sum_{i=1}^{n}\sum_{j=1}^{c}(\mu ij)^m\,||xi-vj||^2$$

The algorithm of fuzzy clustering can be summarized as follow:

Let X = {x1, x2, x3 ..., xn} be the set of data points and V = {v1, v2, v3 , vc} be the set of centres.

1. Randomly select 'c' cluster centres.
2. Calculate the fuzzy membership 'μij' using:

$$\mu_{ij}=1/\sum_{k=1}^{c}\left(\frac{dij}{dik}\right)^{\left(\frac{2}{m}-1\right)}$$

3. Compute the fuzzy center's 'vj' using:

$$v_j=\left(\sum_{i=1}^{n}(\mu ij)^m xi\right)/\left(\sum_{i=1}^{n}(\mu ij)^m\right),\forall j=1,2\ldots c$$

4. Repeat step (2) and (3) until the minimum 'J' value is achieved or ‖U(k+1) – U(k)‖ < β. Where, 'k' is the iteration step. 'β' is the termination criterion between [0, 1].

U = (μij)n*c' is the fuzzy membership matrix.

'J' is the objective function.

IMPLEMENTATION OF ALGORITHMS

- The data collected from the confined location are plotted in a scatter plot using both the K-means clustering algorithm and Fuzzy C-means clustering algorithm [2].
- The MAC ID will not provide any information regarding the type of vehicle because it is unique for each and every wireless network. Hence, I have chosen to plot the graph between travel time and time index.
- Assigned the time index for each 15 minutes. Hence there will be 96-time index for a whole day from (12.00am to 12.00pm).

- Here the number of clusters to be formed are predetermined as 5. Preferred to classify the vehicle into five groups such as bikes, cars, auto, buses and pedestrians.
- The five cluster groups which are formed in the plot indicates different type of vehicle with certain accuracy for both algorithms.
- I have assigned different colors for each scatter points on the graph which indicates the cluster which it belongs. The scatter plots different colors for each scatter points on the graph which indicates the cluster which it belongs.
- The scatter plots are plotted for both K-means clustering algorithm and Fuzzy C-means algorithm [6]. The Data collected from the WiFi MAC Sensors for the duration of one week plotted.

PLOT OF UNCLUSTERED DATA POINTS (K-MEANS)

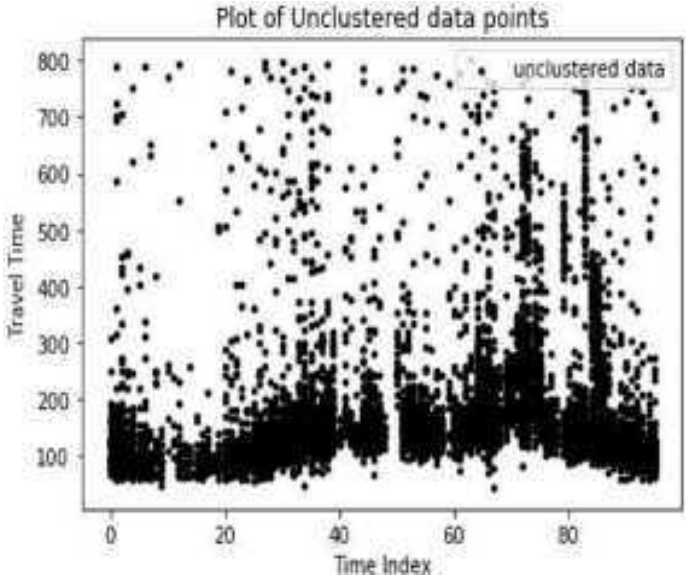

Fig 3. Plot of Unclustered Data Points

CLASSIFICATION AND RESULTS

The classification of vehicle entirely depends on the travel time of the vehicle travelling through the distance between the Wi-Fi MAC scanners. The Classification of vehicles is done based on the peak and off-peak hour of the road. Peak hour is a part of the day during which traffic congestion on roads and crowding on public transport is at its highest. Off-peak hour is a part of the day which is not being in the period of maximum use. This is the main consideration for classification of vehicle.

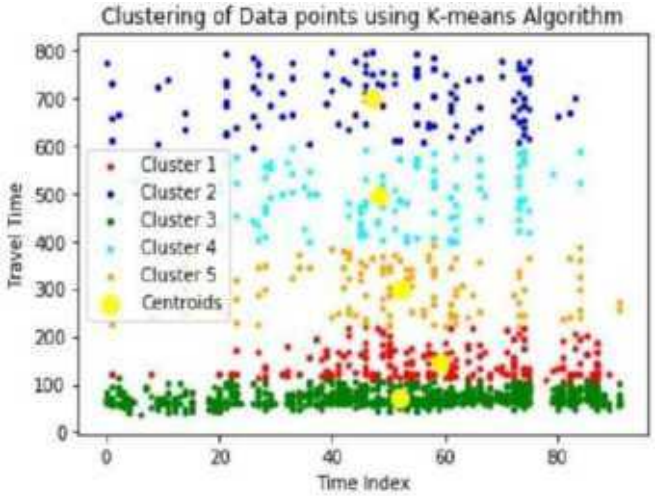

Fig. 4 Clustering using K-means Algorithm

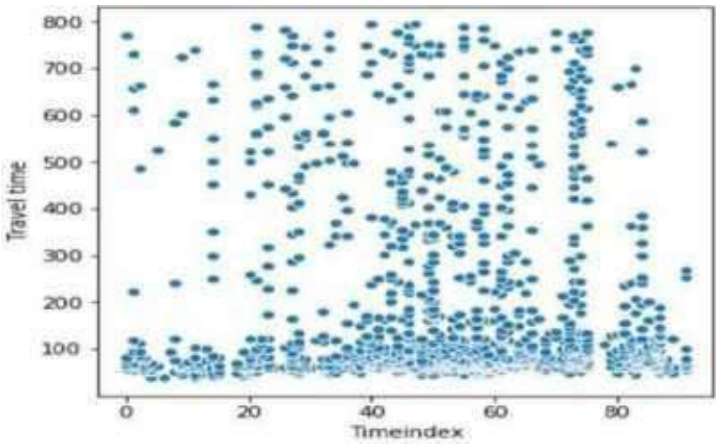

Fig 5. Plot of Unclustered Data Points

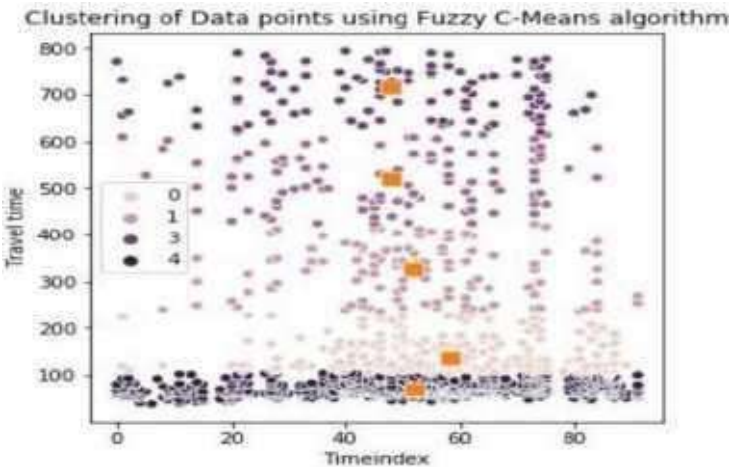

Fig 6. Clustering using Fuzzy C-Means Algorithm

During the peak hours, bikes may travel at a speed higher than that of cars because of the congestion. During the off-peak hours, cars travel with higher speed when compared to bikes and hence the travel time of cars is low when compared to bikes in off-peak hours. At both instances, buses will travel at a speed slower than both bikes and cars.

The peak and off-peak hour of the day are found out using the histogram plot of data. The histogram is plotted for the timestamp recorded on the WiFi MAC Sensors as each timestamp indicates the hit of the wireless network on the scanners.

IDENTIFICATION OF PEAK AND OFF-PEAK HOUR USING SCATTER PLOT

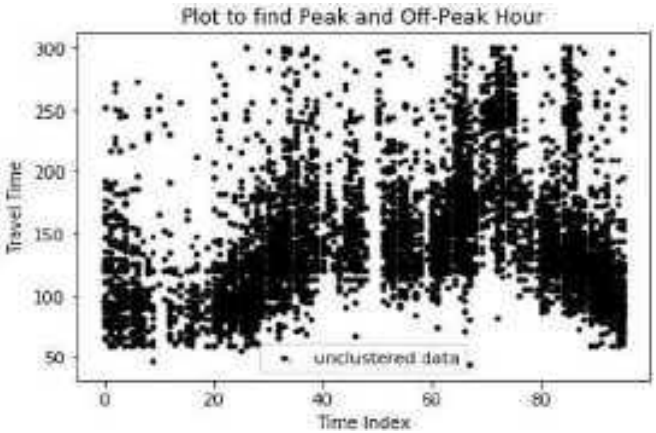

Fig. 7 Identification of Peak and Off-peak Hour

From the scatter plot, the peak and off-peak hour observed commonly are,

1. Peak Hour – 8 AM to 11 AM & 4 PM to 8 PM
2. Off-peak Hour – 5 AM to 7.30 AM & 2 PM to 4 PM

Plot of Clustered Peak and Off-Peak hour data using K-means algorithm

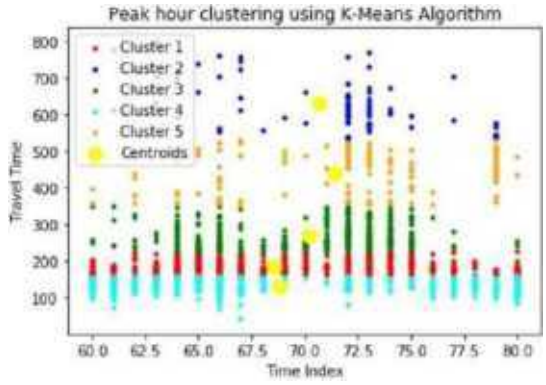

Fig 8. Clustered Peak Hour Data using K-means Algorithm

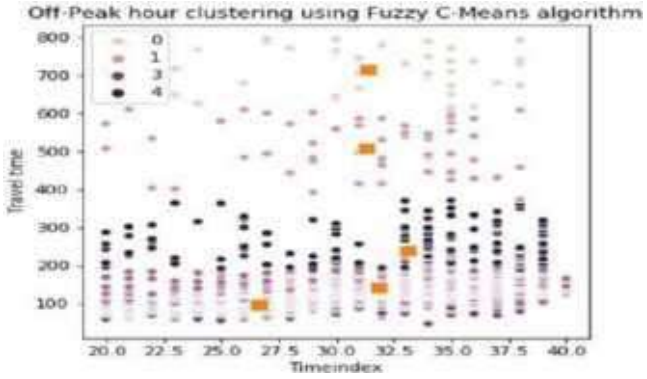

Fig 9. Clustered Off-peak Hour Data using K-Means Algorithm

Plot of Clustered Peak and Off-Peak hour data using Fuzzy C-means algorithm

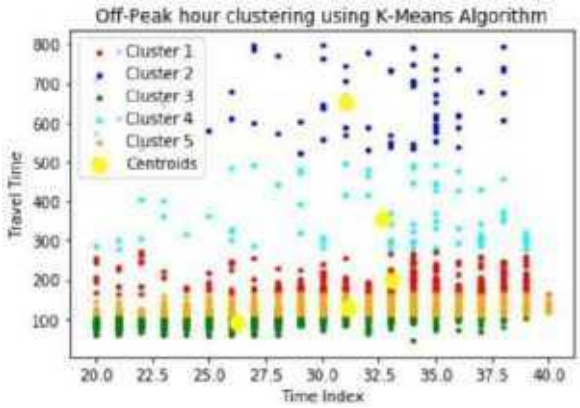

Fig 10. Clustered Peak Hour Data using Fuzzy C-Means Algorithm

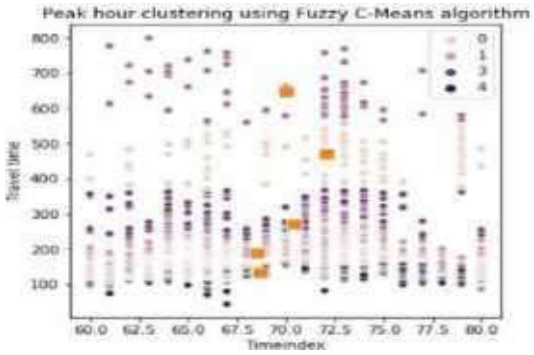

Fig 11. Clustered Off- Peak Hour Data using Fuzzy C-Means Algorithm

Analysis of the Clustered Data

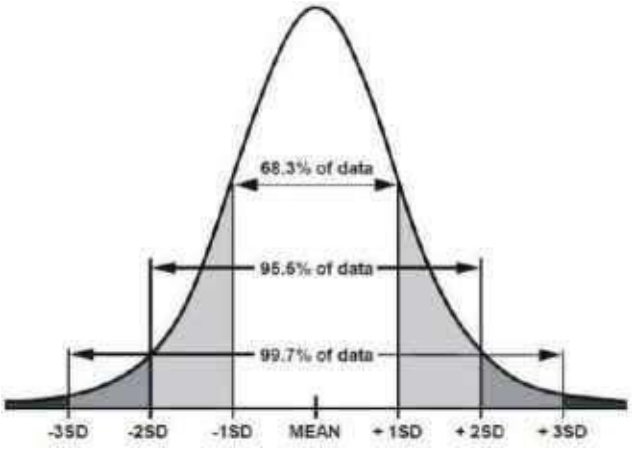

Fig 12. Normal Distribution Curve

CLUSTERED DATA ANALYSIS USING NORMAL DISTRIBUTION CURVE (K-MEANS ALGORITHM)

TABLE 2. Normal Distribution Curve (K-Means)

Clsuter (K-Means)	Peak Hour Data		Off-peak Hour Data	
	Within 1 SD	Within 2 SD	Within 1 SD	Within 2 SD
Cluster 1	63.51%	91.43%	62.35%	93.51%
Cluster 2	65.23%	90.73%	64.25%	91.63%
Cluster 3	64.21%	92.61%	63.27%	92.57%
Cluster 4	66.71%	89.59%	61.97%	93.57%
Cluster 5	63.78%	91.69%	63.47%	90.38%

CLUSTERED DATA ANALYSIS USING NORMAL DISTRIBUTION CURVE (FUZZY C-MEANS ALGORITHM)

TABLE 3. Normal Distribution Curve (Fuzzy C-Means)

Cluster (Fuzzy C-Means)	Peak Hour Data		Off-peak Hour Data	
	Within 1 SD	Within 2 SD	Within 1 SD	Within 2 SD
Cluster 1	69.57%	96.23%	71.56%	97.86%
Cluster 2	70.29%	95.96%	69.25%	96.56%
Cluster 3	69.88%	97.56%	72.44%	98.03%
Cluster 4	71.65%	97.23%	70.55%	97.32%
Cluster 5	72.85%	96.94%	73.83%	97.96%

CLASSIFICATION OF MODE OF TRANSPORT

Classification using GPS data

From the Car GPS data

TABLE 4. Classification using Car GPS Data

Origin (Latitude)	Origin (Longitude)	Destination (Latitude)	Destination (Longitude)	Distance (km)	Travel time (seconds) (peak hour)	Travel time (seconds) (Off-Peak
13.003915	80.247516	12.995195	80.249517	1	185.23	98.64

From the Bus GPS data

TABLE 5. Classification using Bus GPS Data

Origin (Latitude)	Origin (Longitude)	Destination (Latitude)	Destination (Longitude)	Distance (km)	Travel time (seconds) (Peak hour)	Travel time (seconds) (Off-Peak
13.003915	80.247516	12.995195	80.249517	1	456.87	267.76

Classification using Google Travel time Prediction

Travel time of Car

TABLE 6. Classification using Google Travel time Prediction (Car)

Origin (Latitude)	Origin (Longitude)	Destination (Latitude)	Destination (Longitude)	Distance (km)	Travel time (seconds) (Peak hour)	Travel time (seconds) (Off-Peak
13.003915	80.247516	12.995195	80.249517	1	180	90

Travel Time of Bike

TABLE 7. Classification using Google Travel time Prediction (Bike)

Origin (Latitude)	Origin (Longitude)	Destination (Latitude)	Destination (Longitude)	Distance (km)	Travel time (seconds) (Peak hour)	Travel time (seconds) (Off-Peak
13.003915	80.247516	12.995195	80.249517	1	150	120

Travel Time of Pedestrian

TABLE 8. Classification using Google Travel time Prediction (Pedestrian)

Origin (Latitude)	Origin (Longitude)	Destination (Latitude)	Destination (Longitude)	Distance (km)	Travel time (seconds) (Peak hour)	Travel time (seconds) (Off-Peak
13.003915	80.247516	12.995195	80.249517	1	720	660

CLASSIFICATION USING FIELD DATA

1. Origin: Latitude – 13.003915, Longitude – 80.247516 (Foot over bridge I)
3. Origin: Latitude – 12.995195, Longitude – 80.249517(Foot over bridge II)

TABLE 9. Classification using Field Data (Up)

Mode of Transport		Hour (seconds) (Manual Observation)	Hour (seconds) (Manual Observation)	Hour (seconds) (WMS Data)	Off-peak hour (seconds) (WMS Data)
Car	1	233	89	227	82
	2	243	93	234	87
	3	227	84	231	91
	4	249	86	242	85
Auto	1	334	314	316	297
	2	341	309	322	291
	3	337	317	311	304
	4	329	312	319	296

1. Origin: Latitude – 13.003915, Longitude – 80.247516 (Foot over bridge I)
2. Origin: Latitude – 12.995195, Longitude – 80.249517(Foot over bridge II)

TABLE 9. Classification using Field Data (Down)

Mode of Transport		Hour (seconds) (Manual Observation)	Hour (seconds) (Manual Observation)	Hour (seconds) (WMS Data)	Off-peak hour (seconds) (WMS Data)
Car	1	237	84	226	85
	2	242	93	234	91
	3	231	95	219	93
	4	235	89	229	83
Auto	1	331	321	319	292
	2	343	313	324	301
	3	347	323	311	296
	4	339	309	329	295

SUMMARY OF CLASSIFICATION

TABLE 11. Range of Clusters

Cluster	Range of cluster in Peak Hour (K-Means)	Range of cluster in Off-Peak Hour (K-Means)	Range of cluster in Peak Hour (FCM)	Range of cluster in Off-Peak Hour (FCM)
Cluster 1	44 - 177	47 - 141	44 - 161	47 - 119
Cluster 2	178 - 262	142 - 230	162 - 230	120 - 189
Cluster 3	263 - 392	231 - 404	231 - 368	190 - 372
Cluster 4	399 - 564	416 - 627	373 - 555	374 - 611
Cluster 5	566 - 800	638 - 796	560 - 800	618 - 796

TABLE 12. Summary of Classification

Mode of Transport	Travel time in Peak hour (seconds) (GPS)	Travel time in Off Peak hour (seconds) (GPS)	Travel time in Peak hour (seconds) (Prediction)	Travel time in Off Peak hour (seconds) (Prediction)	Travel time in Peak hour (Seconds) (WMS Data)	Travel time in OP Hours (seconds) (WMS Data)
Bike	-	-	150	120	-	-
Car	185.23	98.64	180	90	227	82
Auto	-	-	-	-	316	297
Bus	456.87	269-76	-	-	-	-
Pedestrian	-	-	720	660	-	-

RESULTS OF CLASSIFIED MODE OF TRANSPORT

Plot of Classified Peak Hour Data using K-Means Algorithm

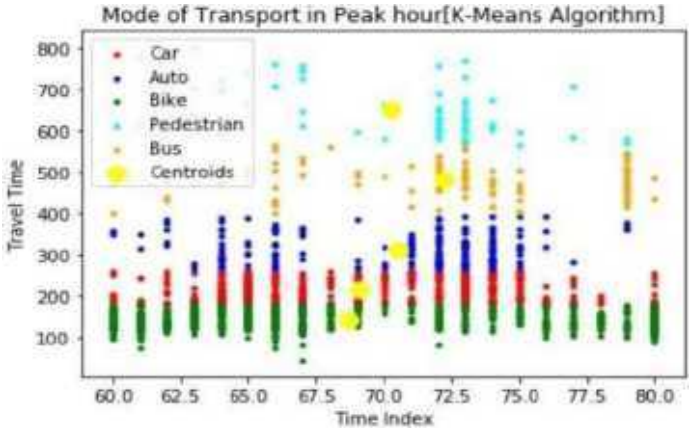

Fig 13. Mode of Transport in Peak Hour (K-Means)

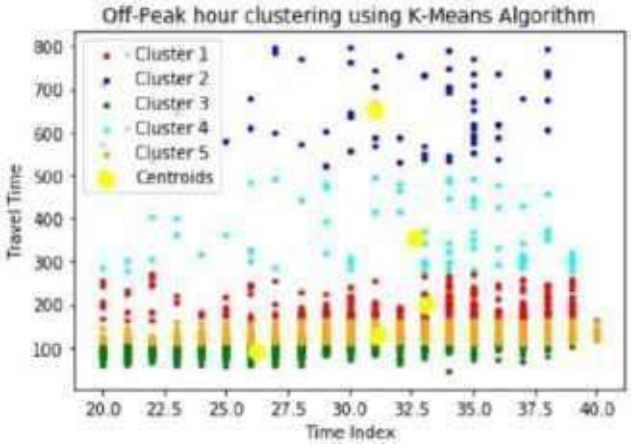

Fig 14. Mode of Transport in Off Peak hour (K-means)

Plot of Classified Peak Hour Data using Fuzzy C-Means Algorithm

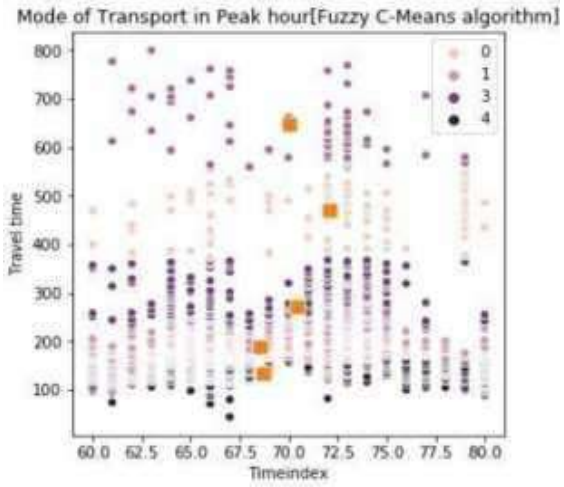

Fig. 15 Mode of Transport in Peak hour (FCM)

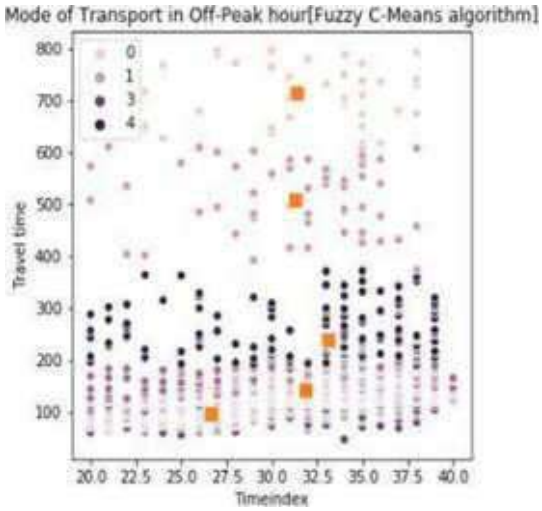

Fig 16. Mode of Transport in Off-Peak hour (FCM)

CONCLUSION

The project has helped in the classification of different mode of transport using machine learning tasks. The method K-Means algorithm and Fuzzy C-Means Algorithm are used to classify the given data points according to their similarities as these two clustering algorithms produces linear clustered data points. K-Means algorithm is based on Euclidean distance whereas Fuzzy C means Algorithm is based on Mahalonobis distance. The clusters of the dataset are classified based on the travel time because each mode has different travel time which varies at peak and off-peak hour. The clusters formed are analyzed with statistical tools and verified for the similarities in the cluster data points. The pattern of classification differs for peak and off-peak hour for each mode of transport. The classification of mode of transport is carried out based on the travel time obtained from the GPS data, Google prediction in maps and also through field trips (WMS data). The classification is more effective in Fuzzy C-Means

when compared with K-means algorithm, this is because Fuzzy C-means classify clusters based on how the standard deviation varies with the mean.

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Smart Cities with Big Data Analytics; A Review

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ABSTRACT. SC "Smart City" is an evolving model targeting at vindicating the encounters upraised due to the constant spread and growth. Merger of telecommunication technologies and revolution in field of info, the visualisation of the 'SC' is rapidly converting to realism. City administrations and managements in a plenty of countries are exploiting on these developments to improve citizens lives and to upsurge sustainability and competence. ICT "Information and Communication Technologies" is the permitting machinery for revamping. This know-how is harvest enormous capacities of data known as BD "Big Data". As a result of fast growth of such data, results require to be planned and delivered for handling and extraction of value and information from these datasets. Additionally, the main project owners require to be capable to achieve valued acumens from this type of wide-ranging and swiftly varying data, stretching via routine trades to consumer interfaces and social networking data. This type of value may be delivered utilizing BDA "Big Data Analytics" that is solicitation of progressive analytics methods on BD. It is literature's methodical analysis on BDA in SCs. Some of the most important research findings have been presented by us in data analytics area. The aim of our work is to explore few of the various analytics approaches and techniques that may be used for BD. We used a systematic literature review on BDA systems in smart cities to address these questions.
Keywords: SC "Smart city(s)", BDA "Big Data Analytics", BD tools

INTRODUCTION

It looks as if each big city is attempting towards upgrading itself into a SC. Plenty of fundamentals are there which contribute in making a city smart. For instance waste management, water management, conveyance, and security are few of the several zones of emphasis. Upcoming smart cities include the elementary requirements and advanced machineries for unproblematic and basic living. There are numerous zones of growth in a city which must be recognised to redesign the existing state. A modest description of a SC is "a city which is well furnished with elementary infrastructure to deliver valued lifestyle to the residents."

The SC conception arose as an approach towards mitigation of the extraordinary encounters of constant development, growing density of residents and in parallel delivering enhanced superiority of life to the residents and guests as well [1]. A SC is comprised of smart mechanisms like smart farms, smart buildings and smart clinics etc. All these establish several city areas wherever senses of label "smart" have diverse meanings in every domain [2]. The ICT applications and rigorous utilization of digitalised artefacts like actuators, devices and cells have vital resources for appreciating smartness in any of SC fields [3]. Though, "smartening" of numerous city areas is not sufficient for a city to be smart, while the interrelationship between the fundamental city areas must be considered to grasp smartness of city [3, 4]. A SC is observed as a complete frame of systematic structures or system of systems. This combined opinion for a SC indicates information's cross domain sharing [5]. This all-inclusive outlook for SC typifies the sense of "smart" in background of "SC" associated to revamping of specific city area.

A comparatively fresher machinery, BD, has enormous prospective for increasing and making utilization of SC services. BD has fundamentally enormous data which may be examined by industries to create suitable calculated moves and corporate verdicts. BD analysis is executed to study huge data to expose configurations and attain perceptions to mine valued info.

BD plays a vital role in SC in processing data gathered via IoT devices so that supplementary analysis may be made to identify the configurations and requirements in the city. Devices fitted all over the city produce enormous data, but if it's utilized effectually, there are plenty of developments that may be carried out.

LITERATURE SURVEY

The projected structure was totally cloud-based, like any city may organize it with subordinate preliminary as well as repairs costs. Authors also presented a "proof-of-concept", utilizing actual permit data from NY (New York) City [6].

Genuine effort had been engaged by authors to describe the fundamentals of "SC" in the background of emerging countries and to discover the chief restrictions detained to stand on the way of conversion of cities to "SCs" [7].

This paper emphasized on theme of DMT "data mining technology" and BDA for estimating its usefulness in municipal energy intake data analysis [8].

The paper targeted towards building analytical BD prediction framework for climate temperature founded on Map Reduce algorithm [9]. The effort was on classifying essential encounters and innovative approaches for quantifying resilience. Specifically, the chief feature of this issue was how the large-scale failures to be modelled and how to address impacts and recoveries relating the service providers, infrastructure, clients, and climate. The second feature was generic vulnerability recognition methodology in organizing and facilitating via BDA. Third feature was to appreciate what flexibility metrics are desirable and the manner in which same can get developed [10].

A complete synopsis of the data analytics background has been studied on the electric automobile combination to green SCs. It acted like a guide for upcoming data analytics requirements and explanations for integration of electric vehicle with SCs [11]. In [12] author has thrown light on the encounter of under-utilizing the BD produced by SCs from ML perspective. Specifically, the occurrence of wasting unlabelled data has been tapped. A three-level learning framework for SCs has also been presented which matched BD's hierarchical nature produced by SCs with an objective of providing various stages of knowledge abstraction. [13] Projected a small budget future STS to deliver improved facility by deploying traffic update promptly.

It aimed delivery of the spirit of smart cities. [14] presented a crisp summary of SCs, trailed by the structures and features, configuration, basic design and real-life executions of SCs. At the end certain challenges and prospects had been recognised via extensive literature survey on SCs. Paper [15], predicted that in IoT era, the requirement of dispersed BD sharing and processing applications would intensely upsurge as the data creation and consumption would be pressed to the network edge.

BDA "BIG DATA ANALYTICS"

The term BD has lately been pragmatic to data sets which breed hugely as these convert obstinate to work with utilizing old-style DMS "Database Management Systems". There are data sets with afar magnitude from capability of generally utilized software gears and storing systems to internment, stock, accomplish along with routing the data within a acceptable passed timeline [16]. BD magnitudes are continually accumulative, presently going from a few dozen TB (terabytes) to many PD "Peta-bytes" of data in a solo dataset. Thus, few problems linked to BD comprise arrest, storing, exploration, sharing, analytics and visualizing. Fronting with structures of raw-data such as "variety", "velocity", and "volume" of BD enables progressive tools to incredulous complication and concealed frame of them. Hence, BDA is projected for "simulations," "experimentation," "data analysis," and "monitoring." Nowadays, companies are discovering big sizes of extremely thorough data so the facts can be discovered which were not known prior [17]. So, BDA comes into play where advanced analytic methods are implemented on BD sets. Analytics founded on huge data samples discloses and influences trade revolution. Still, the greater the data set, the extra tough it proves to succeed [17]. Industrial experts trust that BD analytics is the next 'blue ocean' which carries prospects for establishments [18] and it is termed as "the fourth paradigm of science" [19].

Earlier, BD was well-defined by the "3Vs" but currently there are "5Vs" of BD that are also known as the characteristics of BD as follows:

Volume: Very huge volumes of data is considered (Terabytes and Zeta bytes)

Velocity: Frequency is described on which data is taken produced and shared

Variety: As the name indicates, it covers several types of data

Variability: It covers variation in the form and the meaning of data with respect to time.

Visibility: It details that data must be reachable and visible through a platform to those who require the same.

Veracity: It talks about data quality.

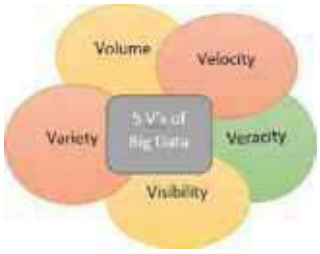

Fig 1: 5 V's of BD

TOOLS AND METHODS

With technology progression and the amplified masses of data floating in and out of establishments on routine basis, the requirement for faster and extra effectual methods of analysing such data has emerged by default. Having loads of data in hand is no more sufficient to create effectual conclusions at required time. These types of datasets may no longer be effortlessly analysed along-with old-style data management and analysis methods and arrangements. Consequently, here ascends a requirement for novel tools and approaches focused for BDA and also the compulsory architectures for storage and management of such data. Therefore, rise of BD has a consequence on all from the data itself and its gathering, to processing, to concluding mined conclusions.

BD STORAGE AND MANAGEMENT

The old approaches of structured data storage and recovery comprise data marts, interactive databases and data warehouses. The data is uploaded for storing from operative data stores utilizing ETL "Extract, Transform, Load" or ELT "Extract, Load, Transform", tools that mine data from outdoor sources, renovate the data to fit operative requirements, and lastly load data into data warehouse or database. Therefore, the data is cleaned, transformed, and classified beforehand making accessible for online analytical function and data mining [18].

Hadoop is nothing but a structure for execution BDA that offers consistency, manageability and scalability by an enactment for MapReduce paradigm. Hadoop comprises of two main mechanisms: First is HDFS for the BD storing and second is MapReduce for BDA [19]. The HDFS storing function offers a dependable distributed file system. HDFS has two type of nodes: First are "Data Nodes" and second are "Name Nodes". Data is stowed in simulated file blocks transversely the multiple Data Nodes and the Name Node behaves as a regulator between data node and client, guiding the client to specific Data Node that comprises invited data [18].

BD ANALYTIC PROCESSING

Post the BD stowage, arises the analytic processing. [20], states that there are few acute needs for BD processing. The primary need is rapid loading of data. As the disk and traffic of network hinders with enquiry executions all through loading of data, so it is essential to decrease the time of loading of data. Another need is swift processing of query. To accomplish the needs of hefty assignments and instantaneous appeals, plenty of enquiries are critical from the viw point of response time. Hence, the data placement structure should be proficient of holding great query process speed as volumes of queries upsurge quickly. Moreover, the third need for BD processing is the extremely effective storing area usage. As fast development in consumer actions may require scalable storing capability and figuring control. Lastly, the fourth need is the robust adaptively to extremely dynamic assignment patterns. BD sets are analysed by diverse applications and customers, for various targets and commitments. In numerous methods, fundamental system must be extremely adaptive to unforeseen dynamics in data processing, and not precise to definite assignment features [20]. Map Reduce is a similar model of programming, stimulated by "Map" and "Reduce" of functional languages that is appropriate for BD processing. It is Hadoop's core, and accomplishes the data processing and analytics functions [21]. In accordance to EMC, the MapReduce paradigm is founded on addition of extra assets, instead of growing the influence or capacity of storage of a solo computer; or it can be concluded as scaling out instead of scaling up.

SMART CITIES

SCs will indorse the utilization of info, technology and data to improve and expand its structure and services. This comprises access to assets like electricity and water. Offering homes that are reasonable to all, facility of good schooling and clinical services and intensification of IT connectivity.

Almost all government services will be made more reachable to residents of city and visitors. Services will be accessible online and will offer more answerability, transparency and additional participation of the community. E-groups formation will permit people for giving expression to their feelings, views and obtain response, follow programs and events with the support of cyber tour worksites.

SCs will definitely increase the access to public transportation and offer innovative way out for excessive traffic. Solutions will be such as smart parking, smart management of traffic and integrated transport modal. SCs will be more cyclist and pedestrian welcoming with key administrative services at smaller, walk able distances.

Smart cities will improve or grow unplanned or poorly planned zones like slums, with an idea to construct cities safer and lesser accident-prone. Utilization of video surveillance, illegal activities will be traced, and severe security actions will be taken to guard senior citizens, ladies and children.

City hear effects will be minimized by generating and preserving playgrounds, parks and amusement spaces. Living spaces will be constructed to house the rising population and also improve community standard of living.

Infrastructure will be more viable and environment-friendlier, by decreasing the quantum of waste produced and also by watchful intake of natural resources.

The impression and definition of SCs will have progressive step by step approach as primarily it was planned in the nineties, and many countries have reached a decent destination but final result need further inputs, government wish and budget [22], [23]. It is tough to provide a general definition of SC. On the grounds it may be a simple explanation that the smartness of a city can be straight mapped by accessing the service given to the residents but on papers it can be very complex to pen down [24].

BIG DATA AND SMART CITIES

BDA approaches have been extensively utilized for analysing instantaneous data that may resolve the issue of data processing complexity. SCs take aids of specific data processing by arraying “fog and cloud platforms”. The techniques are positioned to generate a perfect image of clusters and data classifications and also to generate awareness for forthcoming time behaviour by pattern recognition.

BDA has a significant share in SC building process. Processing data gathered via sensors and associated devices fitted in entire city will support mining valued awareness and improved policymaking. BDA may be applied in various zones in SC like conveyance, clinical infrastructure, schooling etc.

Smart transportation

Model’s resultant of BD traffic may support advance transportation systems by decreasing traffic jam by providing diverse itinerary and lessening the quantum of accidents by examining accident history [26]. Additionally, BD collected from smart transport systems may support set consignments and provide advancement to shipping developments by reducing wastages in production network. The Smart transportation data may also provide supplementary plentiful leads. For instance; data supporting in lessening the ecological effect and boosting in security by refining end-to-end client know-how and numerous others [25], [26].

Smart healthcare

It is an idea counting various constituents and technologies which include: wearable devices, sensors, ICT and furthermore [27]. The analytics of data collected from sensors fitted near the patient's body [28], [29] or in the neighboring location [30], [31] may be used by insurance organizations and clinical staff to advance their facilities. Furthermore, the analytics of big health care data can support in anticipating epidemic and recognize ailment signs and irregularity recognition for saving lives, provide treatment and for up gradation of the life’s quality [25], [32].

Smart education

The vital objective in the use of BD in smart education context is the demonstration of data that empowers users to lookout data processing outcomes precisely. The next aim is providing support for improved conclusion creation. Big education data analytics may also mend teaching quality in schools, institutions and universities [33].

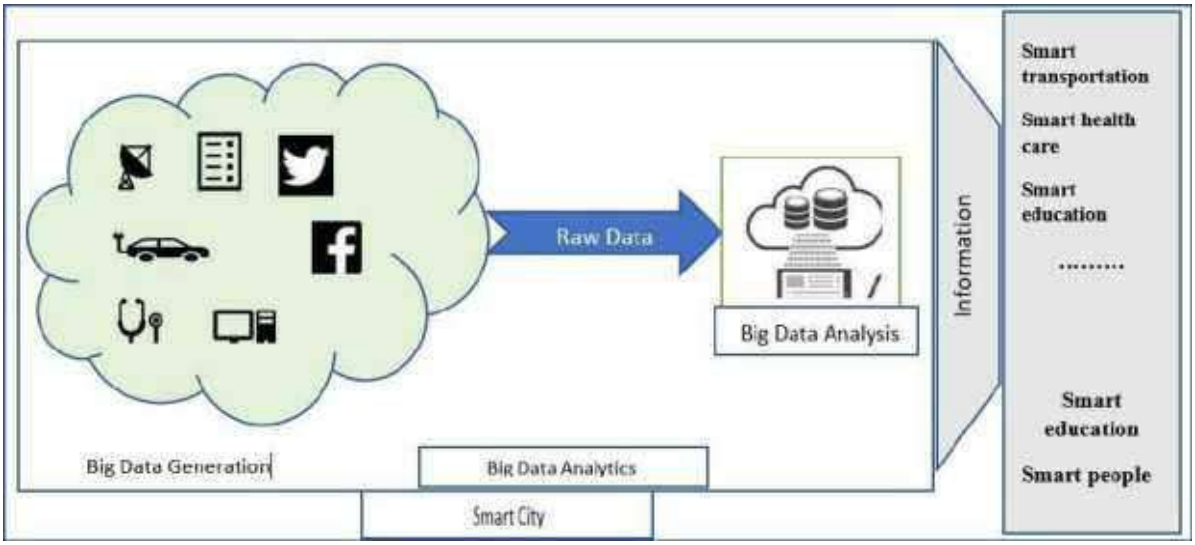

Fig 2: BD in Smart Cities

CONCLUSION

SC is a developing model aimed at resolving the issues that have arisen as a result of the constant spread and development. The visualization of the 'SC' is increasingly converting to realism as telecommunication technologies converge and the field of information undergoes a revolution. In a number of countries, city governments and managements are taking advantage of these technologies to enhance citizens' lives and increase sustainability and competence. The enabling technology for revamping is ICT. These technologies harvest vast quantities of data, referred to as BD. We attempted to present a systematic literature review that we used to investigate the importance of BDA and BD tools and methods in smart cities. BDA has a vast scope and major role in smart cities, which includes better governance, pollution, economy, transportation, and other facets of smart cities.

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An Efficient VHO Algorithm To Enhance QoS In Internet Of Vehicles With The Integration Of 5G

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Abstract. In a developing country such as India, the intellection of smart city and the boom for a wide range of vehicles, Internet of Vehicles (IoV) has gained a lot of consideration by furnishing numerous benefits, including traffic congestion control, smart parking, vehicle emergency and monitoring levels of pollution. Furthermore, IoV provides support for vehicles over internet aid communication. In order to have a better communication between Vehicle-to-Everything (V2X) we require an advanced network infrastructure. The currently available networks like 3rd generation (3G), 4th generation (4G) or long term evolution (LTE) are not adequate for these kinds of communications; There comes the 5th Generation (5G) cellular network into the picture. The 5G offers real-time crowd sourcing, higher data rates, low latency for transmission and sensing as a complementary base for information. In addition to the leading edge network infrastructure, the mobility of vehicles urges to have a perfect handover (HO) mechanism among heterogeneous networks. This paper discuss about the integration IoV with 5G and the importance of vertical handover (VHO) mechanism using an Artificial Intelligence algorithm and analyze its performance based on few of the parameters such as data transfer rate, transmission delay, mean throughput, packet delivery ratio (PDR) and Quality of Service (QoS).
Keywords: IoV, smart city, 5G, heterogeneous network, handover, QoS.

INTRODUCTION

A heterogeneous network is the one that applys a various kinds of access technologies. It is also used in wireless networks, such as a wireless network that provides service over a wireless LAN on the other hand, being able to preserve service while shifting to a cellular network [2,15].

A handover is a telecommunication & mobile communications course of action during which a associated cellular call or data session is switched from one person to another. Horizontal Handover: When a user switches between two individual network access points of the same type, then it is known as horizontal handover[14,16]. When a user switches between two different network access points of distinct kinds, then it is known as vertical handover. Handover is also known as handoff.

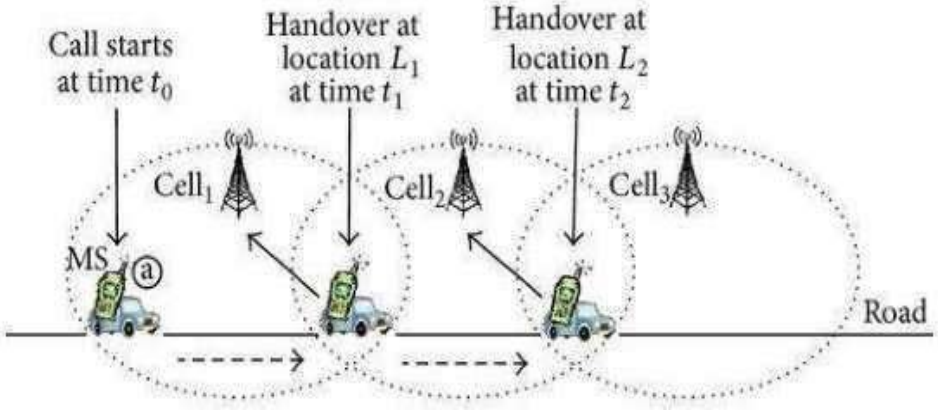


Fig 1. Handover process

Horizontal Handover

When a user switches between two individual network access points of the same type, then it is known as horizontal handover.

Vertical Handover

When a user switches between two different network access points of distinct kinds, then it is known as vertical handover[12,13].

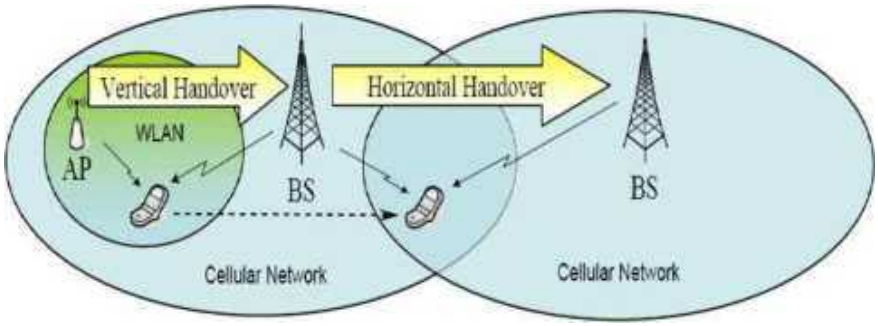
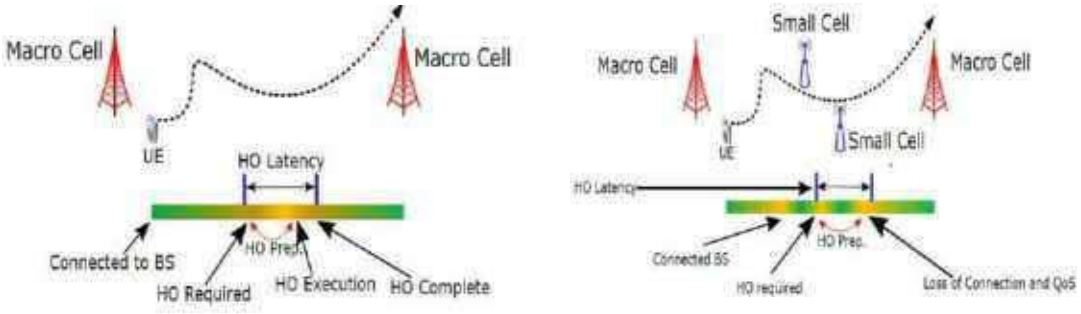


Fig 2. Handover Types



(a) (b)

Fig 3. Handover scenario a) existing wireless networks b) future wireless networks

Phases of handover[5,6,7,22]

During the process of handover, generally it carries out through three phases namely, Initiation / information gathering phase, Decision phase & Implementation phase.

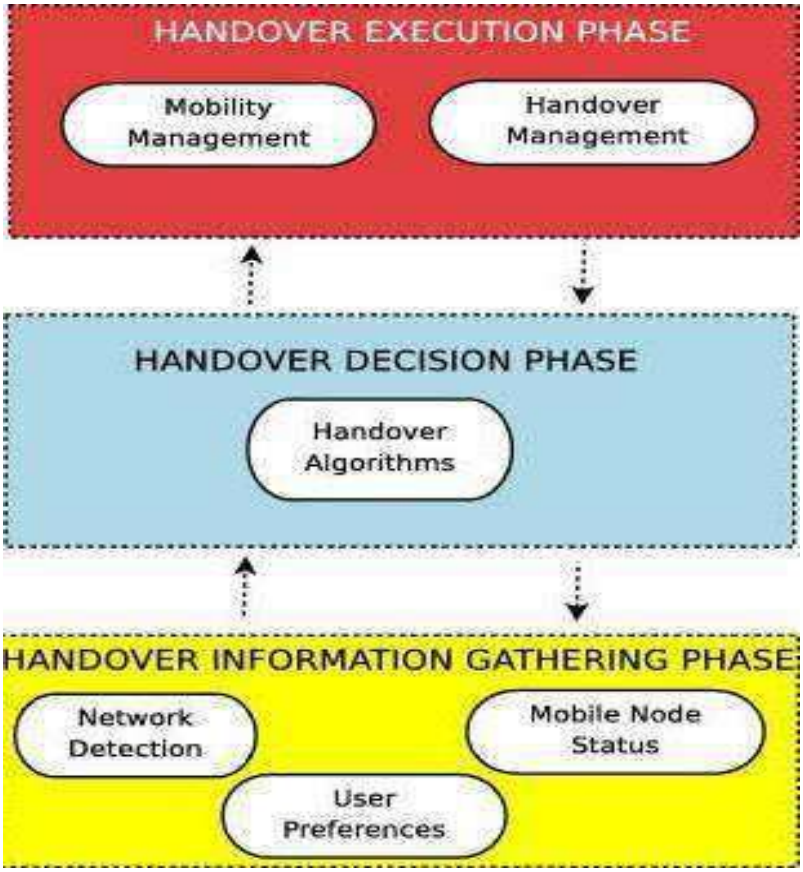


Fig 4. Handover process phases

Internet of Vehicles (IoV)

The IoV is an advancement of the traditional Vehicular Ad-Hoc Networks (VANET), which points to a network of multiple entities such as vehicles, roadways, pedestrians, parking lots, and municipal infrastructure that allows for real-time communication[17,18].

Vehicle-to-Vehicle (V2V), Vehicle-to-Road (V2R), Vehicle-to-Human (V2H), Vehicles (V2I), and Vehicle-to-Sensor (V2S) interconnections are used to connect vehicles and pedestrians via portable devices, Road Side Units (RSUs), and public networks. As a result, a network of smart objects is created.

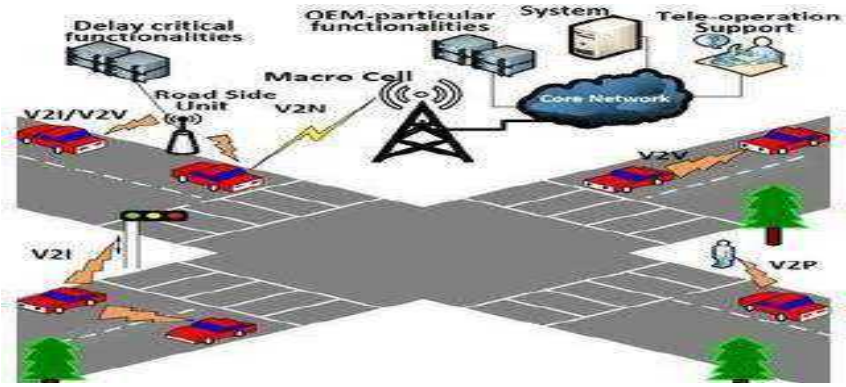


Fig 5. Concept of IoV

LITERATURE REVIEW

In [1], in this paper, the authors proposed a handover mechanism in which the handover decisions are made based on a dynamic Q-learning algorithm along with dynamic threshold computation with the help of entropy for signal characteristics. By using reinforcement learning algorithm for HO decision they reduced the number of avoidable handovers. In order to solve scalability problems in the way of choosing a network the 32 fuzzy rules of Fuzzy-Convolution Neural Network (F-CNN) are used. And they stated that by the proposed algorithm, 25% of unnecessary handovers and 2% of handover failure are decreased and mutated jelly fish upgrades the throughput upto 15%-20%, also reduces delay and packet loss.

In [2], the authors introduced an advanced VHO decision employing multi criteria metrics in the field of heterogeneous network. They state that network priority multi criteria VHO decision algorithm has enriched the performance of the networks than those of equal priority and mobile priority. With the proposed algorithm 84.60% of unnecessary handovers were decreased, where as 20.23% of network balance and average blocking probability were improved when compared to traditional method[20].

In this paper [3], the authors have examined some of the techniques related to handoff management, along with their pros and cones during the process of hanfoff in VANETs. In addition to it they reviewed peculiar algorithms and technologies related to handoff management in regards to throughput, delay and latency in VANET were considered to find their drawbacks. They proposed a technique based on cluster HO analyzing the latest innovation of mobile edge computing in the process of IoV communication. The backup mobile edge-node was incorporated to enhance the present cluster-base. And their proposed node takes the responsibility of restoring the BS list along with the locality of the moving vehicle as the clusters. This ideation was developed and titled dynamic edge-backup node (DEBCK). They contrasted their proposed technique with other relevant techniques with respect to throughput, network disconnectivity, and packet loss rate. They stated that their modelled DEBCK could adequately reduce the rate of packet loss and overhead on clustering process. In addition to it, DEBCK had heightened the throughput, furnish reliable connection with the help of their proposed ideation: the edge mobile node.

The authors of the paper [4] had a systematized study on eighty four literature works about the interaction among IoV, V2X, and 5G. They had a clear analysis on the advancement of 5G technology, its specification and framework correlated with the V2X ecosystem with the integration of IoV. At the beginning they focused on Challenges of 5G in the field of vehicular communications, IoV architecture and different kinds of V2X interactions. After the review of 84 literature works they stated that, with the superlative functionality and metamorphic path so far surpassed, 5G technology gained the potential to be the universal solution for V2X communications.

In the literature of paper [5], the author worked to address the shortcomings of 5G network slicing in IoV, verified them in practical vehicular framework. They introduced 5G network slicing infrastructure that has substantiated, quantified with various kinds of traffic, Radio Access Technologies (RATs), in addition to the present low power wide area network (LP-WAN) such as long range wide area network (LoRaWAN) and LTE technologies. The advancement is based on the architecture of distributed multi-access edge computing (MEC). The solution they provided is capable of unifying heterogeneous radio technologies like cellular network, precise Internet of Things (IoT) communications with capability in the vehicular scenario, generating detached network slices devoid of speculating the Core Network (CN) scalability. They showed that their solution offers flow confinement and supports sureness for rigorous enforcement in addition to bandwidth distribution in order to attain greater responsive services. They mentioned that, by using their proposed method they had minimized slice set-up time of lesser than 2.5 ms when the slice instance is already configured[5].

In the paper [6], the authors studied about the use of Coherent Beam forming (CB) technology to minimize communication costs. They adopted the CB technology with the integration of IoV and 5G. They first gave an abstract mathematical representation of the concept and demonstrated that its an NP-hard model which is not possible to solve straightaway. Then they proposed a basic paradigm for the mentioned difficulty, to reduce the cost of communication to fullest extent while quenching the transmission requirements. They proposed an worthwhile heuristic algorithm iterative coherent beam forming node design (ICBND), with the help of looping procedure to estimate the total count of the minimal CB-nodes on the entire road. And stimulated it, results shown that there idea can diminish the considerable cost of communication.

Future generation VANET requires seamless connectivity with first-class QoS [7]. Timely information delivery and reliability are the essential components in VANETs [8]. In [9] the authors had concentrated to alleviate the standards of video playing in a moving vehicle. Authors of paper [10], proposed a fast handover solution for network based distributed mobility management (DMM) using the HO-Initiate process. They stated that their proposed mechanism has reduced 72.3% of handover latency when compared to DMM[19].

Summary of above discussed literature works towards integration of IoV, Vertical handover and 5G.

After having a detailed study on the previous works related to IoV, Vertical handover, 5G and there integration, the synopsis of the carried out literature survey is formatted in a tabular format. This table provides an overview of the existing efforts have been made to improve the integration process of IoV, Vertical handover and 5G for a better performance and seamless connectivity. The performance of discussed techniques are evaluated based on some important parameters such as throughput, delay, QoS, and PDR.

Table 1. Summary of existing research works

S.No.	Author	Technique/algorithm	Throughput	Delay	QoS	PDR
1.	Shaik Mazhar Hussain, et al.[1]	Dynamic Q learning algorithm, fuzzy rules, jellyfish optimization algorithm	✓	✓	✗	✓
2.	Gita Mahardhika, et al.[2]	Multicriteria Vertical Handover Decision Algorithm	✗	✗	✓	✗
3.	Khalid Mahmood Awan, et al.[3]	Cluster-based technologies, Edge computing	✓	✗	✗	✓
4.	Sanchez-Iborra, Ramon, et al. [5]	Distributed Multi-Access Edge Computing and cloud computing architecture	✗	✓	✓	✗
5.	Lan Wu, et al.[6]	Coherent beamforming (CB) technology	✗	✗	✗	✗
6.	Siti Sabariah Salihin, et al.[7]	New optimal HO decision model	✓	✗	✓	✓
7.	U. Kumaran, R. S. Shaji[8]	HO decision algorithm	✓	✓	✗	✓
8.	Emna Bouzid Smida, et al.[9]	Predictive HO mechanism	✗	✗	✗	✗
9	Mohammed Balfaqih, et al.[10]	Analytical expression, HO initiate process, DMM	✓	✓	✗	✓

PROPOSED METHODOLOGY

From the literature survey it was clear that there are some of the gaps in the process of integrating IoV, Vertical handover and 5G. Inorder to fulfill the gaps that are identified in the literature survey, there is a requirement for efficient algorithm that satisfies the following objectives.

Objectives of proposed methodology

- To increase the user friendliness for better user satisfaction and to improve the QoS.
- To have a proficient handover mechanism with minimum time delay by ensuring without loss of packets.
- To attain high security that is to prevent unauthorized access.

Pseudo code for Proposed Algorithms

*Algorithm 1***:** V2I-MHA PSEUDO CODE FOR DOWNWARD NETWORK SELECTION

```
Connect UE to BSm;
If there exists candidates in set C
  {
    List out all potential candidates;
```

```
        Execute V2I-MHA decision process;
    }
Else
    goto step 1;
If any SAP meets the requirements
    {
        Handover to the selected SAP;
    }
Else
    goto step 1;
```

During the downward network selection, firstly the user equipment (UE) that is the vehicle of the user is connected to Base Station Management (BSm). Then it search for the candidates in the set C, if any candidate is found then it will list all the potential candidates. Then it executes Multi-criteria based handover algorithm for V2I communication (V2I-MHA) decision process[11]. Further it searchs for the System Analysis Program Development (SAP) that is adequate for the requirements. If it finds any such SAP then the handover takes place to the selected SAP.

Algorithm 2: V2I-MHA PSEUDO CODE FOR UPWARD NETWORK SELECTION

```
Connect UE to SAP;
If there exists candidates SAP in set CN
    {
        Execute V2I-MHA decision process;
    }
Else
    Handover to macro-cell BS;
If any call events occurs
    {
        Execute V2I-MHA decision process;
    }
Else
    goto step 1;
If any SAP meets the rrequirements
    {
        Handover to the selected SAP;
    }
Else
    Handover to macro-cell BS;
```

During the upward network selection, firstly UE vehicle is connected to SAP. Then it search for the candidate SAP in the set CN, if any candidate is found then it will executes V2I-MHA decision process. Otherwise it will handover to macro-cell BS. Again if any call events occurs then it executes V2I-MHA decision process. Finally it checks for the SAP that is aptly suits for the requirements. If it finds any such SAP then the handover takes place to the selected SAP. Otherwise handover takes place to the macro-cell BS. The entire downward and upward network selection process is executed with the support of the advanced 5G network infrastructure.

CONCLUSION

In order to have an intelligent transport system in the smart cities, we need have an well advanced network infrastructure. There comes the 5G into the field, which plays a crucial role in this process. Though we have an advanced network infrastructure, it is important to have the best handover mechanism for the fast moving vehicles to shift from one network to the another. In this paper, we analysed the principles behind various handover algorithms. In accordance with the review of literature works, we introduced a new idea by which we can integrate the IoV, Vertical handover and 5G. By our proposed idea we can enhance the throughput, security, QoS and user friendliness. On the other hand, the delay and packet loss during the handover process can also be minimised. In the future, we will improve the results by using other optimization approaches. In Addition to it, the

proposed algorithms will be (stimulated by using software such as NS tool etc) tested on real-time applications. Along with it, we will extend the proposed work with the help of deep learning models.

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Evaluation of Construction Labour Productivity for High Rise Building Construction Mumbai Using Artificial Intelligence

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ABSTRACT. Mumbai is one of the most crowded cities in India and due to scarcity of land, vertical movement of building is started. Therefore in this study of evaluating construction labour productivity, three major construction works are selected. 88% of responses were received in the form of a filled questionary. The data were analyzed using the Relative Importance Index(RII) and the top 10 factors are evaluated. It was observed that labours are interested in attending seminars to improve and are also cautious for COVID-19. Those top ten factors are used for creating fuzzy sets. It was found that maximum productivity of 90.3% was observed for a constant input of 54%-56% to all 10 parameters equally. For varying input, the productivity output was less. So management or contractor will be able to provide required facilities to labours so that the productivity can be increased at the site.
Key Words: Labour Productivity, High rise Building, RII Method, Fuzzy Logic.

INTRODUCTION

The most important indicator of the construction industry's performance is productivity. It has been rapidly declining over the last decade due to a lack of a consistent productivity assessment method and a lack of awareness of several factors influencing worker productivity. Expert systems, statistical models, action response models, artificial intelligence, and other methodologies have all been created to assess construction productivity. Artificial Intelligence approaches have been identified as being used to solve difficulties in construction management studies for decades. These techniques have a robust and dynamic learning mechanism with effective recognition skills to solve challenging nonlinear situations. Fuzzy logic is one of the most extensively utilised Artificial Intelligence techniques among the several methodologies. A number of things have an impact on labour productivity. Some elements, such as poor weather and political unrest, are beyond our control. Some may be internal to the worker, such as his capacity to work in a group, his perspective, and his passion for his task, among other things. Some aspects, such as giving enough training to workers on the use of equipment and machinery, can be managed or improved. In this live research work Construction of high rise, buildings were considered which are located in Mumbai City. For the prediction of CLP, Fuzzy logic was used.

LITERATURE SURVEY

When the knowledge supplied is in descriptive rather than quantitative form, fuzzy expert systems have been employed to efficiently handle complicated issues. The major goal is to incorporate the influence of qualitative and quantitative factors into Fuzzy expert systems to estimate labour production rates. Values for concreting column production rates and their influencing factors were gathered by a questionnaire survey. During the questionnaire survey, ten key qualitative and quantitative parameters are chosen on a Likert scale of 1 to 5. For productivity estimation, the Fuzzy expert system created in this work was compared to two previously utilised Fuzzy expert systems. Root Mean Square Error was used to compare the performance of previous systems and the system established in this study. According to the findings, the study's technique has higher linguistic and numerical accuracy than earlier systems with reduced Root Mean Square Error. [1]

The scope of this research is restricted to building construction projects. Because we only polled experts with more than 25 years of experience, the number of responses is similarly limited. The number of respondents was reduced as a result of this restriction. Future research can use the findings of this study to reproduce it in other construction projects such as roads, dams, and bridges, taking into account the research findings as well as the CLP circumstances in other parts of Nepal. Work in progress on a conceptual paradigm for technical management. Work to completion work schedule pressure work delay change order

during execution actual work rate work checked and completed acceptance rate rejection rate rework remained work to completion work schedule pressure work delay level of coordination between design and technical specifications working area per person/number of people in the workforce To prevent site congestion, less restricted access, and increased productivity, total computed working area needs of working area necessary personnel completion of the task on time Stocks Inflow Rate Legend 1 3 total productivity growth International Journal of Civil Engineering Researchers and stakeholders, on the other hand, can use the FAHP for factor analysis as part of their research in modelling CLP and detecting links between critical components that can assist enhance CLP. [2]

However, the majority of Indian development projects have been delayed. Labour productivity that is lower than predicted is a common cause of construction project delays. Although it is simple to measure labour productivity, it is sometimes difficult to govern. The purpose of this research is to determine the most important elements that influence labour productivity. This study is remarkable in that it is one of the rare attempts to directly capture the perceptions of construction workers, rather than managers or supervisors. This research should help construction project managers increase labour productivity at their sites. A survey of construction employees was conducted to determine what factors affect their work productivity. The Relative Importance Index (RII) technique was used to rate the elements revealed in this way, which was based on the respondents' 0–3 importance scale. A survey of management engineers who are directly involved with construction labour in the production of construction works was also used to find techniques for improving labour productivity on the job site. These factors were also ranked according to how effective the survey participants judged them using RII. These metrics were mapped with the factors they mitigated in the study's second phase. These findings should aid project management teams in getting the most work out of construction labour. They can take proactive efforts based on the recommendations in this study to maintain optimal productivity and detect early symptoms of declining productivity. [3]

This research looks at a data-driven method to building Construction Labor Productivity (CLP) models that take into account influencing labour factors. Support Vector Machine (SVM) and Random Forest (RF), two state-of-the-art machine learning-based classifiers, were utilised to model CLP. To begin, a preliminary study of prior research was conducted in order to identify any CLP-related parameters. The list of CLP elements was then ranked by experienced Project Managers in terms of most influential in Malaysian Residential through a pilot poll. The most influential determinants for labour were their lack of work experience, job category, education/training, nationality, skills, age, and marital status. Based on these contributing factors, data was collected from all construction staff in Malaysian residential projects. Utilizing SVM and RF, CLP models were created using the data gathered. The performance of the models was assessed using several statistical indices, including the Percentage of Correct (PC), Heidke Skill Score (HSS), Probability of Detection (POD), and False Alarm Ratio (FAR) , and the False Alarm Rate (FAR).Peirce skill score (PSS). The CLP was accurately simulated by the SVM and RF. In forecasting, multiple categories of productivity, the POD for both models were found to be above 90%. The models' efficiency was demonstrated by the reliability graphs. The findings suggest that advanced machine learning approaches can be utilised to predict CLP with great accuracy. [4]

Poor productivity results in time and cost overruns, making the construction industry's best performance unrealistic. It is impossible to improve productivity without first recognising and analysing the elements that have a negative impact on it. The goal of this study is to present a productivity analysis model for various types of building projects that uses fuzzy logic and the relative importance index approach to estimate the probability of the effect of factors influencing productivity. To attain this goal, a questionnaire survey was conducted among respondents in the Indian construction industry who worked on four different types of projects: residential, commercial, infrastructure, and industrial. The relative significance and ranks of elements were determined using the relative importance index approach based on the results of the questionnaire. The Fuzzy Logic Toolbox of MATLAB was then used to create a probability evaluation model to analyse productivity. The suggested model's applicability was tested in seven construction projects, and the likelihood of factors having an impact on productivity was calculated. The findings of using the model in construction enterprises show that manpower, motivation, and time are the most important contributing factor groups for most projects. [5]

A questionnaire was prepared and sent to sixty contractors based on the Analytical Hierarchy Process approach to collect their thoughts on how labour productivity might be affected. The AHP was used to examine a total of 56 feedbacks. According to the data, job satisfaction and security, a lack of incentive plans, talent and experience, drug usage, overtime, and weather changes all have a significant impact on labour productivity in GS. Furthermore, the developed AHP model provides a framework for managers to analyse various variables and, as a result, increase labour productivity.[6]

A mathematical model of construction worker productivity was created. It accomplishes this by classifying 17 elements that influence construction worker productivity into five groups. Fuzzy logic was utilised to describe the factors mathematically. A formula for calculating construction employees' productivity is proposed. The authors' approach is unique in that it takes into account a variety of elements that have the ability to influence construction workers' productivity. A single assessment of ceiling formwork was conducted to demonstrate how the formula works. The validation of a model demonstrated that it is capable of accurately analysing, evaluating, and predicting the productivity of construction employees. [7]

Labor productivity is one of the least studied components of the construction industry. Productivity enhancements result in large cost savings with little effort. Because construction projects have such slim profit margins, efficiency gains are essential to becoming a successful contractor. The greatest hurdle to boosting labour productivity is labour productivity assessment. The significance of important factors influencing labour productivity was evaluated. In the cities of south Gujarat, a study of civil contractors was done. A total of 51 feedbacks were analysed using the Analytic Hierarchy Process (AHP) and the Relative Importance Index (RII) methodologies. According to the RII Technique, the five most significant factors are payment delays, labour skill, technical specification clarity, material shortages, and labour motivation, in that order. High/low temperature, rain, high wind, labour motivation, and physical fatigue are the first five critical characteristics, according to the AHP Technique, in declining order. Contractors must take action to increase labour productivity in building projects by addressing these factors. [8]

In order to plan and allocate resources efficiently for a construction project, it is necessary to analyse labour productivity. By polling labourers and their supervisors, a detailed questionnaire addressing significant elements impacting job productivity was identified in this study. To combine the replies and determine the essential elements, the relative importance index (RII) was utilised. A field research is undertaken based on the parameters discovered in order to design an automatic productivity assessment tool. Data collected from wearable devices is used to estimate worker performance. By training a neuro-fuzzy interference system, the data is calibrated against the estimated labour performance of the site supervisor. The created model can be used as a framework for assessing labour performance on a building site automatically. This has a lot of potential in terms of rationalising the resource allocation process on major building sites.[9]

Construction labour productivity is a critical tool for analysing data, planning, budgeting, and establishing construction projects. The impact of several variance factors has a negative impact on labour productivity in the building industry. To estimate construction labour productivity, we continue to rely on established techniques that include reference published data or estimator expertise. The membership function is constructed and used in a fuzzy optimization technique to improve construction productivity. In comparison to existing traditional work, the results from the predicted model appear to be a more effective model with reasonable generalisation capabilities. Furthermore, this study offers an understanding of a probabilistic model that includes internal as well as external variable elements including supervision, work standards, government restrictions, and public labour unions. [11]

Variations in work environment and managerial effectiveness have a big impact on construction labour productivity. Understanding the nature and extent to which specific characteristics influence production is critical. The main purpose of this study is to learn more about the elements that affect daily job-site labour productivity by analysing their relative importance and impact on work output. This study investigates the role of a collection of factors in daily job-site labour productivity changes. When it comes to establishing everyday tasks, this is critical for practitioners such as site engineers. The organised approach presented to perform a major ranking of parameters relevant to an engineering process may be of interest to other researchers and practitioners. [12]

The labour estimating problem can be modelled using fuzzy logic in a realistic and reasonable way. This study makes several contributions, including developing a fuzzy reasoning method that mimics the decision-making process used in estimating labour productivity, illustrating a reasoning framework that can be modified to apply to various scenarios, and comprehending construction activities and the construction process.[13]

This work presents an integrated fuzzy System Dynamics (SD) approach for modelling and optimising labour productivity. The SD method is used to describe the complex interrelated structure of numerous factors that influence labour productivity. This work presents an integrated fuzzy System Dynamics (SD) approach for modelling and optimising labour productivity. The SD method is used to describe the complex interrelated structure of numerous factors that influence labour productivity. [14]

DATA COLLECTION

For this research work, a questionnaire was distributed to nearly 446 construction workers from three different sites. Filled 393 questionnaires were received. Those are used for further analysis. The responses received are shown in the following figure no 1.

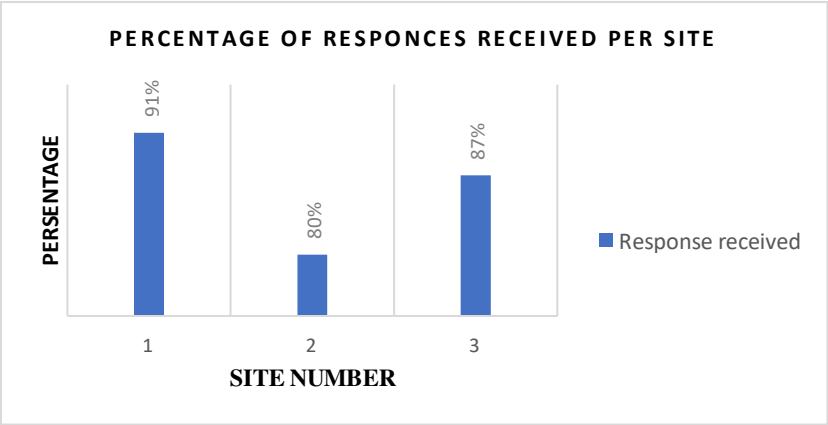

Fig 1 Response received from sites

For this received data, the internal consistency was checked using the Cronbach alpha test and the value was observed as 0.92 which was in the excellent category.

DATA ANALYSIS

Using this data, the top ten factors affecting construction labour productivity was evaluated and ranked as 1 to 10 as shown in Table No 1.

Table 1. Top most 10 factors affecting CLP

Notation	Question asked	RII	Ranking
X_1	My company organize workshops/seminars/training for workers.	0.890	1
X_2	Rate the welfare facility is provided by the company?	0.890	2
X_3	The frequency of injury/accident occurrence at the site.	0.880	3
X_4	The required medical facility is provided to the labours if found positive & hospitalized?	0.878	4
X_5	Have you paid a fine for not using PPE?	0.859	5
X_6	Safety training is conducted on the construction site?	0.857	6
X_7	Working environment on site.	0.851	7
X_8	4.Frequency of Visit of Higher authority at elevated floors.	0.849	8
X_9	In Covid -19 pandemic situation, work carried out by adopting guidelines given by the government?	0.847	9
X_{10}	Wages paid on regular basis?	0.837	10

Those factors was evaluated from 46 factors considered for this study. Fuzzy logic (MATLAB R2020b version) is used for finding optimum percentage of labour productivity. For this mamdani model was adopted. Total 521 rules were created and then those are used for calculation of CLP. The process adopted for calculation of productivity is demonstrated in figure no 2.

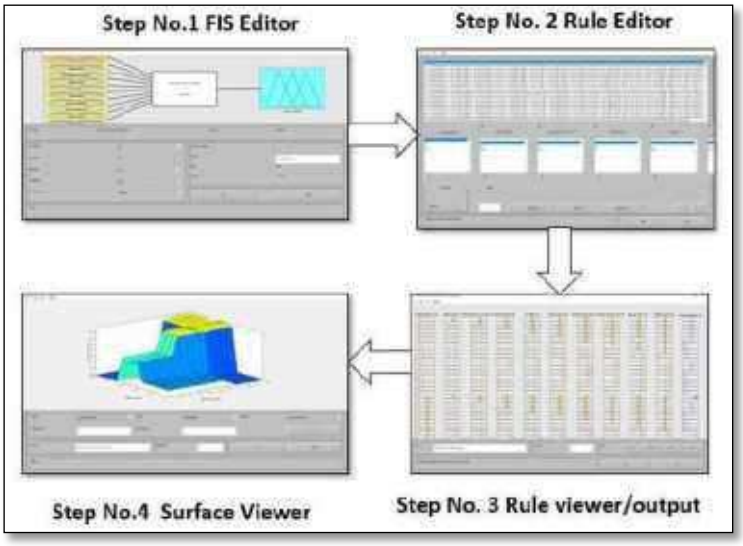

Fig 2 Process adopted for calculation of CLP

RESULT OBTAINED

In the creation of fuzzy sets, the top 10 factors evaluated using RII Method are used. The following two cases are used for providing input for the fuzzy set for output calculations,

- The input for all ten parameters is the same.
- The input for all ten parameters is varying.

The result obtained for the above two points is as shown in figure no. 3.

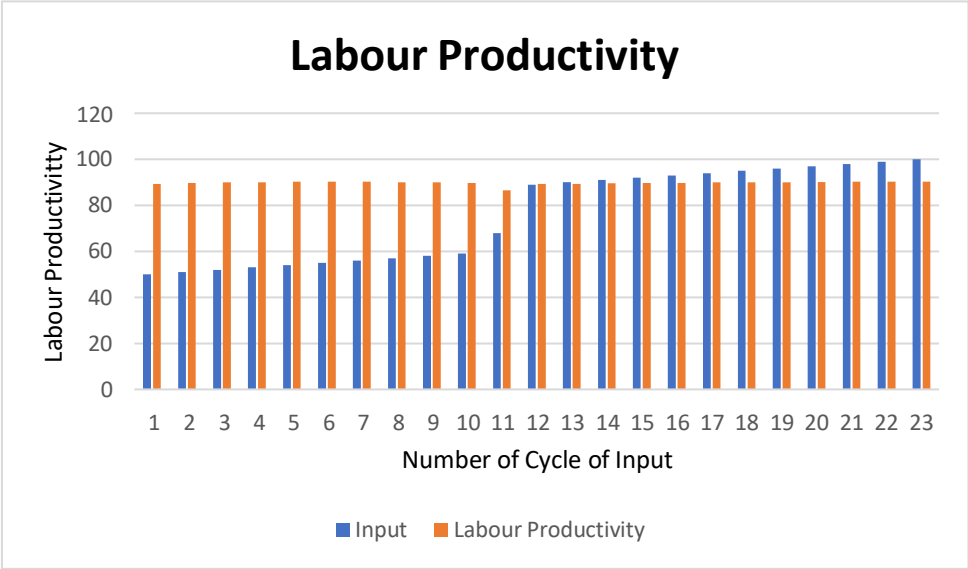

Fig 3 Output obtained from Fuzzy sets

The same process was adopted for validation of result and it was observed that the same percentage of productivity was calculated by fuzzy logic for different parameters keeping logic as same.

CONCLUSION

This study is carried out for the construction workers who are working at high rise building construction sites. And nowadays it is essential to take additional care of construction labours, This includes providing medical facilities in case of emergency during the COVID-19 pandemic for the family of the labour. Following points are observed,

1. Labours are most interested in learning about the work they are doing so wish to attain workshops and seminars etc.
2. Medical facilities are required for them and family in the pandemic. Additional care shall be taken by the contractor/ client.
3. Wages are at 10^{th} position as nowadays most of the contractors pay according to the market rate to the workers.
4. 90.30% of CLP was observed for 54-56% of equal input from all factors shall be provided to the labours.
5. If varying input was given to all the factors like all nine factors have input as 100% and for anyone, it is 50%, then the output is 50% respectively. In any case of varying input, the output does not reach 90.30%.

So, it is concluded that Management can adopt any percentage of input from 54%-56% base on budget availability, facilities available & policy of the company so that maximum productivity can be achieved at the site.

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To Solve Vehicle Routing Problem By Using an Agglomerative Clustering Method

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Abstract: The proposed plan for Vehicles is to decrease the value of spread by which this can supply goods to consumers by a certain limit, which is referred to as a vehicle coordination difficulty. In the factor area look approach, a helpful vehicle directing may be developed by calculating the division network regard while taking into account the customer's region either the route wherever the customer lives. The essential goal of this paper is to diminish the complete detachment made an outing to pass on the items to the customers. The suggested estimation is a chain of significance-based updated agglomerative bundling computation system which does use as one piece from the data mining circumstance effectively. The recommended computation reduces this total detachment performing out on each course and that essential thing that needs to acknowledge is that, the further developed gathering estimation can diminish the total partition when stood out from the in advance proposed variable area look for system.
Keywords: Centroid, Cluster, Agglomerative Clustering, Savings Matrix, Vehicle Routing Problem.

INTRODUCTION

In general, there exist a variety of applications that can give clients with a capable course of product. In the sense of a product, it could be any home machine item that is gradually used. The problem of automotive planning began to be identified in 1959 [3], also in that system of customer games with all its identified regions and associated interest of an object, including that the essential product can be transferred to customers of a single station. With a specific registered number of moving vehicles of certain critical and air conditioning conditions [1]:

1. The solicitations of every consumer are met
2. For every customer is provided one car accordingly
3. For every course the entire solicitations should not outperform the restriction of this vehicle which implies as of now described.

From a stockroom unquestionable thing ought to be dissipated a few retailers? A valuable get-together (or) dissemination of item holds transportation records economical; it conserves assets and vitality. As needs be, vehicle coordinating is one of the principal centers to the sort of issues.

The vehicle coordinating issue is a general name assigned to a complete category of issues including those gathering clients by utilizing automobiles. Those issues get their name starting of the fundamental to earth issue of giving geographically dissipated customers items using different vehicles working from an ordinary product station (or) conveyance focus.

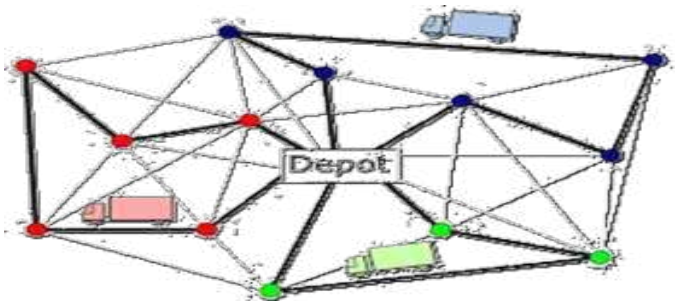

Fig 1: Vehicle Routing Problem Example

A case for a lone dissemination place based vehicle guiding issue is showed up in the Figure 1. For a conventional vehicle coordinating issue, an extraordinary game plan is to spread the things to the customers decisively once from where the delivery center lives and respond over the station. That point of governance lies in the cost of general travel in fulfillment of all the principles. Shipping costs can be reduced by reducing the total partition delivered and in addition the total number of vehicles. While like the set up vehicle controlling issue, the vast majority of this current reality issues are significantly more stunning to grasp. Generally speaking, the conventional vehicle guiding issue relies upon a couple of restrictions similar to the complete vehicle cutoff or some time period to accomplish the clients. A lone station vehicle directing issue utilizes a lone terminal (or) dissemination place to pass on this product to the customers, a couple of estimations and economy techniques are introduced as grasping the single stockroom based steady issues. At the point when everything is said in done, the VRP is a Combinatorial Optimization Problem that also involves 2 essential things are distribution center and objectives. A conventional case to this sort of issue is Soft Drink Company. In that, they do fly out of the association to everything the direct stores to pass on the things and repeatedly got a back to the association. The key impediment took after is to visit the customers only a single time. Vehicle controlling issue is generally called movement issue. For example, sewage should be assembled from nuclear families and endeavors to a redirecting spot, so for that transportation everyone needs a capable course to take off beginning with one spot then onto the following. It is particularly important for the regular transportation since it diminishes the expense of outlining the courses considering the restriction of each vehicle. The remainder about the paper is coordinated as follows. Segment II presents the writing survey. Segment III presents a measurable model, utilizing variable area search technique. Area IV depicts the proposed strategy dependent on Agglomerative bunching calculation technique. Area V depicts the correlation results. The last end is introduced in Section 6.

LITERATURE SURVEY

Dantzig and Ramser distributed the main article 'Trucking Problem,' which referred to a major trucking problem, called the D&R problem, and a number of advanced programs related through this article later its publication [11]. The Clark and Wright algorithm [4] is a champion am ong the most predominant heuristic estimations in the vehicle coordinating issue range. Cordeau et al. d presented a test of whether the equality of equality is applied thoughtlessly to the way in which a union that offers the most savings operates consistently, but the continuous structure continues to do the same course until there is no longer a long-term course. Epicted an examination that equal variation is inconceivably worked on considering the way that union yielding the greatest saving is continually realized, anyway the progressive structure keeps growing a comparable course until there is not any lengthier out pragmatic course. Chopra and Meindl[2][14] offer a response for vehicle course orchestrating, in that they show a coordinating and arranging, transportation issue for an association in which they use a methodology called save supports lattice strategy. The estimation can be masterminded into four phases which are : (1) Classify the partition framework for a provided region , (2) processing the saving cross section utilizing the division network esteems, (3) allocates, consumers to vehicles or courses, and (4) progression the consumers inside the courses. The underlying two phases are illustrated obviously. This third step signifies that give out that consumers to vehicles including courses via , at first every consumer is consigned through an alternate course. In state the two courses can give an achievable game plan by which it doesn't cross as far as possible suggests it tends to be solidified. The technique is gone before till no more possible blends are achievable. For a transport issue, Lumsden and Johnson depicted a practically identical explanation yet it isn't clear. Rand[6][12] performed an examination and does an article regarding the various maintenance methodologies to every vehicle guiding issues. Within that , he fights around the equal interpretation, since that isn't by and large better than the progressive variation. Equal variation is a heuristic and there

is no affirmation from the obtained results that it makes the best plan or close ideal plan of action. The Tabu Search heuristic computations [7][12] to every vehicle guiding issuse having both cutoff including course length controls. The estimation considers a plan of close-by plans got by again and again ousting a point from its current course and reinserting it in another course. This is performed by a method for a summarized development procedure forward of time made by the makers. Over the range of the computation, infeasible plans are supported. Mathematical analyses upon a plan about benchmark issues show the Tabu Search beats this best present heuristics, and Tabu course much of the time conveys the most popular courses of action. Such an assortment of new methods can convey most favorable outcomes appeared differently in relation to Tabu Search [10].The Adaptive Memory Procedure (AMP) [1][8] Rochat and Taillard were the ones who first proposed it. Tabu Search (TS) has been updated to better understand the VRP. Glover was persuaded to develop it as a substitute objective. A basic AMP tenet is that spectacular game plans can be developed by combining small pieces of other incredible courses of action. It is retained a recollection con-5 planned chunks of previous courses of action. Sometimes, a new action is performed by treating data as a piece of memory and enhancing it with a local visual philosophy. A Variable Neighborhood Search algorithm [9] has been developed to address the VRP problem. where four distinct area structures are required to find how to organize excursions within the four distinct area structures Two of them are used to limit total length, while the other two are used to limit overall time. It combines a shaking stage in which three of the space structures are most likely applied depending on the situation. The computation was attempted over a series of benchmark concerns, with the procured designs being differentiated and five estimations supplied ahead of time.

STATISTICAL EXAMPLE

An authoritative base for the vehicle coordinating problem is journeying sales rep issue because the impulsion is "visit all of the customers only a single time" used as a piece of the vehicle controlling issue is actually that equivalent of traveling salesman issue. Depict that a movement man should visit a few "n" number of consumers and return to the early phase in the wake of passing by all of the customers only a single time and the total expense for passing by all of the customers is the staggering issue. The plan is to get a base [5] cost line to visit all of the customers only a single time. Find during the expense for go of city „a‟ through city „b‟ implies counterparts through the expense from city „b‟ via city „a‟, later, at that point, this issue is considered as symmetric.

Table 1: Distance and Demands for Customer

Customer	Location	Demand
1	(40,40)	12
2	(36,26)	21
3	(21,45)	25
4	(45,35)	15
5	(10,10)	16
6	(55,45)	24
7	(26,59)	12
8	(55,15)	17
9	(40,30)	20
10	(20,14)	25

Starting from the central circulation community, items are passed on through the customers: 0-10. At first the division for every customer is given. In Table 1, regions and the solicitations for every customer are provided. As demonstrated by the ebb and flow circumstance, Variable Neighborhood Search strategy utilizes the symmetric expense to returning to the stockroom, for example, the division from 1 to 5 is equivalent to the partition from 5 to 1. The region for the stop (or appropriation focus) is (40 , 40) (x-center and y-turn esteems) and certainly , this solicitation remains 0. Taking into account the customer region, at first partition framework is learned using the Eq.(1) and its expense is symmetric. Eq.(1) addresses the partition between the customer ci and the station k. Eq.(1), Distance grid recipe

Using the variable area look method, the nearest neighbor for each customer is found. Considering that, the vehicles are coordinated for different objective core interests. Shaking step is associated at the last to limit the overall total partition. Each vehicle is having same number of cutoff points of restriction. The most outrageous vehicle limit portrayed for each vehicle in the above representation implies 70.

Table 2: Distance Matrix Calculation

Ci	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	-	15	20	7	42	16	24	29	10	33
1		-	24	13	31	27	17	22	6	20
2			-	26	37	34	15	45	24	31
3				-	43	14	31	22	7	33
4					-	11	52	45	36	11
5						-	32	30	21	47
6							-	53	32	25
7								-	21	35
8									-	21
9										-

Table 3: Solution for VNS Algorithm with Three Routes

	Trip	**Total Distance**	**Total Demands**
Route1	0-3-8-4-0	50	51
Route2	0-5-9-1-0	83	70
Route3	0-2-6-7-0	88	54

Table 3 exhibits that this result including those complete detachment about 221 and three vehicle signifies required to that transport. This methodology diminishes the detachment essentially diverged from the before strategies. When a car is rented step by step to pass on to customers, this reduction is not enough, so such measures are recommended to address a number of vehicle concerns.

PROPOSED METHOD

The total detachment is figured while taking off to pass on specific things to different objective core interests. The total detachment is explicitly relating to the total expense and total time. In vehicle coordinating issue, the standard objective is need to find a course with least complete partition. In the proposed stir amount to isolating travelled is considered as the essential boundary. Extensive event set of issues which occur mainly associated to genuine applications require more number of vehicles to cover a couple of amounts of transport centers. In the proposed work needing to cover the couple of amounts of objective concentrations with least number of vehicles. So the amount of vehicles is considered as a second boundary. In existing Variable Neighborhood Search procedure, at first the partition network characteristics are processed using the Eq.(1) and considering the figured division regard neighborhood for all of the customers are found. Misrepresented Agglomerative Clustering Algorithm (EACA) , proposed approach depends on Agglomerative bunching calculation for tackling the vehicle steering issue with various storehouses. By following the Exaggerated Agglomerative Clustering algorithm, various bunches are identified which is predominantly utilized for steering the vehicles effectively from the storehouse to all the objective focuses.

Flowchart for Exaggerated Agglomerative Clustering Algorithm

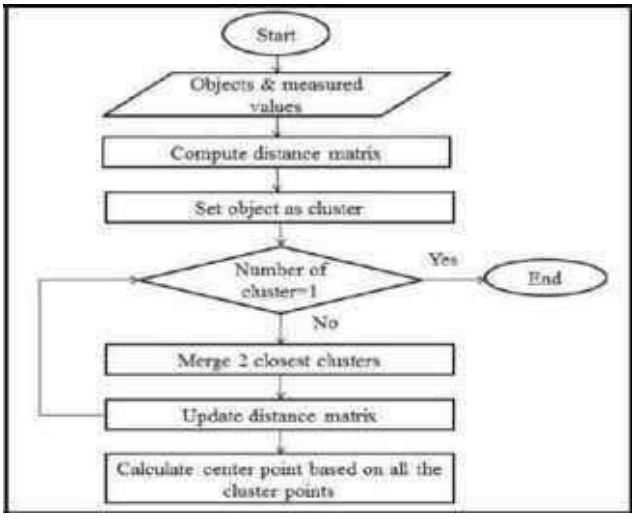

Fig 2: Exaggerated Agglomerative Clustering Algorithm

Exaggerated Agglomerative Clustering Algorithm The calculation ventures as follows:

1. Set the items and estimated values
2. Compute the distance grid an incentive for every one of the groups
3. Set a solitary article as bunch
4. Merge two nearest bunches until the quantity of group is one
5. Update the distance lattice esteems
6. Calculate the middle point dependent on every one of the items

The flowchart for the Exaggerated Agglomerative Clustering Algorithm (EACA) is displayed in the Figure 2. Utilizing the local inquiry strategy, productive courses are found for the vehicles which will get it done for the clients. All the while the all out load for every vehicle doesn't surpass the most extreme limit of that vehicle.

Statistical Example

A collection of 10 consumers including their places also demands are given within the Table 4

Table 4: Customers with Location and Demands

Customers	A(X-axis)	B(Y-axis)	Demands
1	40	40	12
2	36	26	21
3	21	45	25
4	45	35	15
5	10	10	16
6	55	45	24
7	26	59	12
8	55	15	17
9	40	30	20
10	20	14	25

At the point when the grouping is performed for a bunch of qualities, there might be at least two qualities can be framed. In view of the calculation of Agglomerative bunching, two centroid esteems are found with two arrangements of various clients. Each customer has a spot with one centroid point, by and large called as distribution center. Applying the Euclidean detachment formula, the partition within that consumer to explicit stockrooms is determined ultimately the entire division and this complete number of vehicles expected to achieve powerful transport is detected. The last course centers including their characteristics that satisfy the end state are showed up in the Table 6. This procedure gives an unrivaled course of action appeared differently in relation to the past suggestions by different creators.

Table 5: Distance Matrix Calculation

Ci	0	1	2	3	*4*	5	6	7	8	9
0	-	10	16	12	34	25	25	30	9	25
1		-	25	13	31	27	35	22	6	20
2			-	26	37	34	15	46	25	32
3				-	44	15	31	23	8	33
4					-	58	52	46	37	11
5						-	33	30	22	47
6							-	53	33	46
7								-	22	36
8									-	26
9										-

Comparison Results

The example problems happened answered through NetBeans IDE and the recommended Exaggerated Agglomerative Clustering Algorithm gives the best effect while connected to Variable Neighborhood Search algorithm.

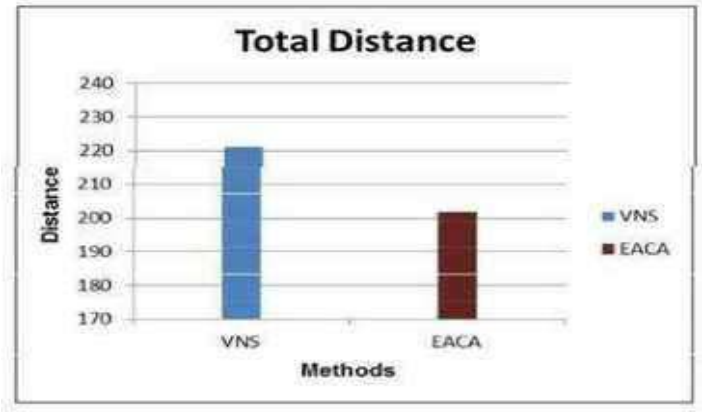

Fig 3: Total Distance

The result is analyzed based on the parameter called total distance. The comparison graph is shown in the Figure 3.

CONCLUSION

While registering the assets grid approach for the Variable Neighborhood system, it offers a respectable response for the little event set, yet for a broad event set, that doesn't allow any predominant outcome. The suggested system gives a predominant game plan upon the generally suggested methods and distorted agglomerative gathering methodologies which are generally used as a piece of the data mining thoughts. Among every one of the current strategies, distorted agglomerative clustering methodology can lessen the total partition of around 7% while utilizing multi distribution centers to passing on these things to consumers.

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Integrated Approach For Performance Management Of Building Based On Internet Of Things

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Abstract. During the operation and maintenance of a structure a monitoring system is essential to monitor the indoor environment- mental conditions. The integration of IoT in rapidly advancing construction is inevitable and it has numerous applications in the operation and maintenance of a structure. This paper discussed the idea of HVAC systems controlled through IoT and some other emerging IoT of applications in building operation and maintenance. ESP8266 Node MCU with DHT11 sensor is used as a temperature and humidity sensing system and to upload the data to the server. The IoT-based temperature and humidity sensing prototype is created to control the HVAC system.3 D model of the proposed building is created by BIM. Finally, discussions were made about indoor environment monitoring, building operation and maintenance, and occupant health and comfort. The uncontrolled indoor environmental factors can directly affect the productivity of the people who use the building.

Keywords: BIM, Performance management, IoT, HVAC system, Wireless sensor networks

INTRODUCTION

The Internet of Things is a network of physical objects (Things) which consists of sensors that are connected through the internet and can communicate information between them and to the end-users. The advancements on the Internet of things (IoT) are growing exponentially, and they have the potential to change the way how we interact with the built environment. It can reduce the administrative workloads for the management of the buildings and also enabling a better quality of services and effective utilization of the resources.

The current construction industry focuses more on the effective design, construction, and delivery of the project, and does not show interest in the operation and maintenance of the buildings. The proper operation and maintenance of the building can significantly reduce the overall repair cost and simultaneously increase the lifetime of the structure. The monitoring systems that can be developed for the operation and maintenance of the buildings is indoor environment monitoring, structural strength monitoring of buildings, waste management, energy consumption management, and parking management. The temperature and humidity are some of the basic parameters for indoor environment monitoring.

In this paper, a temperature and humidity monitoring prototype are developed .3D model of the pro- posed building created using BIM. The HVAC system can be controlled using the wireless sensor network and Internet of Things, which can be useful in the effective utilization of the Heating, Ventilation, and Air Conditioning systems and reduce the wastage of energy.

PREVIOUS STUDIES

Identified many problems and classified them into many classes. Discussed and compared the methods employed to monitor the occupant safety like camera, Wi-fi, and WSN.[1] The researcher devised IoT and Model predictive control-based HVAC systems for smart buildings.[2]. In [3][10][15] incorporated BIM and IoT for developing Otaniemi 3D concepts-based framework.[4] conducted a test on real industrial buildings located in Italy using IoT and Revit architecture.[5][16][20] developed IoT based real-time platform for capturing the performance of the building.[6] framed the QLM based IoT standards for universal messaging. In [7][13] it is proven that LCA tools are sufficient for the early stage of the building design.[8] tested the prototype using IoT and BIM models.[9][18] reviewed the applications of IoT and its research challenges.[11] developed the SNS-based mobile application for CO_2 emission using IoT. In

they discussed IoT-based MPBC systems for intelligent HAVC systems. In [14][17][19] presented the IoT-based environmental monitoring framework and prototype for smart cities.[21] presented a novel algorithm for optimal Placement of sensor for civil engineering applications.

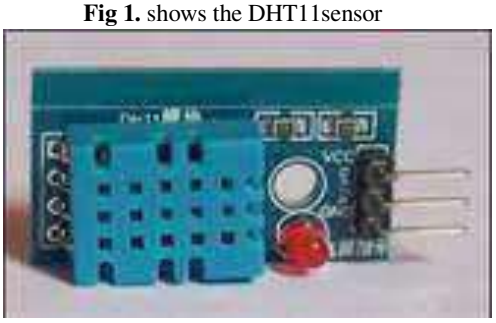
SYSTEM DESIGN

The proposed IoT-enabled sensor module consists of an ESP8266 Node MCU and a DHT11 temperature and humidity sensor. The data from the DHT11 sensor is transmitted to a server using the ESP8266 Wi-Fi Module through wireless communication. The data is received and stored in the cloud, where the real-time temperature and humidity data can be visualized and depicted graphically. The IoT enables the transfer of data anywhere at any time using smart devices like computers and smartphones etc.

Sensor

The temperature and humidity sensor DHT11 are used to measure the temperature and humidity values. The DHT11 has an operating temperature range of 0o C to 50^o C and a humidity range of 20% to 90% with an accuracy of 1^{o}C and 1% for temperature and humidity respectively, which is suitable for indoor monitoring applications. It can operate at a voltage of 3.5 to 5.5V hence low power requirements

Fig 1. shows the DHT11sensor



Wi-Fi module and micro controller

The Node Microcontroller Unit uses a 32-bit micro controller and ESP8266 Wi-Fi module through which the data from the DHT11 sensor is sent to the cloud over the internet. It has an operating voltage of 3.3V and a clock speed of 80 MHz hence it is fast and consumes low power. The Node MCU is connected to a Wi-Fi network. The Node MCU receives the temperature and humidity values from the DHT11 and transmits them to the cloud through the internet.

In the cloud platform, the real-time values sent from the Node MCU can be visualized in a graphical user interface.

Fig 2. shows the ESP8266 Wi-Fi module

Fig 3. Arduino IDE software Program

The Arduino Integrated Development Environment (IDE) shown in Figure 3 is software used to write and upload programs to microcontroller boards. Though the Arduino IDE supports C and C++ languages, it has some special coding structures to make the microcontroller perform its function specified in the program. Figure 4 shows the Arduino IDE software sending the data to the Thing Speak cloud server.

Fig 4. shows Arduino IDE software

Sensor Module

The sensor module for monitoring the temperature and humidity levels in the indoor environment consists of a DHT11 temperature and humidity sensor and an ESP8266 Node Microcontroller Unit. The connections for the sensor module were made using breadboard and jumper wires. The program for the micro controller board was uploaded using the Arduino IDE software.

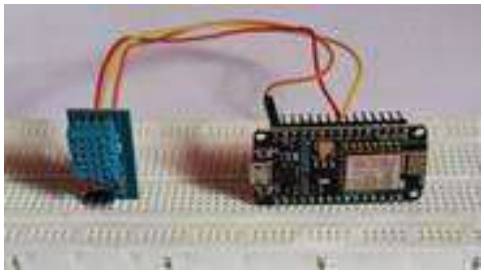


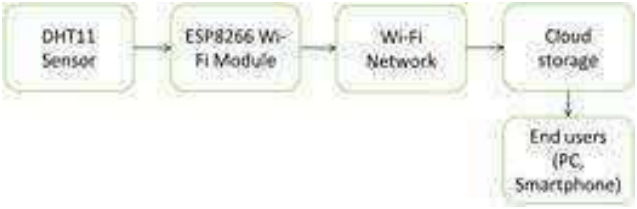
Fig 5. Circuit of the sensor module

SENSOR NETWORK

The temperature and humidity data were collected using the DHT11 Temperature and Humidity sensor and the collected data were sent to the cloud server using the ESP8266 Wi-Fi module. The ESP8266 Wi-Fi module is connected wirelessly to a Wi-Fi network. The temperature and humidity data were sent to the cloud server over the Internet. The process is shown in Figure 6

The data stored in the cloud server can be used to monitor the temperature and humidity of the indoor environment. Through the cloud server, the temperature and humidity can be controlled using a monitoring system.

Fig 6. Block diagram of the sensor network



In Figure 7 it is clearly shown that the DHT11 temperature and humidity sensor is connected to the Node Microcontroller Unit, and the Node MCU is connected to the computer through a micro-USB cable. The program for the microcontroller is uploaded through the micro-USB cable.

DHT11 sensor collects the temperature and humidity data and transmits the collected data to the Node Microcontroller Unit. The Node MCU has the program to process the temperature and humidity data and upload the data to a cloud server, the data received by the Node MCU is sent to the cloud server over a Wi-Fi connection using the ESP8266 Wi-Fi module built in the Node MCU. The Thing Speak cloud server receives and stores the data in an already created channel, from the cloud the data can be downloaded for the study purpose

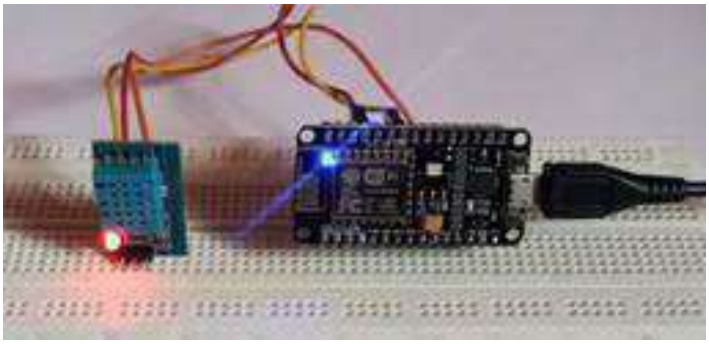


Fig 7. Uploading code to the Node MCU through a micro-USB cable

IoT enabled HVAC System

The Heating, Ventilation and Air Conditioning system can be automated using the current advancements in the Internet of Things. Here we discussed an ideology of an IoT-enabled HVAC system that can be adopted in smart buildings. The previously discussed IoT-enabled temperature sensing module can be used to control the HVAC systems on a large scale. The data sent by the Node MCU to the cloud can be used by a centralized control center of a building to control the HVAC system. It has a scope ofreducing the effort of manual operations and can be helpful in effectively providing the service to the occupants. It also has a wide scope on energy management by reducing the unnecessary overheating and cooling of the building. Thereby maintaining the optimum indoor temperature and humidity conditions to maintain the occupant's comfort. The uncontrolled indoor environment conditions can directly affect the mental and physical health of the people and thereby reducing the productivity of their work

RESULTS AND DISCUSSIONS

The data were collected using the DHT11 Temperature and Humidity sensor and stored in the cloud server using the ESP 8266 Wi-Fi module. The readings were taken using the designed sensor module, in the Department of Civil Engineering for a period of twenty-two days from 8th March of 2021 to 12th April of 2021. The readings were taken from morning 11 am to afternoon 4 pm for five hours and the results were discussed below.

Maximum and Minimum Temperature Data

In figure 8, the maximum and minimum temperature readings were shown for each day from 8th March of 2021 to 12th April of 2021 and it shows a maximum temperature of 33ºC and a minimum temperature of 29ºC.

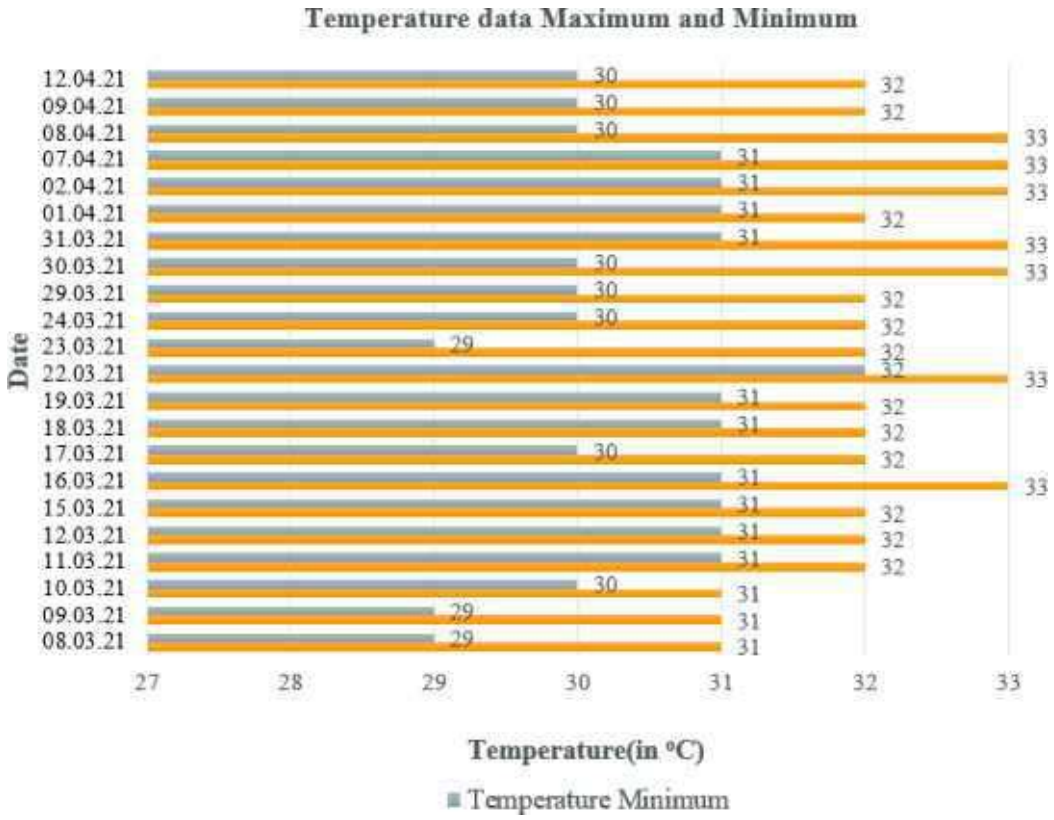


Fig 8. shows maximum and minimum temperature data

Maximum and Minimum Humidity Data

In Figure 9 the maximum and minimum humidity readings were shown for each day from 8th March of 2021 to 12th April of 2021 and it shows a maximum humidity of 56% and a minimum humidity of 40%.

Average Hourly Temperature Variation

In figure 10, it can be seen that average temperature values were minimum of 30.40oC during the morning time (11 am to 12 pm) and gradually increased in the afternoon period (12 pm to 2 pm). In the period of 12 pm to 2 pm the temperature rapidly builds up from 30.40℃ to 32.09℃ and it hits the maximum value of 32.18℃ around 2 pm and maintains it up to 4 pm. The temperature starts to build up in the indoor space and reaches a maximum of 32.18℃. This temperature rise may be due to the lack of air movement inside the building.

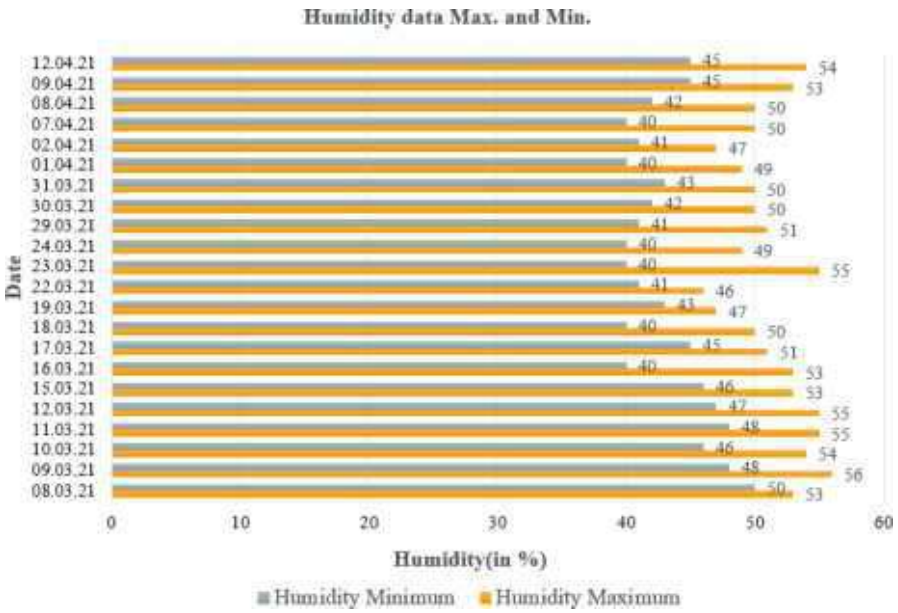


Fig 9. Shows Maximum and Minimum Humidity Data

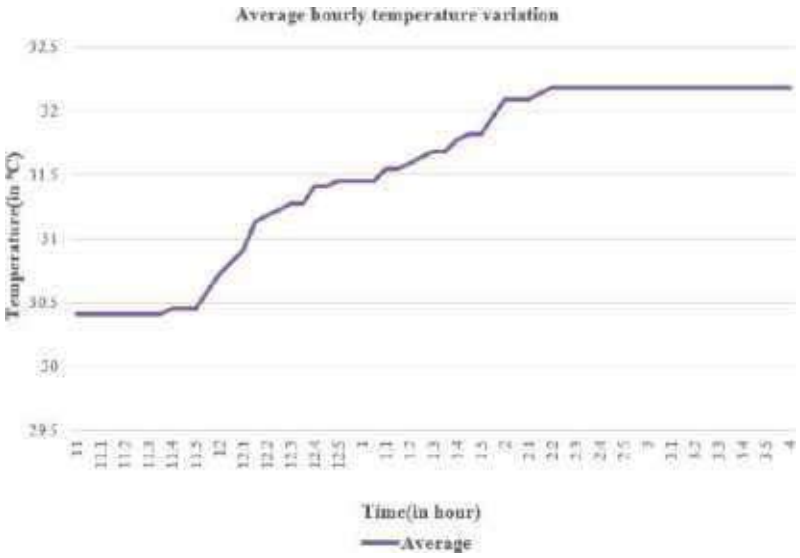


Fig 10. Shows the average hourly temperature variation

Daily Average Temperature Variation

Fig 11 shows the average temperature of each day from 8th March of 2021 to 12th April of 2021. From the above graph, it can be inferred that the average temperature was above 30°C for all days. The average temperature values were lesser at the start of march month due to rain and reaches the maximum of 32.57°C at 22.03.21. But on any day the average temperature was not less than 30°C.

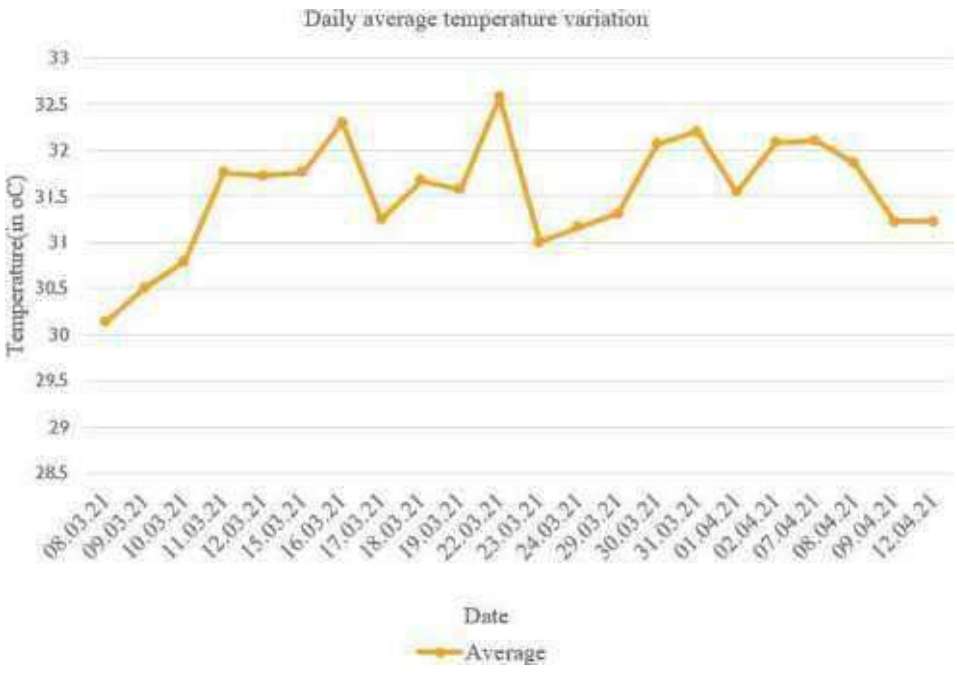


Fig 11. shows Daily Average Temperature Variation

Average Hourly Humidity Variation

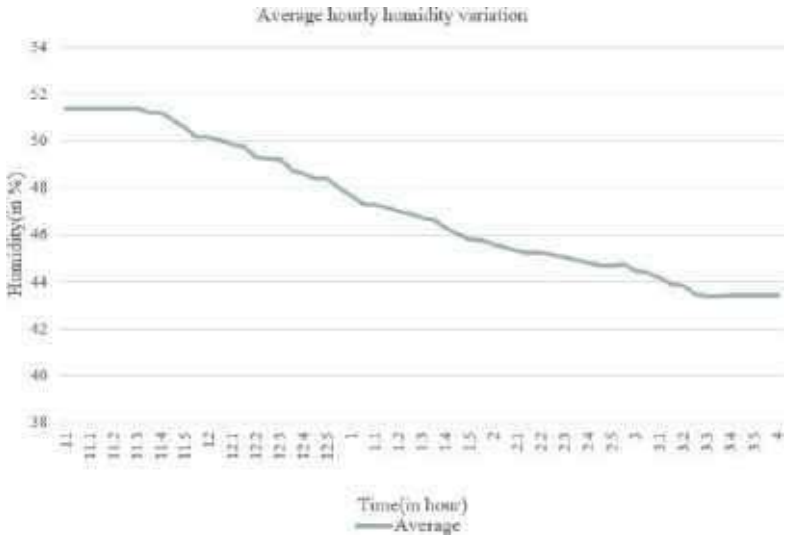


Fig 12. shows average Hourly humidity variation

In the above fig 12, it can be seen that the humidity values were above 50% in the morning (11 am to 12 pm) and it gradually decreased in the afternoon period (12 pm to 4 pm). Also, it can be inferred that the humidity decreases as temperature increases. The humidity decreases from a maximum of 51.40% to a minimum value of 43.40% in the evening.

Daily Average Humidity Variation

Fig 13, shows the average humidity of each day from 8th March of 2021 to 12th April of 2021. From the above graph, it can be inferred that the average humidity was higher in the initial days of march month and gradually decreases as the average temperature increases. The maximum humidity was recorded as 51.32% and a minimum of 43.72% at 22.03.21 when the maximum average temperature of 32.57oC was observed.

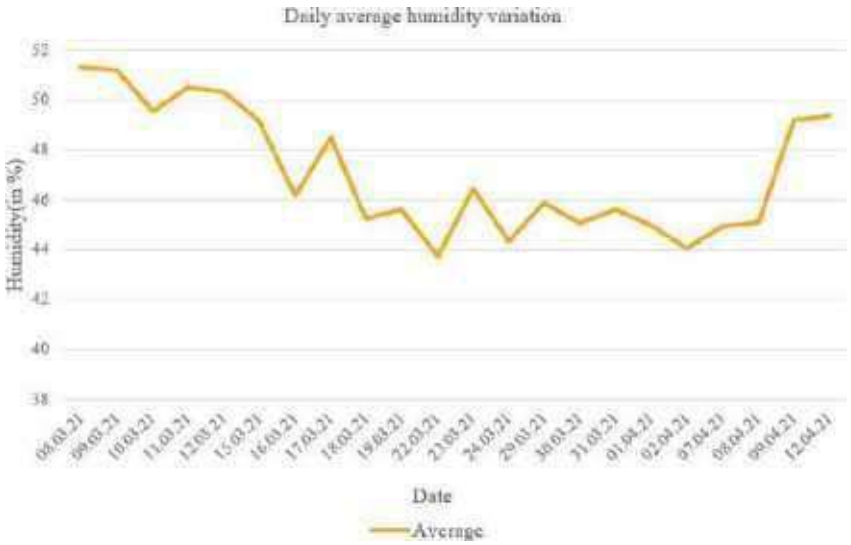


FIG 13. shows Daily Average Humidity Variation

Comparison of Average Hourly Temperature and Humidity Variation

The below fig 14 shows the comparison of average hourly temperature and humidity variation. From the above graph, it can be inferred that the temperature increases and humidity decrease over the day. The humidity was higher in the morning and it decreases as the temperature increases over theday.

The following points were inferred from the above shown recorded data using the created IoT-based temperature and humidity sensor module.

1. The recorded maximum temperature is 33oC and the recorded minimum temperature is 29oC in 22 days. For the 22 days, the average temperature is 31.54oC. The maximum recorded average daily temperature is 32.57oC at 22.03.21. The minimum recorded average daily temperature is 30.13oC 08.03.21.
2. The recorded maximum humidity is 56% and the recorded minimum humidity is 40% in 22 days. For the 22 days, the average humidity is 47.10%. The maximum recorded average daily humidity is 51.33% at 08.03.2021. The minimum recorded average daily humidity is 43.72% at 22.03.202

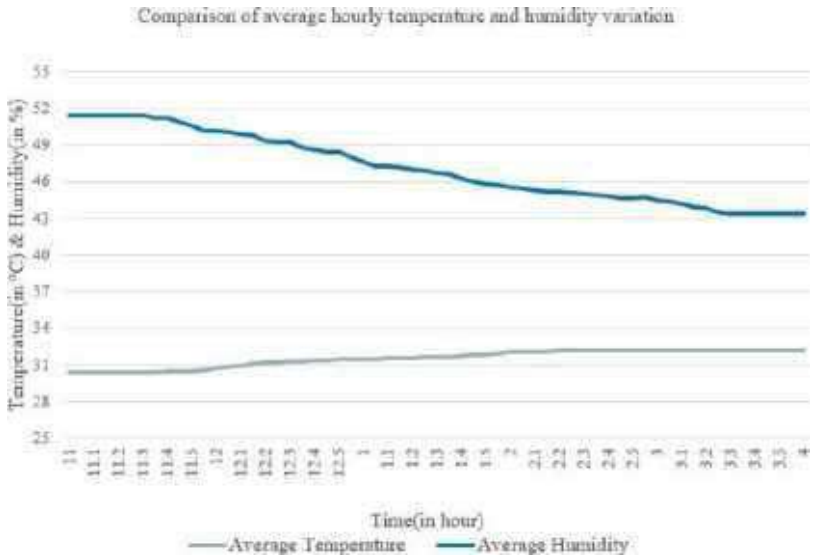


FIG 14. shows average Hourly Temperature and Humidity Variation

3D MODEL OF THE BUILDING

The 3D model of the proposed building is created using BIM and shown in fig.15

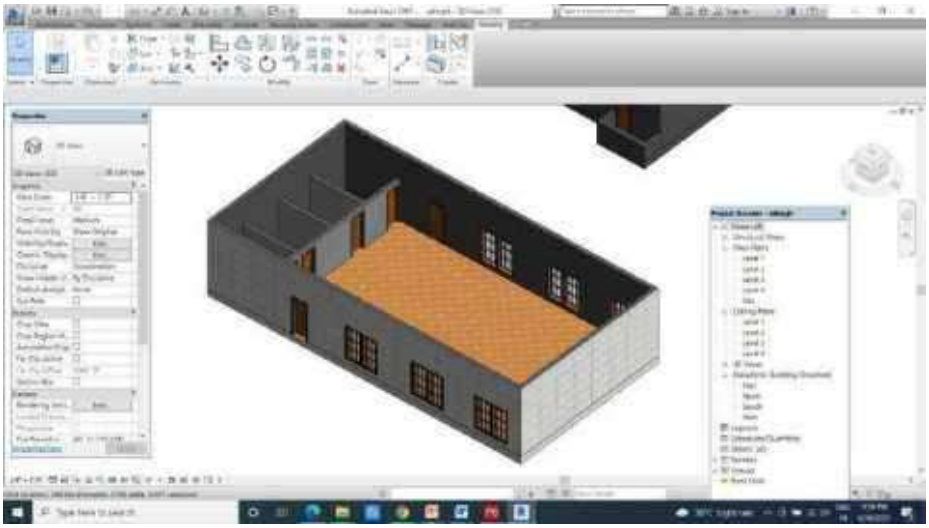


FIG 15. BIM model of the proposed building

CONCLUSION AND FUTURE WORK

The health effects of uncontrolled temperature pose a potential danger to the occupants of the building. It was only discussed about the effects of temperature alone but there are a lot more parameters related to the quality of the indoor environment like humidity, light, noise, air quality, etc. this emphasizes the importance of controlling and monitoring the indoor environment. The designed temperature and humid- ity monitoring system can be used to monitor the indoor environment. On the other hand, the usage of an HVAC system to satisfy occupant comfort leads to large energy consumption. The Ministry of Power states that by increasing the temperature of the room by 1 degree Celsius, we can save about 6 percent of electricity. It also suggests that the ideal temperature is 24 to 25 degrees Celsius for optimal energy saving. Hence an IoT-enabled automated HVAC system can be

helpful not only in controlling indoor air quality but also in increasing the energy efficiency of the HVAC system using a smart sensing module. The Internet of Things makes energy management easy. The IoT-based automated HVAC system increases energy efficiency by eliminating the over-cooling and overheating of the buildings with the help of a smart sensing system. Thereby, the proposed system can reduce the health risks of the occupant and also may increase the energy efficiency of the building.

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Construction Safety Monitoring using Internet of Things (IoT)

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Abstract. The construction industry has one of the highest accident rates, which cause injuries and even deaths. Reluctance among workers regarding precautionary measures is one of the major reasons for the number of deaths. There is a need for the construction industry to change from manpower-oriented to technology-oriented. Manual verification of all the labors for wearing Personal Protective Equipment's (PPE's) is time-consuming. For this, RFID tags can be fixed on all the PPE's and RFID readers can be placed at the entrance. Each RFID tag shall have a unique number and it will be read by the RFID reader. A library can be created in advance for each safety device in use. The library of each safety device (eg: helmet) shall be stored with the RFID details of all the devices of its kind. By using a fingerprint sensor coupled with the RFID reader, the worker's name can be matched with the RFID details of the PPE he had worn on that day. If the labor has worn RFID enabled safety helmet, light-reflecting cloth, and safety shoes (PPE's), then the gate shall open. If the gate is opened, attendance will be provided for the labor, otherwise, the labor shall be marked absent for that day. The names of the labor entering the site and their corresponding PPE details shall be stored in an on-site database. By using this method, we can save more time and also, we can oblige the workers to wear PPE.
Keywords: RFID, PPE, IoT, Constriction Safety, Sensor, Accidents

INTRODUCTION

In India, the construction industry is the second largest contributor to the GDP (Gross Domestic Product) and employs a large number of people. In the last decade, its average contribution to GDP had been around 8-10%. Despite its importance to the economy, it is also a harsh reality that the construction industry is widely regarded as one of the most dangerous because of high accident rates that result in injuries and even death. Accidents on construction sites are often caused by a breakdown of coordination among different departments involved and a lack of proper knowledge on wearing Personal Protective Equipment (PPE). Accidents may occur as a result of building parts collapsing, objects falling on employees, workers falling from heights, working on machines, etc., These accidents cause severeinjuries and even death.

Some common causes of construction accidents: 1) Fall from High place: According to OSHA (Occupational Safety and Health Administration), fall accidents are the leading cause of construction site fatalities, accounting for 36% of all construction worksite fatalities in 2012. Failure to install proper scaffolding, failure to use proper safety equipment, and improper use of ladders and hoists are all common causes of falls. 2) Accidental Slips and Trips: Slipping on a wet patch or tripping over a cable can result in a variety of accidents and health problems for construction workers.3) Electrocution: Exposed wire, power cables, and unfinished electrical systems are frequently present in site. Burns and electric shocks are possible for construction workers who operate near live currents. 4) Falling objects or debris: Heavy machinery, tools, and materials are present on a building site. In between immovable objects, machinery, and fallen debris, a worker can easily become trapped. 5) Fires and Explosions: On construction sites, fires and explosions are commonly occur due to faulty plumbing, leaking gases, and faulty electrical systems.

Structural failure: This could be the result of poor design, poor construction, failure of the foundation, unusual loads, unanticipated failure modes, or a combination of factors. Natural disasters such as earthquakes, floods, and other natural calamities can also cause collapses.

TABLE 1. Statistics for the private sector constructionindustry

Year	Construction Fatalities	Fatality Rate
2011	738	9.1
2012	806	9.9
2013	828	9.7
2014	899	9.8
2015	937	10.1
2016	991	10.1
2017	971	9.5
2018	1008	9.5

Table 1 shows the yearly trend of fatalities in the construction industry. The construction industry is one of the most fatal industries [1]. From the statistics provided by the Bureau of Labor Statistics, we can conclude that number of accidents in the construction industry goes on increasing over the past decade. It shows the importance of construction workers' safety at the site. The labors must be educated about safety and prevailing precautionary measures available in the industry. Ignorance among workers regarding PPE is also a major reason for accidents at the site [1]. Also, it is in the hands of contractors and organizations involved to provide necessary training to labors on accidents. Most of these accidents could have been avoided in the first place if the worker had chosen to wear appropriate protective gear. Figures 1 and 2 show the number of accidents that had occurred due to structural collapse in each state and the number of accidents that occurred in India due to structural collapse every year respectively.

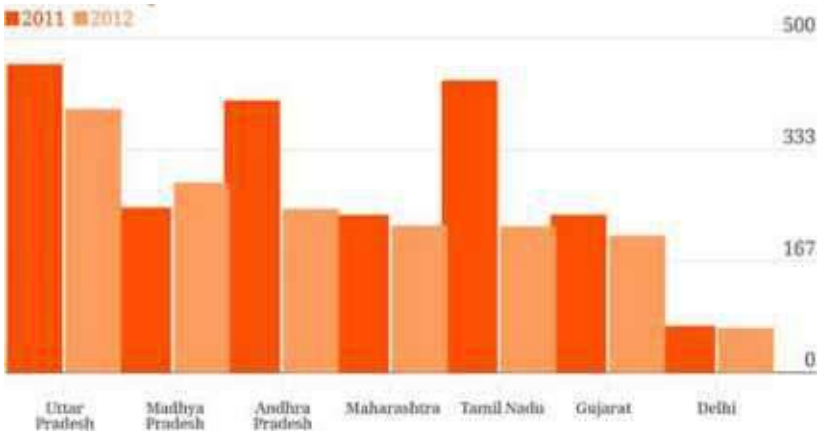

Fig 1. Structural collapse deaths in 2011-2012 (State-wise)

The effects of accidents can be minimized by wearing Proper Personal Protective Equipment (PPE's) shown in Figure 3. On the other hand, construction workers are reluctant to wear PPE's. Some labors feel uncomfortable wearing PPE, and they don't have adequate training to wear PPE's. Workers must be educated and trained on the benefits of wearing PPE's. There is a need for contractors and builders to ensure whether all the labors have worn PPE or not. Manual verification of all the labors for wearing PPE's is time-consuming in a site involving a large workforce. This paper deals with the IoT-based technology through which all the worker's PPE's can be verified in a short duration and also explores the possible add-ins to this technology for continuous monitoring and enhancing the construction workers' safety at the site.

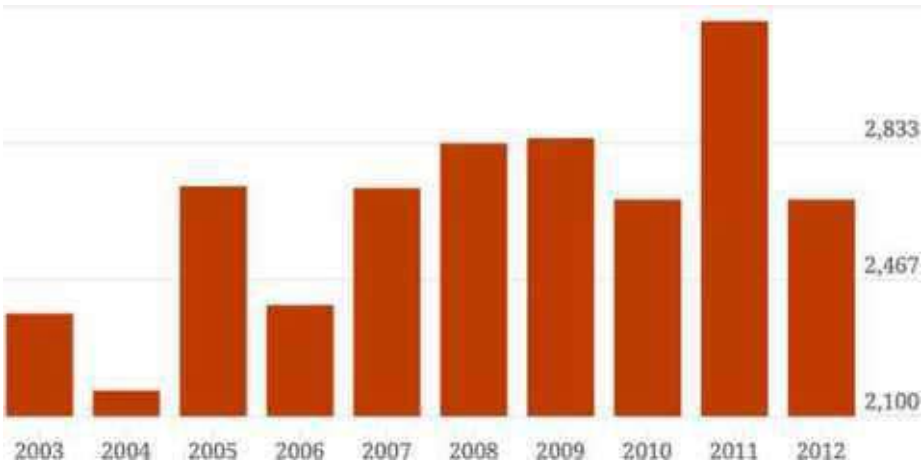

Fig 2. Number of deaths caused by the structural collapse in India

Fig 3. Personal Protective Equipment (PPE's)

PROBLEM STATEMENT

Manual verification of all the labors for wearing PPE's is time-consuming in a construction site involving a large workforce. It may lead to a delay in completing the project. There is a need for the construction industry to change from manpower-oriented to technology-oriented. To overcome this problem, we develop an IoT-based technology through which we can check all the workers for wearing PPE's in a short duration of time

INTERNET OF THINGS (IOT)

The Internet of Things (IoT) is a network of physical devices fixed with sensors software, and alternative technologies that communicate and exchange data with other devices and systems over the Internet. Things have altered as a result of a combination of technologies, including real-time analytics, machine learning, commodity sensors, and integrated devices. Traditional fields such as embedded systems, wireless sensor networks, control systems, automation and others all contribute to the success of IoT. Applications: Consumer applications, Organizational applications, Industrial applications, Infrastructure applications, Military applications, etc.,

In real-time, we can easily access data and information that is located a long-distance away. This is made feasible by a system of devices that enable a person to get any data from any location on the earth.

Good communication is possible across a system of linked devices. It eliminates inefficiencies by making system communication clearer.

Automation is important for managing daily tasks without the need for human interaction, automating tasks in a business helps to improve service quality while reducing the need for human intervention [1-3].

RELATED STUDIES

The researcher explained the methods to enhance construction site safety. Manual verification of all labors for wearing personal protective equipment is time-consuming, so RFID tags are used for verifying whether a labor has worn PPE or not. The RFID readers and sensors are LoRa enabled for long-distance transmission and energy saving. Both construction site and site office are connected with a wireless 4G network. If the helmet count is equal to workers count then the system operation is safe otherwise it alerts the site office. [4] Internet of Thing (IoT) based safety system to enhance safety in underground construction site. RFID technology, Ultrasonic detection technology are some of the IoT technologies. The worker's safety helmet, which is built using RFID-based positioning technology, has a portable warning device coupled with an IoT tag. Each Internet of Things tag is made up of an RFID chip and a wireless antenna with a unique electronic code that stores all relevant information about the worker who wears it. The tag's antenna is utilized to send and receive wireless signals in order to communicate with neighboring RFID readers. RFID readers are installed on existing structures to create a wireless network that allows tags and control centers to communicate in real time and generate early alerts as a safety barrier. When the labors move close to moving automobiles, ultrasonic detectors can be employed to alert them. **[5]** An IoT-based automatic PPE tool pair- testing system using wireless Wi-Fi modules attached to the PPE. If the tool user does not wear the proper PPE, this system will alert the user and the site officer. Hazardous and vulnerable storage materials yards are monitored by using IoT. The physiological status of the workers is also monitored by using physiological sensors. **[6]** Internet of Thing (IoT) technologies to enhance the safety of the workers in road repairing works. When the weather is extremely hot and the personnel have worked for more than three hours, temperature and moisture sensors are utilized to send a voice message to urge them to drink water. When there is a lot of humidity or rain, the system can warn workers of the wet and slick floor on the job site. The roadblock's sensor can identify the presence of an automobile at a particular distance using radar, and loud enough audio messages are broadcast to warn drivers that road mending work is coming up. **[7]** Internet of Things (IoT) is a promising technique to improve construction safety management. Workers' proximity todangerous machines or zones is monitored using Radio Frequency Identification (RFID) and Bluetooth. [8] Internet of Things (IoT)-based real-time safety early warning system. The RFID-based labor tracking system was introduced to aid in the tracking and reduction of human errors, as well as the automatic dissemination of early warnings. RFID readers were positioned along the tunnel axis on the surface of the tunnel segments, with a distance of 40–50 meters between each one. Each person's safety gear was fitted with a portable warning device with an RFID tag so that it could communicate with the readers at all times. [9] The application of IoT technology to prevent accidents and injuries caused by a worker's proximity to a potentially hazardous environment or piece of equipment. An RFID system consists of tags that are affixed to or inside the items to be recognized, as well as a reader that communicates with the tags. Tags are attached inside worker's safety helmets, which are monitored by readers located on a cargo crane, to improve worker safety when working under a cargo crane. The worker wears an RFID bracelet with a passive UHF tag, and whenever the worker approaches the "danger zone," the machine receives a stop signal. [10] A sensing unit in the vehicle's back assures strong coverage, as well as a wearable device for personnel. A radio transceiver, a wake-up sensor, an alarm actuator, and a GPRS module are included in the wearable device. [11] The ongoing trend of VR/AR applications for building a risk-reduced workspace and for imparting risk preventive knowledge to workers. The state of art technologies like VR and AR were reviewed. Hardware, software, and algorithm associated with these technologies were critically reviewed based on selectively chosen articles from SCI index journals. The advantages challenges faced, the gap in research and the future scope of research in these technologies have been identified. [12,13] RTLS can be used to track the location of a human, goods, or tools in real time at any time. RTLS is a means of evaluating the positions of an object within a given area of interest. The Received Signal Strength Indicator (RSSI) and Time of Arrival (TOA) are two techniques that can be used to identify the locations. RLTS is more suitable for indoor location tracking and due to which it has the capacity to use in construction sector. [14] The outline of the evolution of technology in the construction industry. These recent technologies such as artificial intelligence and IoT pay the way to achieve improvement in productivity by removing unnoticed impediments. With the innovations in IT, it is possible to integrate BIM to enable enhanced operation of sensors and IoT. The authors also claimed that using these technologies, we can develop a "Digital Twin" of a real object, allowing us to go from responding to events to anticipating them. [15] Internet of Things (IoT) can be utilized to create a smart environment through digital environment monitoring, smart agriculture, smart metering, and smart calamity alerts. This paper also gives a clear picture of the rising combination of big data and IoT has facilitated the creation of a diverse set of smart

environment applications aimed at end users. [16] Detailed about how to build a methodology for safety monitoring and management in the context of a complex dynamic spatial environment (e.g., ports) using IoT and Multiagent geosimulation methods to create an accurate replication of the complex situations that occur in the real port and to use this replication to assess workers' safety from various consumer security aspects.[17] Developed a smart helmet containing an RFID reader, a thermal infrared sensor, and a Bluetooth module. When a registered worker wearing a hardhat nears the RFID trigger or its linked antenna cable within a particular distance, the RFID sensor is intended to detect the signal given out by the RFID trigger. The signals, which include the registered workers identification and access rights level, as well as the access permission level of the workplace where the registered RFID trigger is located, will be transferred to a cloud server over the 4G wireless network via the smartphone. A thermal infrared sensor is used to determine whether the helmet is properly worn on the person's head. [18]. IoT were used in UK rail industry [19]. Optimization techniques plays a role in sensor placement [20].

From the above Literature Survey, the techniques and methodology for construction safety monitoring using the Internet of Things have been found. Various technologies adopted in the construction industry at present have been identified and studied for their advantages and disadvantages. The latest technologies adopted in other industries such as logistics management have also been studied. From the gathered information we studied the possible technologies to be adapted at a construction site and analyzed whether they will be viable for an Indian context. From the study, it was decided that RFID will be a cheap but effective option that could be adapted in sites involving a large workforce.

METHODOLOGY

The methodology carried out for identifying the problem statement is shown in the flow chart. As in Figure 4, primarily a brief literature survey was conducted to identify the problems in the industry that affects theconstruction workers' safety. Journals were searched with keywords such as construction workers' safety, IoT in construction, and RFID application in the construction industry. Construction accidents were primarily associated with workers' falling from heights, falling objects, building collapse, and electrocutions. Most of these accidents resulted from the ignorance of workers towards protective measures and PPEs. The contractors find it difficult to verify PPEs when the site involves larger manpower on a day-to-day basis. Also, continuous monitoring becomes nearly impossible over time. From the literature study, the need for an automated system that could check the workers for PPE was identified.

The process flow for the automated system was identified. Radio Frequency Identification (RFID) tags will be fixed on the worker's PPE's (safety helmet, light-reflecting cloth, safety shoes). Each RFID tag shall have a unique number. A library shall be created in advance for each PPE (for helmet, safety cloth, and other applicable safety gears) and the corresponding RFID number in each PPE shall be scanned and stored in the appropriate library in advance so that it can be easily matched with worker's name. RFID readers will be placed near the entrance. The unique number in the RFID tags will be read by the RFID reader. That number details shall be stored in the onsite database. Additionally, a fingerprint sensor and gate control system will be placed in the entrance. First, the worker's fingerprints are taken, and the system is reprogrammed to display the worker's name. Next, the corresponding worker's PPEs shall be verified. The workers must wear an RFID-enabled safety helmet, light-reflecting cloth, and safety shoes (other safety equipment can also be added based on the nature of work). The RFID reader will read them, and show the corresponding RFID number in the device. If the worker wears all three PPE's and their RFID numbers are matched with their name, then the gate will open. The worker can enter the construction site and attendance will be provided for that worker. Otherwise, the gate will not open and the worker will be marked as absent for that day. The process flow adopted for the labor attendance system based on PPE is shown in Figure 5.

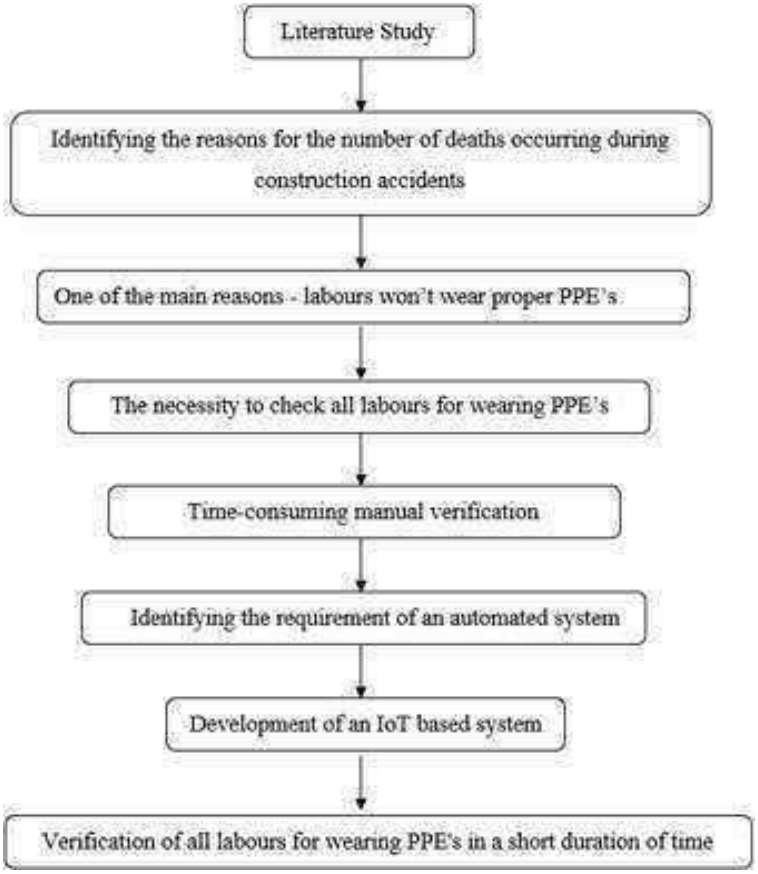

Fig 4. Methodology of the research work

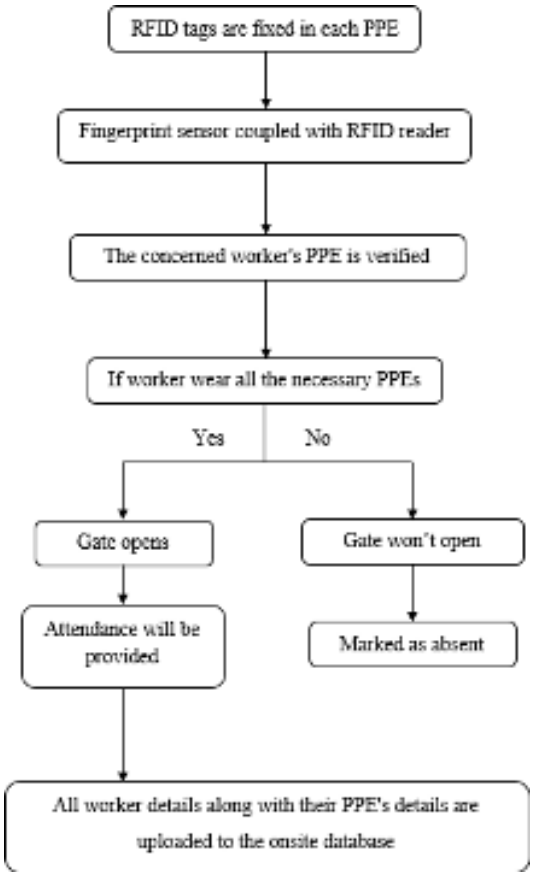

Fig 5. The process flow adopted for the labor attendance system based on PPE

WORKING OF THE ARDUINO MODULE

Arduino Module for Reader combined with Gate Control

The Arduino model for RFID reader with gate is shown in Figure 6.

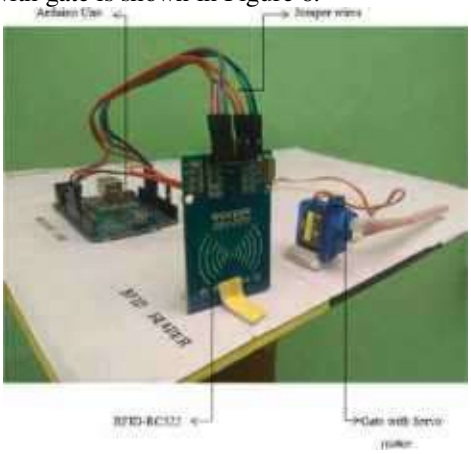

Fig 6. Arduino module for RFID reader

CIRCUIT DIAGRAM OF RFID READER

The RFID reader RFID-RC522 is connected to Arduino by using the breadboard and jumpers. The RFID-RC522 module operates on 3.3V and its frequency is 13.56 MHz. As a result, the 3.3V pin on the module must be connected to the 3.3V pin on the Arduino. If the module is accidentally connected to the 5V pin on the Arduino, it may be damaged. The connection details are: SDA pin is connected to pin 10 on Arduino, SCK pin is connected to pin 13 on Arduino, MOSI pin is connected to the pin 11 on Arduino, MISO pin is connected to pin 12 on Arduino, GND pinis connected to GND pin on Arduino, RST pin is connected to pin 9 on Arduino, 3.3V pin is connected to 3.3Vpin on Arduino and the pin IRQ on RFID RC522 is unused. The circuit diagram is shown in Figure 7. After completing all these connections, an electromagnetic card is to be read by the RFID reader is shown in Figure 5.5. The RFID-RC522 module is an RFID reader that can read RFID tags nearby. The reading distance ranges between 2 and 6 cm. UHF (Ultra High Frequency) RFID readers can be used in the actual construction site because they can read up to 2 mand the tags do not require an external power supply.

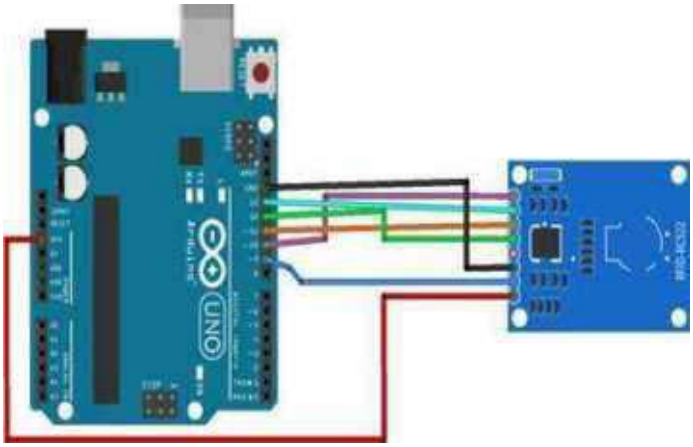

Fig 7. Circuit diagram of RFID reader

CIRCUIT DIAGRAM OF GATE

The Arduino UNO is connected to the servo motor using jumper cables. The servo motor is connected to the 5V pin and ground pin for drawing the power supply. The motor is connected to pin 3 of the Arduino to receive output from the Arduino. When the RFID tags are scanned, the gate shall open to 70^0 for horizontal and stay in position for 7.5 seconds to enable the worker to cross the gate. Both the angle and time of gate opening can be changed by making appropriate modifications in the code. The circuit diagram is shown in Figure 8.

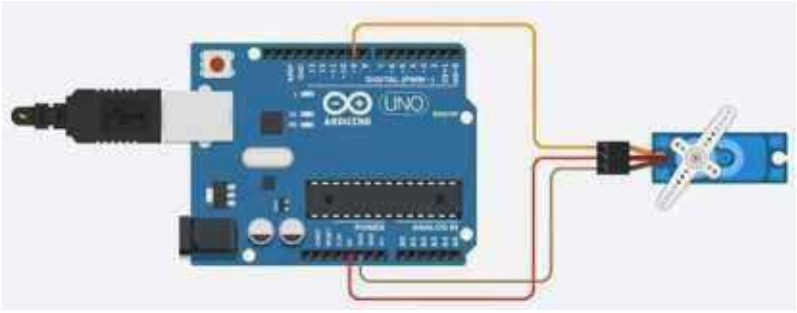

Fig 8. Circuit Diagram for Gate

DATA ENTRY IN EXCEL SHEET

For maintaining labor attendance, the worker's name along with his PPE details for the day can be used. For this Arduino UNO has to be coupled with RFID reader and fingerprint sensor. To enter the data in a locally stored excel sheet in a site office computer, PLX-DAQ for excel is used (Figure 9). It acts as a relay that carries the output from the Arduino and enters the data in appropriate columns of the excel sheet. Similar methodology can be adapted for worker exit as well thereby creating the timestamp of worker entry and exit along with their PPE details. Once the COM port for PLX-DAQ is enabled with the port number to which the Arduino is connected and the appropriate baud rate for RFID (9600 for RFID RCC522), the serial monitors of Arduino IDE where the output is generally displayed gets disabled, and the PLX-DAQ displays the output in a locally stored Excel sheet in the format required. When the Arduino is coupled with the operation of the fingerprint sensor, the labor details along with PPE details, his time in and time-out can be saved and can be used as a record for maintaining track of workers' attendance. PLX-DAQ interface is shown in Figure 9.

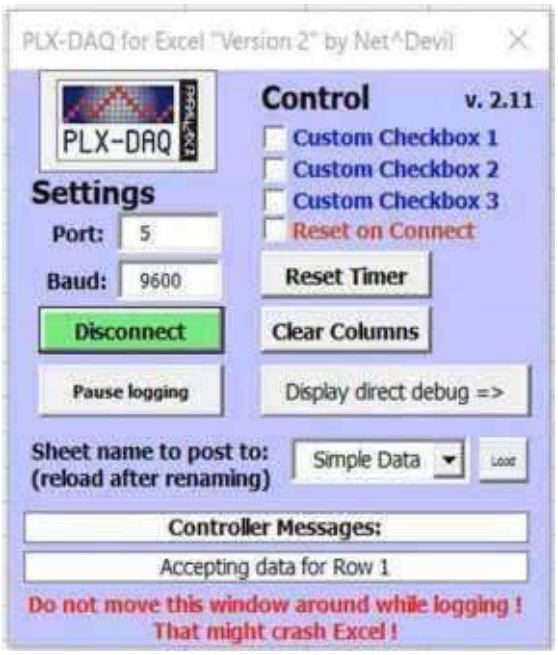

Fig 9. PLX-DAQ interface

WORKING OF THE MODULE

The Arduino board is connected with RFID RC522 reader and a servo motor-enabled gate. When a labor enters the site and verifies his fingerprint, the RFID reader shall look for RFIDs within the read range. The RFID tags affixed in the PPEs worn by the labors will be read (Figure 10). The system shall verify whether the labor has worn all the prescribed PPEs are not. If yes, the gate will open (Figure 11) and the labor's name along with RFID details of PPE he has worn will be recorded in an excel sheet using PLX-DAQ. If the labor has not worn all PPEs, the gate won't open and attendance will not be provided for the labor. Using PLX-DAQ, the date and time of the labor's entry, as well as the RFID UID number of the PPE they wore on that day, will be displayed in an excel sheet (Figure 12).When the fingerprint sensor is coupled with Arduino module, the labor name will also be recorded in the excel sheet. It is also possible to record labor time-in and time-out thereby creating an attendance system based on the presence of PPE, which in turn will mandate the workers to use PPE every day. The desired output in real-time at the site is shown in Figure 13.

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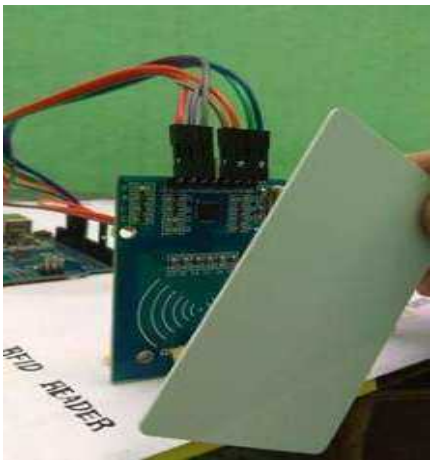

Fig 10. Reading electromagnetic card using RFID Reader

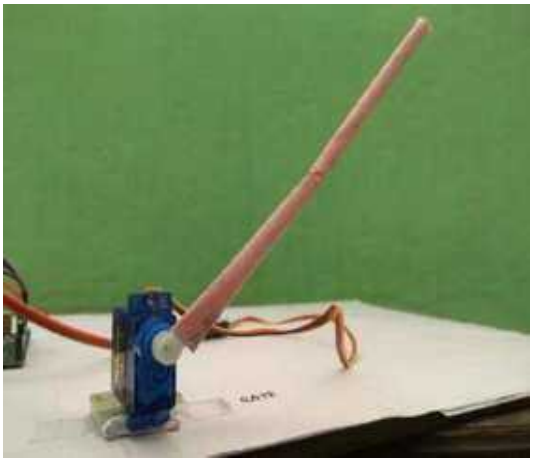

Fig 11. Gate opening after reading the card

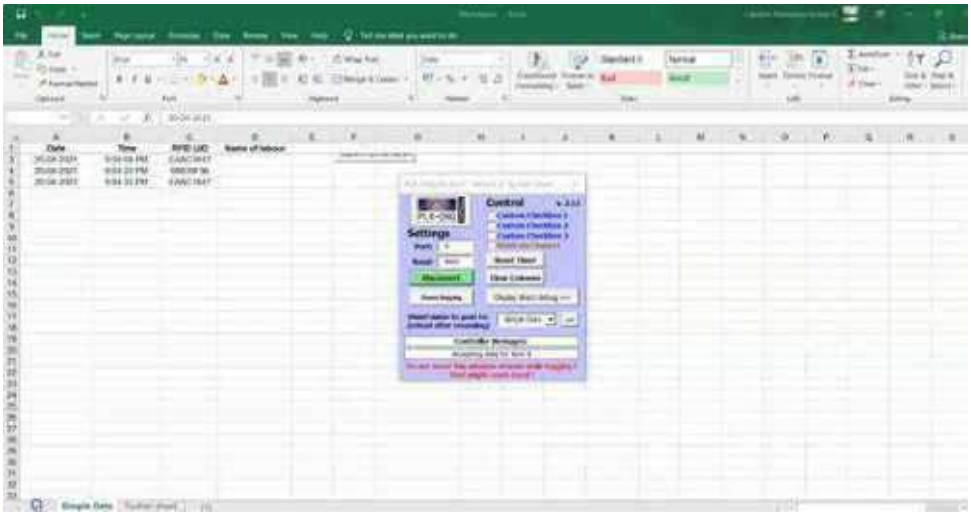

Fig 12. Sample output

	A	B	C	D	E	F	G	H
1	DATE	TIME IN	NAME OF THE LABOUR	LABOUR ID	HELMET UID	SAFETY CLOTH UID	SHOE UID	TIME OUT
2	06.05.2021	8.55	VELUCHAMY M	M102	22 48 72 63	65 82 30 94	19 53 24 85	18.01
3	06.05.2021	8.59	RAVI K	M081	56 66 94 03	71 29 77 36	29 94 48 51	18.02
4	06.05.2021	9.01	MANI S	M042	44 56 82 19	35 46 78 17	48 75 68 62	18.07
5	06.05.2021	9.03	SUNDARAM K	M090	70 18 93 40	49 38 57 83	63 90 72 38	18.08
6	06.05.2021	9.04	MURUGAN J	M048	83 95 02 18	74 81 20 38	64 58 92 15	18.09
7	06.05.2021	9.04	SAMY S	M087	46 18 94 27	48 69 28 45	72 50 48 94	18.15
8	06.05.2021	9.07	MARIAPPAN A	M045	49 82 17 30	59 34 72 28	85 28 49 71	18.16
9	06.05.2021	9.15	PERUMAL T	M070	28 09 18 27	72 28 91 50	79 33 61 58	18.17
10								

Fig 13. Expected output for the real site

CONCLUSION AND FUTURE SCOPE

The construction industry is widely regarded as one of the most dangerous due to the high rate of accidents that result in injuries and even death. The effects of accidents can be minimized by wearing proper Personal Protective Equipment (PPE). To enhance the safety of the labors at the construction site there is a need to check all the labors for wearing PPE's. Manual verification of all labors for wearing PPE is time-consuming. There is a need for the construction industry to change from man

power oriented to technology-oriented. An IoT-based technology is developed through which we can verify all the labors for wearing PPE's in a short duration of time. It can be implemented for sites involving a large workforce. This IoT-based technology includes RFID tags, RFID readers, and an onsite database for storing labor details along with their PPE details.

RFID seems to be a viable option for maintaining track of worker's PPE because on comparing bar codes and QR codes with RFID, RFID has a high reading rate, fast reading speed and does not require line of sight for reading. RFID tags are fixed on all the PPE's. Each RFID tag has a unique number and it will be read by the RFID reader, which is placed at the entrance of the construction site. A library can be created in advance for each safety device in use. The library of each safety device (eg: Safety helmet) shall be stored with the RFID details of all the devices of its kind. By using a fingerprint sensor coupled with RFID reader, worker's name can be matched with the RFID details of the PPE he had worn on that day. If the labor has worn RFID enabled safety helmet, light-reflecting cloth, and safety shoes (PPE's), then the gate shall open. If the gate is opened, attendance will be provided for the labor, otherwise, the labor shall be marked absent for that day. All the labor details along with their PPE's details are uploaded in an Excel sheet by using the PLX-DAQ interface. This IoT-based technology explores the possible adding to this technology for continuous monitoring and enhancing the construction workers' safety at the site.

This IoT-based technology explores the possible add-ins to this technology for continuous monitoring and enhancing the construction workers' safety at the site**.** After entering the construction site, the worker may remove the safety helmet, which can be checked with an Ultrasonic distance measuring sensor (Figure 14).

A module can be made using the required sensor, Arduino NANO, and power supply. The module can be fixed at the back of the helmet by making suitable alterations without affecting the working of the safety helmet (A small projection of the module shall be visible at the back while the Ultra Sonic sensor will be within the helmet's frame). If the distance of the head exceeds a prefixed value (say 5 cm) the system shall send the data to the server. If the time exceeds a maximum limit (eg: 5 minutes), the site office can be alerted. The module's operation can be neglected during tea and lunch breaks.

During an accident time, the worker's location can be found by using a GPS module with Wi-Fi support. A module can be made using a GPS chip, ESP 8266 Node MCU, and power supply. The module can be fixed to the light reflecting cloth over the chest. The module will be connected to the server using Wi-Fi routers at the site. Each GPS chip (Figure 15) will have a unique ID which we can track every day by knowing the RFID of the corresponding light-reflecting cloth. The module's operation can be handy during accidents.

Fig 14. Ultrasonic distance measuring sensor

Fig 15. GPS Chip

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Prosopis Juliflora Ash was used to partially displace cement in an experimental concrete study

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Abstract. We came up with the idea of using Prosopis juliflora (Semai Karuvelam in Tamil) ash as a replacement (partially) for safeguard the environment, cement is used. and resources. The same amount of greenhouse gas (CO2) will be produced by cement, adding to global warming. Greenhouse gas emissions drop as the amount of cement used decreases. Juliflora ash as partial replacement for cement is one of the potential approaches for boosting Mortar blocks' properties such as toughness insulating. The hardness of concrete made with Prosopis Juliflora cement is evaluated (compressive strength, split tensile strength, and flexural strength).

INTRODUCTION

The tree Prosopis Juliflora collects a lot of aquifers as well as humidity in the environment. The TN government as began chopping of timber well with assistance from Public Works Department [1]. As a result, Juliflora as being widely with manufacturing, energy factories, and furnaces, it is used, and other processes, resulting in increased residue formation. Industrial wastes (byproducts) are accumulating to a great extent, posing environmental and economic problems about their disposal. Because cement produces a large amount of greenhouse gases, experts are forced to explore other options, including long-term building practices [2]. Thus, the research gives about outline with research that has been done on using Prosopis Juliflora ash as a partial substitute for cement [3].

Fig 1. Prosopis Juliflora Tree

The type of fuel (shrubby material, hardwood, or cork), the burning method (permanent bed or liquid phase), and the location where the ash is recovered all influence the characteristics of the ash. Wood ash is a potential danger since it is largely made up of microscopic particle matter that can easily be transported into the air by winds, causing major health problems for persons living near the dump site or poisoning waterways by absorbing harmful compounds into the water [4]. As both the expense industrial trash removal raises as well as the amount of ash produced increases, a long-term ash management strategy that incorporates ash into weather patterns is needed [5].

Detailed investigation is being done on pollution in the environment and other crop residues, such as wood ash, that can be utilized as a cement substitute in cementitious materials [6,7].

Fig 2. Juliflora Ash

The demand for cement, which is a key component in cementitious, as a result of the current development boom, has developed. Furthermore, the mortar manufacturing of huge user aggregate, and it necessitates a significant amount of electricity and resources to run. Consequently, utilizing byproduct as well as agro - garbage cremated remains, which resolves a multiple disposing issue while also giving a viable option to cement substitutes in concrete [8]. Therefore, using Juliflora ash as a cement substitute in blended cement is favorable to the environment while also providing a low-cost construction entity, resulting in a long-term connection. Rice husk ash and fly ash are two significant actors that have already demonstrated their effectiveness as mineral admixtures in cement at varied percentages [9].

EXPERIMENTAL INVESTIGATION

Cement

Test on Cement:

1. Perform a Specific Gravity Test
2. Perform a test on the initial and final setting times
3. Cement Fineness Test

The property of specific gravity is 3.150, property of Initial and final setting time 50 mins & 550 mins and also the property of Fineness of cement.

Aggregate (Coarse & Fine)

1. Perform a Specific Gravity Test
2. Moisture Content Test
3. Higher Viscosity Test
4. Soil Sample Test
5. Ductility elastic modulus Computation

The property of specific gravity of coarse aggregate values and fine aggregate values are 2.70 and 2.60. The property of water absorption of coarse aggregate and fine aggregate values are 0.60% and 1.81 %. And also the property of coarse and fine aggregate are 7.18 and 3.

Juliflora Ash (PJA)

Cementitious slurry in three various proportions (NA replacement of 5 percent, 10 percent, 15 percent, and 20 percent by cement's strength) were made, Along with regulate combination, which had a 0.5 moisture proportion. NA's density is smaller than that of cement. Juliflora ash has a specific gravity of 2.71 according to BS 5628-1: 2005. Juliflora ash has an optimum specific gravity range of 1.6 to 2.8.

RESULTS AND DISCUSSION

Cube Test Result

The Compressive Strength of cube at 0% is 19.5Mpa, 21.7Mpa, 23.4Mpa as well as with ash replacement of 5% is 19.7Mpa, 21.96Mpa, 23.4Mpa and 10% is 20.37Mpa, 22.78Mpa, 23.55Mpa and 15% is 20.65Mpa, 22.78Mpa, 23.7Mpa and 20% is 16.51Mpa, 17.03Mpa and 19.92Mpa.

Fig 3. Compression Test on Cubes

The Split Tensile Strength of cube at 0% is 4.3Mpa, 2.4Mpa, 2Mpa as well as with ash replacement of 5% is 2.5Mpa, 4.4Mpa, 2Mpa and 10% is 1.63Mpa, 2.26Mpa, 3Mpa and 15% is 1.74Mpa, 2.24Mpa, 3.2Mpa and 20% is 1.29Mpa, 1.76Mpa and 2.33Mpa.

Fig 4. Tensile Test on Cylinder

The Flexural Strength of cube at 0% is 2.44Mpa, 3.42Mpa, 4.18Mpa as well as with ash replacement of 5% is 2.56Mpa, 3.53Mpa, 4.36Mpa and 10% is 2.87Mpa, 3.59Mpa, 4.5Mpa and 15% is 3.01Mpa, 3.53Mpa, 4.95Mpa and 20% is 2.21Mpa, 2.66Mpa and 3.42Mpa.

Fig 5. Flexural Test on Prism

CONCLUSION

- When all three percentages of replacement were applied, the cube's 7-day compressive strength fulfilled hardness (13.5N/mm2) standard. The strength of concrete of a cuboid using 20% Juliflora ash supplementation between 14 & 28 days was found to be lower than the normal strength (18 and 20 N/mm2) of a control specimen.
- When 20% of the cement was replaced with Juliflora ash, the split tensile strength was found to be lower than expected. After 28 days, the flexural beam's hardness was determined to be the same for all three cement percentages containing Juliflora ash sufficient. All of the strength requirements were met when 5%, 10%, and 15% of the cement was replaced with Juliflora ash. However, a replacement rate of 5% to 10% will be more cost-effective. As a result, replacing cement with Juliflora ash at a rate of 5% to 10% for PPC is recommended.
- With increasing replacement, workability is observed to decline. Because Juliflora ash absorbs more water than cement, this is the case. Juliflora ash is a pozzolanic substance because it contains smaller particles and hence has a greater surface area per particle. Because of its high pozzolanic activity, Juliflora ash is suitable for use as a cement substitute.
- When compared to the control specimen, the strength properties of the concrete drop marginally as the Juliflora ash concentration increases. The obtained strength, however, is still greater than the target strength. Due to pozzolanic processes, strength also rises with age. As a result of its employment in concrete, Juliflora ash is transformed from an atmospheric problem of valuable a reference regarding development of a very unconventional bonding that works ingredient.

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An Experimental Investigation on Lightweight Engineering Cementitious Composites and its Applications

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Abstract. In the world of speedy development, there's a necessity for materials that are improved strength and property. The significance of micromechanics with in the materials design strategy is emphasized. The distinctive characteristics of ECC based on experimental and theoretical applications has attracted several scientists. In order to drop the weight of ECC, LWECC have been employed. The densities of LWECC lies from 900 and 1600 kg/m^3 has been implemented. Addition of ductility, lightweight ECC can further expand the applicability. uses of polymeric micro-hollow-bubble, glass micro-bubbles, natural lightweight aggregates perlite and air-entrainment admixture in M40 mix designs. Flexural strength and compressive strength are examined. The experimental results show that strain hardening and multiple cracking can be attained. However, the strength characteristics of ECC significantly vary with type and content of lightweight filler used. Mixes by adding light weight fillers in correct size and proper distribution exhibit more superior mechanical performances, thermal conductivity and load bearing capacity.

INTRODUCTION

Light weight engineered cementitious composites (LWECC) can be outlined as a sort of composites that is associated with an expanding negotiator that will increase the degree of the mixture whereas reducing the DL [1]. It's finer than the standard concrete with tightness lower than 1500 Kg/m^3. By adding of air entraining negotiator and expanding agent Self-weight of the material is reduced. LWC are extensively practiced in construction fields because of their advantages like less shrinkage, less density, high heat resistance and low thermal conductivity. The composite materials with air voids are known as LWECC [2]. Normal fine aggregate is replaced by lightweight aggregate (aggregates with voids) predominantly occurs in structural implementations with less weight and permeability needs. Lightweight concrete in structural applications normally has a tightness between 1500 and 2000kg/m^3 when compared to normal concrete 2300–2400kg/m^3[3] . ULCC (Ultra-lightweight cement composite) has low tightness below 1400kg/m^3 and the compressive strength about 60MPa, using ULCC in structures is critical due to their material weight. While lightweight concretes are traditionally made by lightweight aggregate, which is normally weaker than cement matrix but provides a small resistance to crack generation [4]. LWC is especially used in constructions for low SF weight, such as high-rise buildings, composite structures and long-span structures. Application prospective of LWECC is controlled by its high creep, low toughness strength and diminishment of LWC provides more superiority[5]. They are an excellent anti-fatigue performance, high strength, lightweight and high corrosion resistance. LWECC can also hold out against chloride, acidic, moist environments and alkaline attack for long time interval. Therefore, increases the time interval of construction materials than its actual duration of time period [6]. Although the startup fund of LWECC structures are higher than other composites, there is a noteworthy ability for saving cost because of diminish maintenance expenses in complete life time cost. The enhancement of FRP is also a successful method to sort out the problems of poor ductility and high brittleness of ULCC, that produce a better perspective for understanding the LW design in structures. In this project, lightweight ECC material is developed by adding polypropylene in 1.75% and fine aggregate(sand) with 10% of vermiculite and compared with nominal mixes of ECC [7].

MATERIALS AND THEIR PROPERTIES

Cement

Cement act Cement used as a binding agent in both ECC and PCC [8]. Here locally available OPC of 53grade was used. The physical properties of cement is mentioned in the Table 1 [9].

TABLE 1. Physical properties of cement

Test Conducted	As per IS 4031-1998	Values
Initial Setting Time (min)	Minimum 30	130
Final Setting Time (min)	Maximum 480	198
Specific Gravity		13.5

Sand

The fine sand is used for casting ECC. The sand that passing through 250 micrometer sieve and get retained on 150 micrometer sieve was used. The sand was sieved manually for this work. properties of sand is mentioned in the Table 2 [10].

TABLE 2. Physical properties of sand

Test conducted	Values
Specific gravity	2.66
Unit weight (kg/m^3)	1381
Water Absorption	3-4%

Vermiculite

Vermiculite is formed due to hydrothermal alteration of phlogopite or biotite or by weathering actions. It's a type of hydrous phyllosilicate minerals that expands seriously when heated. Physical Properties of Vermiculite is shown in table 3 as per the specifications of supplier [1].

TABLE 3. Physical properties of vermiculite

Test conducted	Values
Specific gravity	3.1
Water Absorption	2.65%
Fineness Modulus	2.46

Fly Ash

Pozzocrete 40 type Fly Ash was used in the research work. Fly ash with Portland clinker, possibly utilized as a part of cement. The accomplishment of fly ash in RCC structures is exceeding fortunate [11]. The fly ash minimizes hydration without influencing the strength properties, by providing better compaction to the concrete mixtures it increases the ultimate strength properties of concrete [12]. Beside many dominant properties, it arrests the formation of the fine void (air voids) spaces in concrete mixes where these voids would be further occupied by other materials like water or cement [11]. Therefore, the strength properties of the composites are improved by adding fly ash. Properties of fly ash is shown in table 4 as per the specifications of supplier [6].

TABLE 4. Properties of fly ash

Properties	Values
Compressive Strength	5500-8000
Flexural Strength	6000-8000
Tensile Strength at break (psi)	4500-6000
Elongation at break (%)	100-600

Water absorption	Negligible (0.01-0.03)
Specific gravity	0.90-0.91
Tensile Modulus (ksi)	165-225
Compressive Modulus (ksi)	150-300

Polypropylene (PP) Fiber

Polypropylene Fiber is one of the synthetic fibers that is formed from polypropylene melt. When compared to polyamide fibers, Polypropylene fiber has superior resiliency and elasticity [7]. Polypropylene (PP) fibers has better heat wrapping properties and it's highly rebellious to alkalic substances, acids and other organic solvents because of its high pull-out strength and high firmness strength, the Polypropylene fibers reduces the plastic shrinkage cracking at early stage by increasing the firmness properties of fresh concrete which resists the tensile stresses created due to typical volume changes. However, the uniform distribution of fibers in the concrete plays a major role in strength contribution of concrete. The properties of polypropylene fiber is shown in table 5 as per the specifications of supplier[13].

TABLE 5. Properties of Polypropylene (PP) fibers

Test conducted	Values
Specific gravity (g/cm^3)	0.9
Diameter (μm)	37
l/d ratio	324
Length (mm)	12

Superplasticizer

Superplasticizers are also known as HRWR (high range water reducers). Superplasticizers are chemical substances used to reduce the content of water which is require for attaining the stability of concrete, by reducing the cement content, water-cement ratio superplasticizers increase slump value of the concrete [14]. superplasticizers was absorbed by cement particles, that delays or prevents the process of exterior hydration of cement. Superplasticizer increases both the strength characteristic and workability of the concrete [12]. It reduces the water content more than 30%.

Mix Proportions

Preparation of the specimens includes the materials like cement, fly ash, sand, vermiculite, PP fiber, water and superplasticizer. These materials were selected in order to minimize the density(weight) of the composites. The numerous mix ratios of LWECC [15]was shown in table 6.

TABLE 6. Mix proportions

Mix	Grading Size (vermiculite)	Cement	Fly ash	Sand	Vermiculite (replacement of sand 10%)	Water binder	SP (%)	PP fiber (volume)
M1	Conventional	1	0.5	0.89		0.50	1	1.75
M2	<600 μ	1	0.5	0.80	0.09	0.50	1	1.75
M3	600μ-1.18mm	1	0.5	0.80	0.90	0.50	1	1.75
M4	1.18-2.36mm	1	0.5	0.80	0.90	0.50	1	1.75

Water Absorption Test

$$Percentage\ of\ Water\ Absorped = (Dry\ Weigth - Dry\ Weight)\ x\ 100$$

The water absorption test was conducted by placing the specimens in curing tank. By taking the dry weight of the cube specimen before keeping it inside the curing tank. Wet weight of the specimen is taken after 24 hours of curing. Hence the water absorption percentage was calculated by the formula mentioned above.

Density calculation

Bulk density of a blender is the mass(weight) of freshly mortar needed to fill the specimen of a unit volume. Density plays the major role in determining the capacity of concrete to work in the support of the structure, solute movement, water and durability. Depending up on the quantity and solidity of the aggregate, water, cement content and the amount of entrained air may vary the unit weight of the composites. Density can be calculated by dividing mass by volume, that is indicated by the unit kg/m^3.

Compression strength Test

The compression test (cube strength) was conducted by compression testing machine. The cube strength of the concrete could be a computation of the concrete's capability to with stand and resist loads. It's measured by applying load and crushing the specimens, executed in compression testing machine. Cube specimen of size 100mm x100mm x 100mm was used to determine the compressive strength of the composite. A total three No's of specimen were casted for every mix and tested after curing for 28 days. The specimen is demoulded and set down in compression testing machine where the axial load is applied gradually till the cube gets collapsed. The maximum deflection of load taken by the cube is determined as ultimate load. Fig 1 represents the micro cracks developed.

Fig 1. Crack pattern

Flexural strength test

The flexural performance of the LWECC mixes is measured by casting 3 No's of specimens in each mix. Prism specimens of size $40 \times 40 \times 160$ mm were tested under the Instron 5,982 with a capability of 100 KN. The specimen under goes three-point load bending test at the span of 100 mm spacing in between the supports were conducted to calculate the flexural strength. The test setup was followed ASTM C348-14,44. The specimens was tested after curing for 28 days. The specimen bends as shown in fig 2.

Fig 2. Flexural behavior

RESULTS AND DISCUSSION

Density of LWECC

It is found that the density is inversely proportional to the grinding(small) size of the vermiculite. Where the density decreases with increase in the grinding size of vermiculite as show in fig 3. The self-weight of PP fiber decreases about 8.9%.

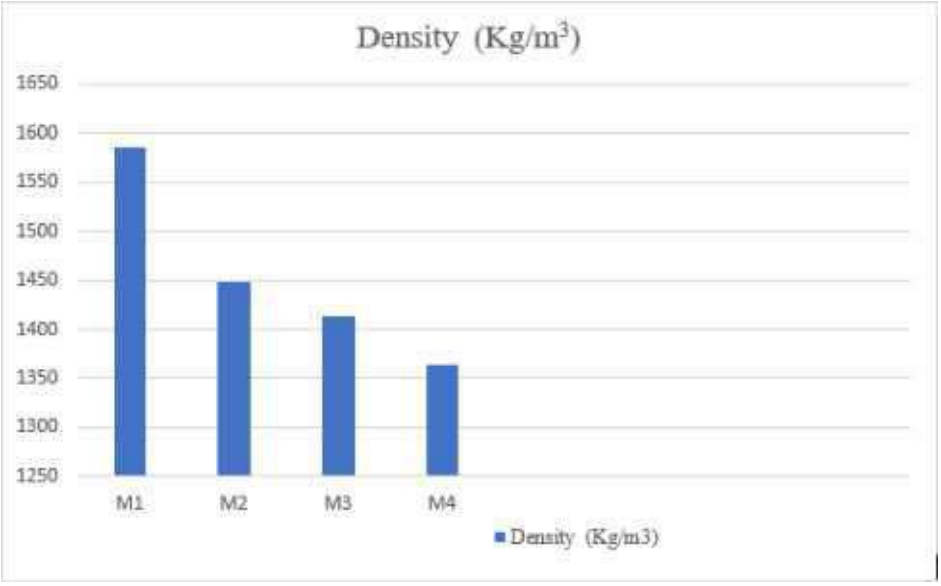

Fig 3. Density of conventional ECC

Water absorption test

This test was conducted to find out the amount of water that's absorbed by the specimens. On taking the dry weight of the cube specimen before keeping it inside the curing tank. Wet weight of the specimen is taken after 24 hours of curing. The output of water absorption test along with it's wet weight and dry weight of each mix was shown in table 7.

TABLE 7. Comparison of Actual and Theoretical Compressive Strength

Mix no	Dry Weight (kg)	Wet Weight (kg)	Water Absorption (%)
M1	0.840	0.890	5.6
M2	0.768	0.813	5.5
M3	0.795	0.835	4.7
M4	0.770	0.815	5.5

The average percentage of water absorption by the specimen was about 5.6%. The minimum percentage of water absorption by the specimen can be recommended up to 5.5% and the maximum is about 7%. So, the progressed LWECC can have the sufficient water absorption capacity.

Compressive strength test

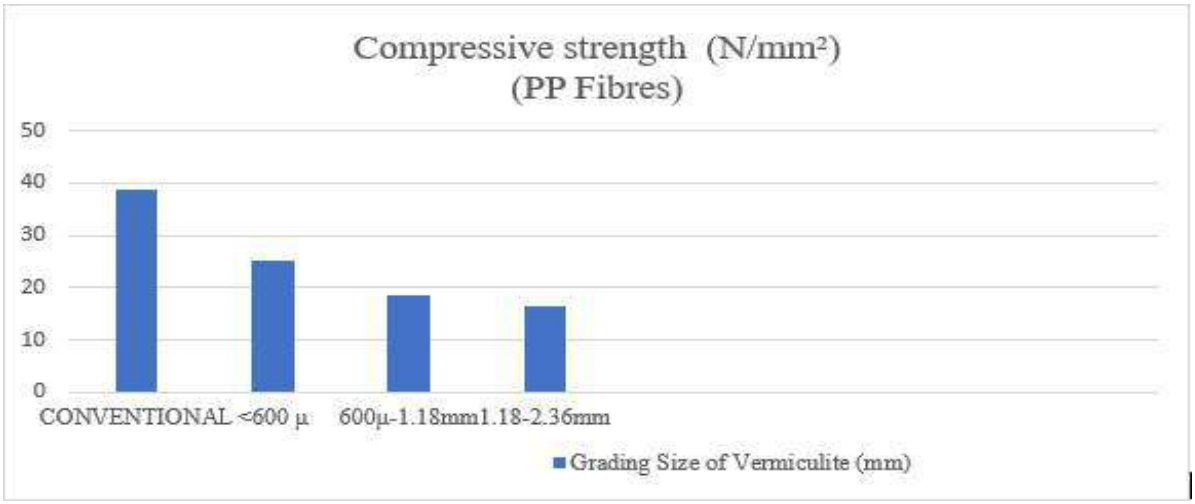

Fig 4. Compressive strength of PP fibers (28 days)

Fig. 4 shows the compressive strength of LWECC with PP fiber, in which the conventional mix attains a compressive strength of about 38.69 N/mm² and a mix containing vermiculite with grading size about 1.18-2.36mm attains a minimum strength of 16.46 N/mm². For the 2nd mortar mix, the grading size of fine aggregate (Vermiculite) was directly related to the compressive strength. i.e., the compressive strength increases with the minimum grading size of vermiculite. The compressive strength may also be increased due to the presence of polypropylene fibers about 1.75 %. However the compressive strength gets decreased by 41% when compared to the conventional specimen containing 0 % of vermiculite.

Flexural strength test

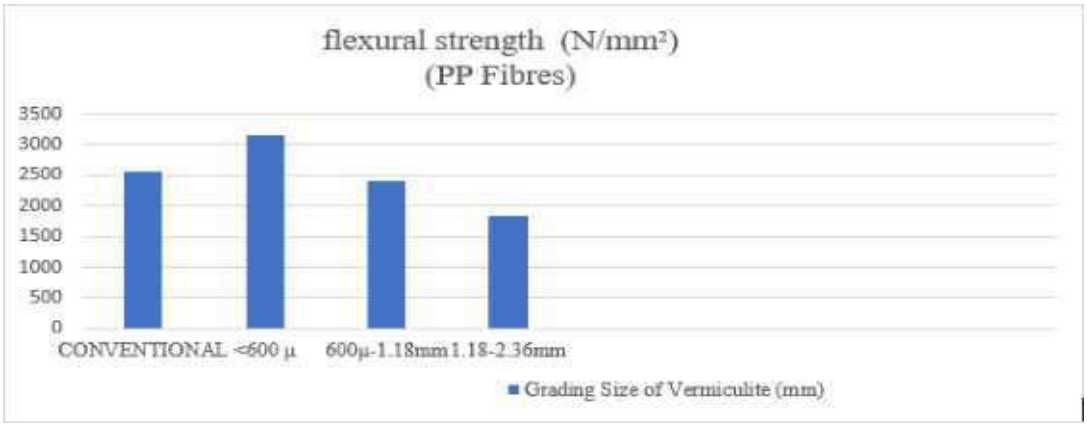

Fig 5. Flexural strength of PP fibers (28 days)

Fig. 5 shows the flexural strength of LWECC with PP fiber, in which the conventional mix attains a flexural strength of about 2570 N/mm² and a mix containing vermiculite with grading size about 1.18-2.36mm attains a minimum strength of 1850 N/mm². For the 2nd mortar mix, the grading size of fine aggregate (Vermiculite) was directly related to the flexural strength. i.e., the flexural strength increases with the minimum grading size of vermiculite. The flexural strength may also be increased due to the presence of polypropylene fibers about 1.75 %. However, the flexural strength gets increased by 31.54 N/mm² when compared to the conventional specimen containing 0 % of vermiculite.

CONCLUSION

In the present project, the mechanical properties and durability properties of Light Weight Engineered Composites (LWECC) were experimentally investigated, and the following conclusions were obtained.

- Light weight engineered cementitious composites (LWECC) was progressed with 10% replacement of fine aggregate have attained the density about 1400 Kg/m³ to 1500 kg/m³.
- The progressed LWECC have attained a water absorption volume of about 5 to 6 % and it's within the limit. Since, the specimen developed with minimum gradation (small size) of vermiculite attains minimal water absorption and shows better compressive strength.
- The obtained compressive strength of polypropylene fiber gets decreased by 41% when compared to the conventional specimen containing 0 % of vermiculite.
- The minimum gradation of the vermiculite plays a major role which influences the strength characteristics of LWECC. Both the compressive and flexural strength gets decreased as the size of vermiculite increased.

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Effects Of Different Loading Conditions On BS460B Steel Reinforcing Bar Using Multiphysics Modelling Technique

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Abstract. Nowadays, BS460B bar (steel reinforcing bar) also called as rebar are every useful to strengthen the concrete constructions and gives support to the constructions. In this study five samples of BS460B bars are developed using different loading conditions. This present article shows the simulation performed to investigate the effects of the different loads and corresponding von Mises stresses developed when the load is applied. This present article also investigated the total deflection under gone by the bars under different loading conditions. The effects of different loading conditions were evaluated in terms of the von Mises stresses (principal stresses), and the total displacement developed in the rebar steel. From the obtained results it is observed that on increasing applied load, von Mises stresses increases linearly with the load applied which is presented in the graph.
Keywords: BS460B, simulation, von Mises stress, Frequency, Loads.

INTRODUCTION

BS460B is also known as Rebar (steel reinforcing bar). Rebar can be drawn in to wires and rods. Rebar is used to strengthen the concrete constructions [1-2]. There is a wide range of application Rebar in construction fields like flyovers, bridges, dams, concrete rods, building industrial structures [3]. Rebar has many advantages like excellent fire resistance, flexibility in design, minimum maintenance [4]. There are some disadvantages associated with rebar like less corrosive resistance and can't able to resist the impact loads and vibration loads which leads to largest disasters like collapsing dams, bridges, flyovers and buildings [5]. To overcome such disasters rebar corrosive properties and load bearing capacities should be calculated by force vibrations analysis in BS460B steel bars [6]. In this study, the properties like density, poison ratio etc. are taken in to the considerations. Moreover, many researchers carried out investigation to how to increase mechanical properties of different materials such as copper alloy, titanium alloy, stainless steel and many difficult to fabricate materials by changing the different process parameters [7-12]. Researcher [13-14] performed simulation to study the effects of different loading conditions on the composite materials using COMSOL Multiphysics. The geometric model of the steel bar is developed in COMSOL and the force vibrations analysis on the bars is performed by using software COMSOL multi-physics. This study is done to find the different mechanical properties of BS460B steel bar to overcome the deflections and calculate load bearing capacities, various conditions and parameters are followed. Total displacement, stresses like von Mises stresses (principal stress) and maximum and minimum stress distribution the steel bars are evaluated.

MATERIALS AND METHODS

BS460B (steel reinforcing bar) also called as rebar this material is added to the cylindrical geometry. Cylinder is developed in the COMSOL multi-physics software, some of properties like density (kg/m^3), Young's modulus (Pa), Poison's ratio is taken in to considerations while material is added to the geometry. Frequency domain and Eigen frequency methods are used in this simulation techniques to get the desired results. Under the frequency domain, the maximum and minimum stresses developed in the cylindrical cross section is calculated. The stresses which can be calculated by the frequency domain are von Mises stress also called as principal stresses. The frequency domain is used to evaluate the stresses acting in different locations. Eigen frequency is also called as natural frequency are used for calculations of total displacement and the amount of deflection under different loading conditions. Total displacement or deflection is expressed in unit meters and millimeters. Figure 1 shows rebar

steel used in the construction. Whereas, table 1 shows different values of Eigen frequency and angular frequency used in this study.

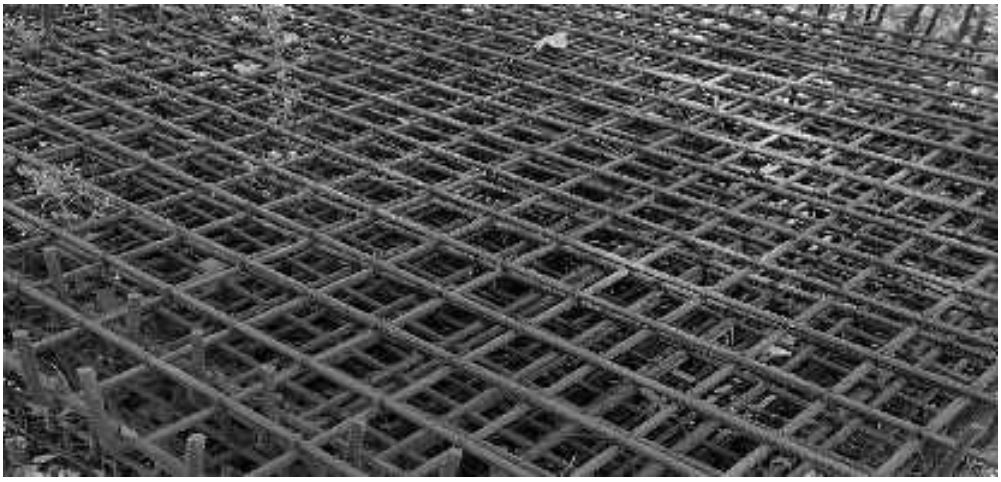


Fig. 1 BS460B (steel reinforcing bar) rebar bars used in construction

Table 1 Eigen frequency and angular frequency

Eigen Frequency (Hz)	Angular Frequency (rad/s)
1703.3	10702
1704.4	10709
2311.5	14525
3518.3	22106
3520.2	22118
3782.9	23769

MODELING AND SIMULATION OF COMPOSITE MATERIALS WITH COMSOL

Geometric model

In this study, the geometric model of cylindrical shape is developed using COMSOL Multiphysics software. The generated model is object type and solid, the cylindrical shape is developed with the required radius and height, the dimensions of the model is given in meters the generated model can be seen in the figure 2.

Boundary conditions and applied load

In this analysis, the boundary conditions are stated. One end is fixed, while the other is unrestricted. Different loads are given to the free end in an axial direction.

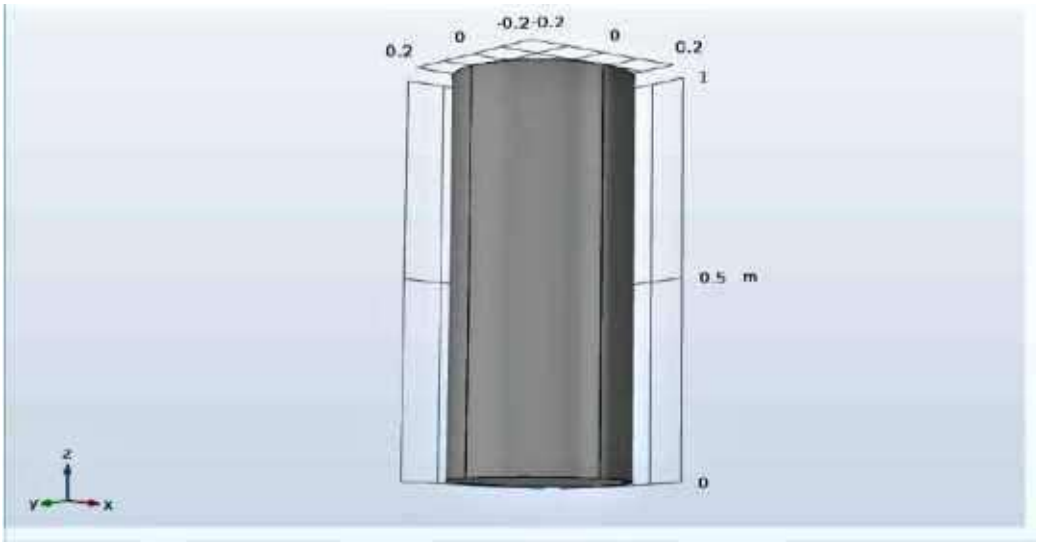


Fig. 2 CAD model of BES460B bar

Material parameters

The materials parameters like young's modulus, density, Poison's ratio, shear modulus, bulk modulus of the material considered for the simulation are listed in the table 2.

Table 2 Material properties of the rebar steel

Property	symbol	Units	Value
Density	rho	kg/m^2	2
Young's modulus	E	pa	13e9
Poisson's ratio	nu	1	1
Bulk modulus	K	N/m^2	15
Shear modulus	G	N/m^2	4.2e9

RESULTS AND DISCUSSION

During the simulation of the model, several loading circumstances are shown in Tables 3 and 4. For different samples investigated, the evolution of von Mises stress (primary stress) and deflections, solid material von Mises stress, through-thickness von Mises stress, and line graph of von Mises stress and total displacements in the solid model were all examined.

Prediction of von Mises stress and Total displacement

Many academics have recently used von Mises methods to investigate virtual stresses created in models because of the application of loads. The von Mises stresses are created in the model and projected as shown in Figure 3 (a) of different samples in this study. The greatest values of the von Mises stress in the current model are 306 kN/m^2, while the smallest values of the von Mises stress are 10.2 kN/m^2, matching to the variance in the applied load as shown in table 2. The consequences of the

various loads applied during the simulations are shown in Figure 3 (b). In the developed model, increasing the loads causes von Mises stress to grow as well. The maximum tension in the model may be seen at the red-colored fixed end. Figure 3 (s) indicated deflection occurred in the model during the simulations with the different loading conditions. In this investigation the total deflection is considered as total displacement, and it observed that as the load increases, the total displacement increases as presented in the figure 3 (d). Moreover, figure 3 (e) shows slice view of the bar after simulation with different loads.

Stress Prediction

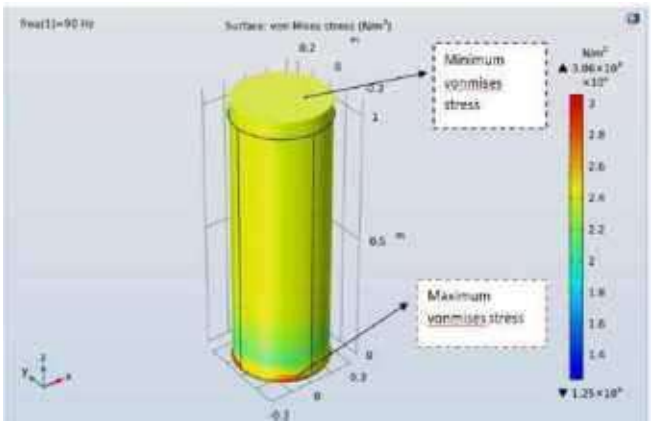
Many academics have recently used von Mises methods to investigate virtual stresses that emerge during load application. The von Mises stresses, as well as the interface of the laminates, are anticipated in this study, as shown in the figure for several samples. The maximum value of von mises stress is 5KN/mm2 and the minimum value is 2KN/mm2 as shown in this diagram, correlating to variations in the applied load as shown in the table. The fixed end, which is highlighted in red in the diagram, has the highest stress. Figure 3 depicts the many forms of von Mises stresses that emerge during the loading in the simulation.

Table 3 Applied load and von Mises stress

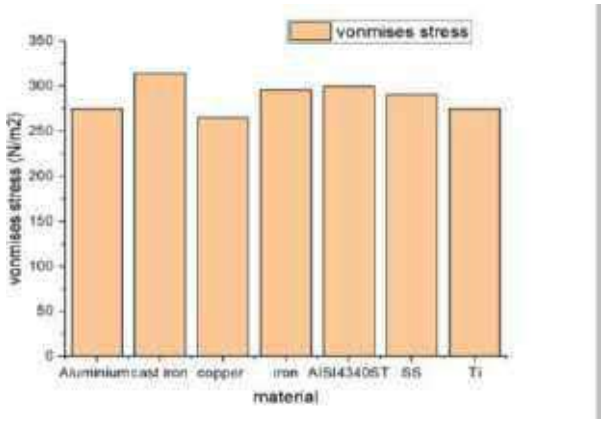
Sample No	Load (N)	von Mises stress (kN/m^2)
1	1000	10.2
2	1500	15.3
3	2000	20.4
4	2500	25.5
5	3000	30.6

Table 4 Applied load and total displacements

Sample No	Load (N)	Total displacement (mm)
1	1000	0.00149
2	1500	0.00148
3	2000	0.00147
4	2500	0.00146
5	3000	0.00145



(a)



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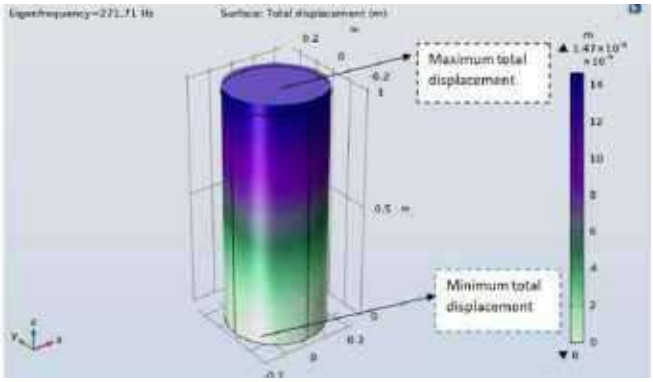

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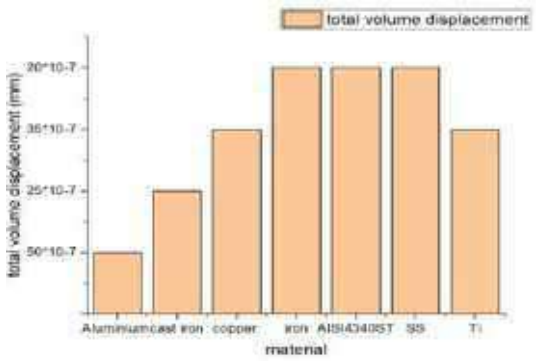

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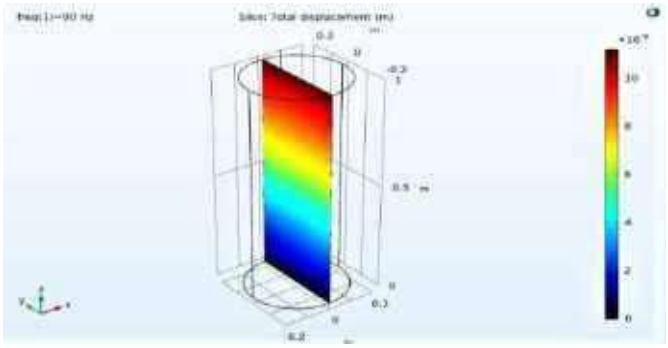

(e)

Fig. 3 (a) Von Mises stress developed in the bar (b) Von Mises stress graph (c) Total displacement in bar (d) Total displacement graph (e) Slice view of the bar

CONCLUSIONS

The BS460B bar is utilized in this study to investigate the impacts of various loading circumstances. COMSOL Multi-physics software was used to run all the simulations. The effects of various loading circumstances on von Mises stresses and total displacements are presented in this study. The following are the findings of this investigation:

- Near the fixed end of the bar, the surface von Mises stress (or) primary stress reaches its highest value.

- Near the free ends, the total displacements (or) total deflections reach their maximum values.
- As the load in different samples is increased, the von Mises stress values grow linearly.
- At the maximum load application, the maximum deflection and total displacement are observed.

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Investigation On Effects Of Variation Of Applied Load On Helical Bevel Gear Made Of Different Materials Using Simulation Technique

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Abstract. Gears are the devices used to transmit power even with high torque. Gears are damaging due to different loads applied on the teeth and heat generated in transmission. Usually, gears are made of different materials. In this study, force vibrational analysis is done on the helical bevel gear for different materials such as Aluminum, cast iron, copper, iron, steel, titanium. In this investigation, different material is selected for manufacturing of gears which can sustain even under the different loads and impact loads. Simulation is performed to analyse the effect of the application of loads on various materials. The stresses developed by the application of loads is von Mises stress and the total deflection in the gear. It is reported that with the variation of the loads being applied, von Mises and displacement both changes linearly with the load applied.
Keywords: Gears, simulation, von Mises stress, Deflection, Load.

INTRODUCTION

Gear has a wide range of applications in the automobile industries, the main purpose of gears is to transmit power [1-2]. Usually, gears are made up of different materials like steel, brass, bronze, cast iron, ductile iron, Aluminum, powdered metals, and plastics [3]. Even though gears are capable to transmit high torque and increased efficiency [4]. There are some disadvantages like damaging the gears when excessive and impact loads are applied. Breaking of gear teeth and gear teeth wear decreasing the life span of gear teeth [5-6]. Many researchers investigated how to increase the mechanical properties of different materials such as copper alloy, titanium alloy, stainless steel, and many difficult to fabricate materials by changing the different process parameters [7-12]. Researcher [13-14] performed a simulation to investigate influence of load being applied on the composite materials using COMSOL Multiphysics. In this study, forced vibrations analysis is carried out for helical bevel gear using different materials under fixed loads. The properties of different materials are studied and applied as the gear materials. The geometric model of helical bevel gear is developed in SOLIDWORKS software and the force vibrations analysis of helical bevel gear is performed using COMSOL Multiphysics software. Properties of various materials such as Aluminum 6063-T83, cast iron, copper, iron, steel AISI4340, titanium beta-21s, structural steel is studied. In this study, investigation on the effects various loading condition on the mechanical properties of different materials were performed. Results of this investigation were evaluated in terms of stresses like von Mises stresses (principal stresses), total displacement, and maximum stress distribution in the materials.

Materials and Methods

The material which is used in this study includes Aluminum 6063-T83, cast iron, copper, iron, steel AISI4340, structural steel, Titanium beta-21s. These materials are added to the geometry in the COMSOL Multiphysics software and the geometric model is developed using solid works software. The properties like density, young's modulus, Poison's ratio is considered for all these mentioned materials. The methods followed in this study include the Eigen frequency and frequency domain. Under the Eigen frequency method, the total vibration and deflection in the material are evaluated. Total deflection and displacement are calculated using Eigen frequency. The total displacement and deflection are expressed in meters and millimeters. Total displacement is calculated for all the mentioned materials. In the frequency domain, the minimum and maximum stresses are

developed in the helical bevel gear were evaluated in terms of von Mises stresses. Stresses in different materials and at a different section in the parts are calculated by frequency domain.

Table 1 Eigen frequency and angular frequency

Eigen Frequency (Hz)	Angular Frequency (rad/s)
111.43	700.16
111.46	700.32
125.65	789.49
254.61	1599.8
254.64	1600.0
315.27	1980.9

MODELING AND SIMULATION OF HELICAL BEVEL GEAR

Development of CAD model

The geometric model is developed using SOLIDWORKS 3D CAD software by including different commands like extrude, loft, extrude cut, trimming, mirroring, and generating planes in the software. The geometric model is developed as per the required dimension and is presented in the figure 1. The helical bevel gear simulation was done by considering different parameters in COMSOL Multiphysics software.

Boundary conditions and applied load

The boundary condition in this force vibrational analysis includes the body part as the fixed constraint and the other end as free. The load is applied to the gear teeth perpendicularly.

Material parameters

The properties of material like density, Young's modulus, Poison's ratio, shear modulus, the bulk modulus is considered for the simulation and listed in Table 2.

Table 2 Properties of different materials for bevel gear

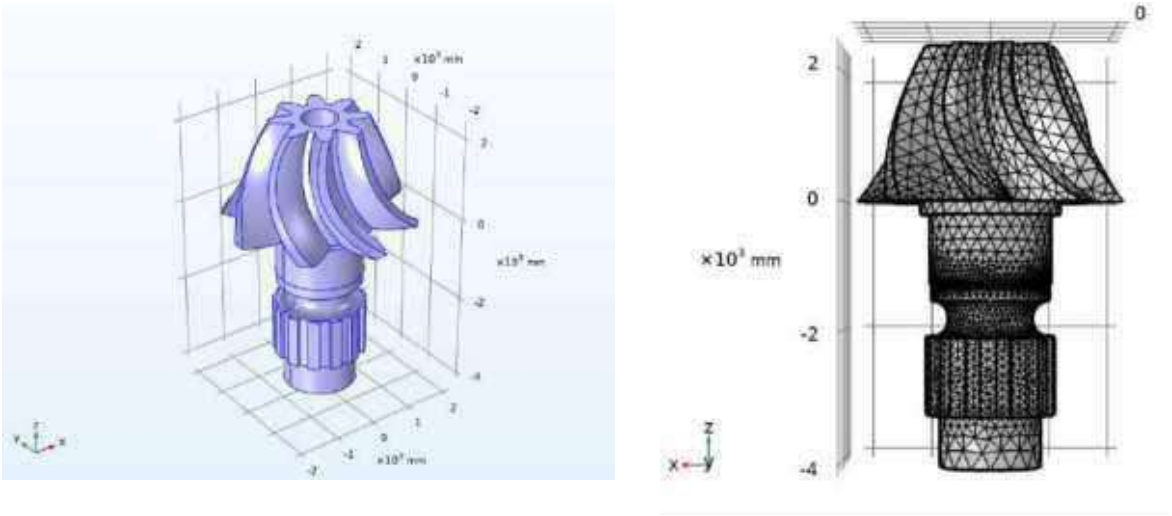

Fig. 1 Different view of the geometric developed

Property	Aluminium 6063-T83	Cast iron	Copper	Iron	Steel AISI4 340	Structural steel	Titanium beta-21s	Units
Density	2700	7000	8960	7870	7850	7850	4940	Kg/m^3
Young's modulus	69e9	140e9	110e9	200e9	205e9	200e9	105e9	Pa
Poisson's ratio	0.3	0.25	0.35	0.29	0.28	0.30	0.33	1

RESULTS AND DISCUSSION

Prediction of von Mises stress and Total displacement

Table 2,3 presents the loads to be apply in during the study, predicted von Mises stresses, and total displacement in the gears for different samples. In recent studies, different investigators used the von Mises methods for the prediction of the virtual stresses induced in the material during different application of various loads. Present examination focused on prediction of von Mises stresses in materials of the different samples made of different materials. From this investigation, it can observe that maximum and minimum stresses as 314 N/m^2 and 265 N/m^2 respectively. Whereas the maximum and minimum stresses are represented using different colors.

Table 2 Applied loads and corresponding von Mises stress induced in the bevel gear

Sample material	Loads (kN)	Stress (N/m^2)
Al6063-T83	1.50	275
Cast iron	1.50	314
Copper	1.50	265
Iron	1.50	296
SteelAISI4340	1.50	300

Structural steel	1.50	291
Ti-beta-21s	1.50	275

Table 3 Applied loads and total displacements

Material	Loads (N)	Total displacement (m)
Al6063-T83	1.50	$5*10^{-6}$
Cast iron	1.50	$25*10^{-7}$
Copper	1.50	$35*10^{-7}$
Iron	1.50	$20*10^{-7}$
SteelAISI4340	1.50	$20*10^{-7}$
Structural steel	1.50	$20*10^{-7}$
Ti-beta-21s	1.50	$35*10^{-7}$

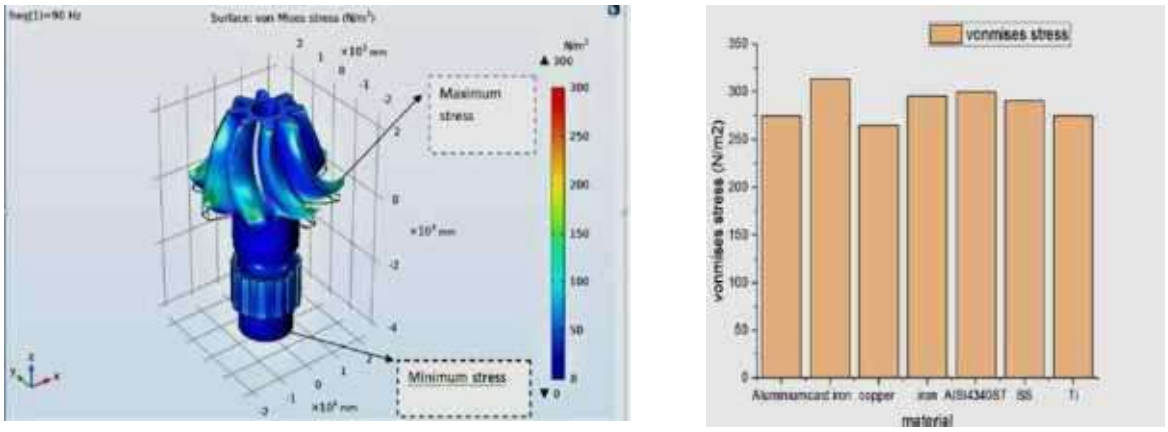

Fig. 2 (a) Stress distribution in the helical bevel gear (b) Effects of different material properties on the stress-induced in the gear

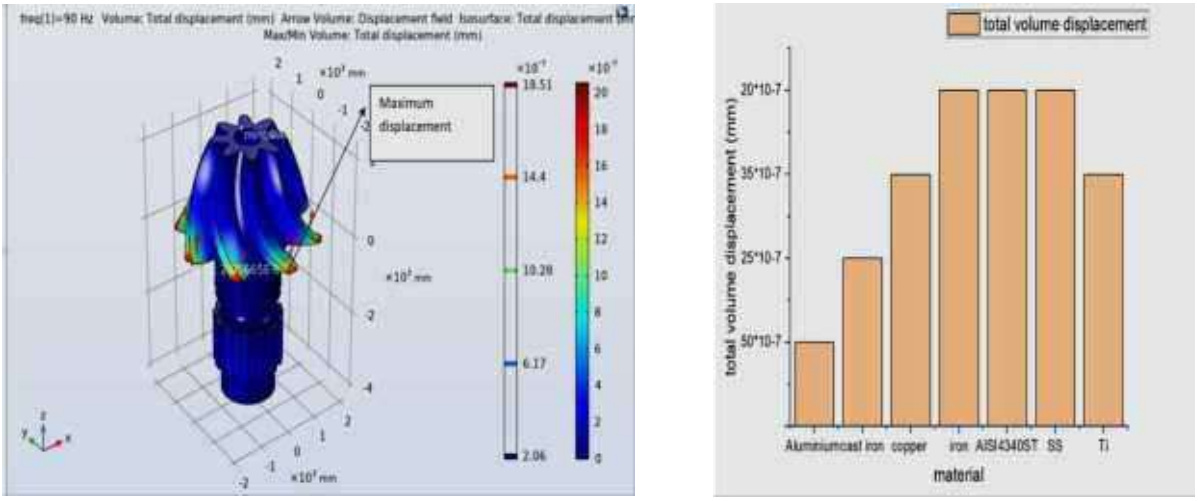

Fig. 3 (a) Total displacement in helical bevel gear (b) Effects of loading on the total displacement

Influence of various loads on von Mises stress

As the loads are varied during the study, the von Mises stress varies with the load along with the teeth of gear which are represented in the figure 2 (a) and Effects of different material properties on the stress-induced in the gear is presented in the figure 2 (b). Whereas figure 3 (a) presents total displacement induced in the helical bevel gear and 3 (b) Effects of loading on the total displacement. As the investigation is done under fixed loading conditions for different types of materials, the von Mises stresses developed in gear are based on the material properties. It is observed that the material which has the highest von Mises stresses is known as the highest load-bearing material. Figure 4 shows effects of variation of different materials on the von Mises stresses induced in the gear.

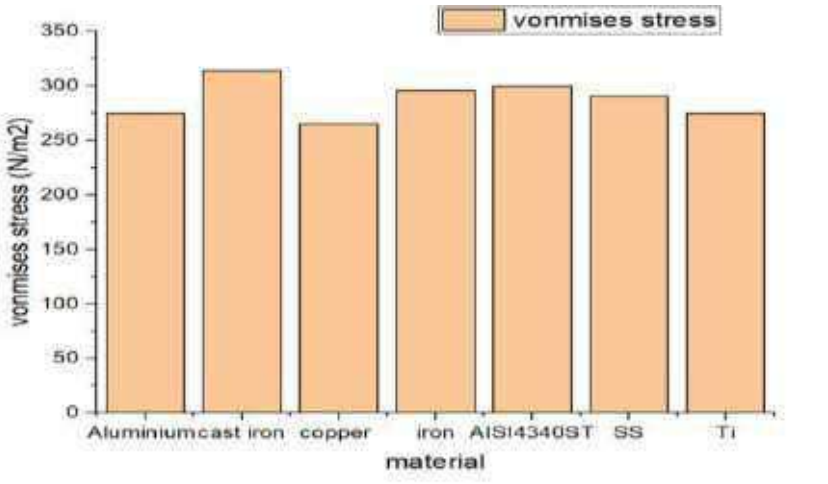

Fig. 4 Effects of variation of different materials on the von Mises stresses induced in the gear

CONCLUSIONS

In this study, the helical bevel gear is made of different materials under fixed load conditions, to investigate the effects of load in different materials on the helical bevel gear. This study presents the different von Mises stresses and total displacements which are developed in the different materials the following conclusions are drawn from this investigation:

- It is observed that the maximum values of the surface von Mises stress induced near the teeth of the helical bevel gear.
- The maximum total displacement or total deflection is observed at the body of the helical bevel gear.
- In the different materials used in this investigation, different stresses and deflections are developed according to their mechanical properties.
- The material in which high stress developed is considered as the highest load-bearing material.
- Materials like iron, steel AISI4340, structural steel have the highest load-bearing capacity.

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Impact Of The Infills On The Mechanical Properties Of 3D Printed ABS Material

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Abstract. The day to day challenge for engineers and academicians in Additive Manufacturing process is to identify the right infill shape to strengthen the material. Sample fabrication was done by 3D printing techniques using ABS material. The influence of print parameters and the specific effect of various infill shapes on the mechanical properties of ABS material needs to be examined. The strong and durable structure is created by the infill pattern in the print. The hardness of the ABS polymer material with Cross 3D infill shape shows maximum hardness and minimum Yield strength and Ultimate Tensile Strength. The ABS material also shows minimum hardness with zig-zag and triangle infill shapes and maximum elongation with Tri-hexagon. The triangle infill shape showed minimum elongation and maximum young's modulus and Ultimate tensile strength. The tri-hexagon infill shape showed maximum elongation and yield strength.

Keywords: Additive Manufacturing, Fused Deposition Modeling, infill shapes, Microstructure analysis, Mechanical properties

INTRODUCTION

Additive manufacturing (AM) or three-dimension (3D) printers are designed as component production machine by assembling printable materials into their layers. Fused Deposition Modeling (FDM), Direct Ink Writing (DIW), Stereolithography (SLA), and Selective Laser Sintering (SLS) are the various 3D printing methods that are currently in use. One of the most widely used printing techniques of all of the available methods is Fused Deposition Modelling (FDM), as it is of relatively low cost [1]. The FDM process creates high control on the mechanical characteristics by various printing factors like filaments that using, layer height, layer orientation, shells number, height between platform and nozzle, etc. Liu and Jiang, Xu, and Stringer stated in their research that the FDM process has a limitation, this process requires support structures for the assistance of overhang, edge or hole features resulting in material wastage and an increase in the printing time. Jiang, Stringer and Xu 2018, Johnson and French in their work, examined the impact of infills on the mechanical properties in FDM.

AM is a process of modelling any image from the CAD data, "AM process tessellates solid CAD data into thin layers that are later manufactured layer by layer until the final solid geometry is achieved. The basic components of the AM process can be Solid Polymers, Liquid Polymers or Powder depending on the process type" [2].

Berman 2012; Chulilla Cano 2011; Espalin et al. 2014; Chua et al. 2003 in their work stated that there is wide progress in the 3D printing technology, starting from prototype culture to the production of final parts intended for everyday use. Advanced applications include the usage of the Shape Memory Polymer (SMPs) filaments for the printing of adaptive structures (Ge et al. 2014; Ge et al. 2013; Raasch et al. 2015; Yang et al. 2015; Bhattacharjee et al. 2015).

Scientists explored the impact of processing factors on regular specimens to identify filament materials like Nylon, Polylactic Acid, thermoplastics and Acrylonitrile Butadiene Styrene in the initial step of FDM [3-4]. Most of the research work has been carried out on 4 infill patterns namely triangle, rectilinear, line and honeycomb to find out the outcomes of the infill pattern and densities on the mechanical properties. So far, any noticeable research has not been conducted on all the infill patterns available. The present paper mainly focuses on the effect of the parameters of FDM on the mechanical characteristics of 3D printed material by utilising ABS material. The factors involved in this study were percentage infill 20% and the thickness of a layer at 0.1 mm. Different infills were taken into consideration and by taking each infill shape as a variable, and keeping the other factors like infill density and layer thickness constant, the specimens were prepared and tested according to the required standards. Printing time also varied depending on the infill shapes. Infill pattern makes a big difference in quality. This research work is carried out to identify the best infill pattern and to find out the printing time for each sample, also to study the effect on the mechanical behaviour of the specimens with the varied infill. It was proved from the previous work that the "Concentric pattern" showed the best elongation [5].

Abbreviations:

3D - Three- dimensional

AM - Additive manufacturing
FFF - Fused Filament Fabrication
ABS - Acrylonitrile Butadiene Styrene
ASTM - American Society for Testing materials
CAD - Computer-aided design
FDM - Fused deposition modelling
RP - Rapid prototyping
STL - Stereolithography
UTM - Universal Testing Machine

METHODOLOGY

Material selection

In the present study, ABS filament is used to find out the effects of various infill patterns under quasi-static tensile loading. The ABS material specifications are considered to print the material with different shapes as shown in Table 1.

Table 1: Material Specifications

Specifications	ABS
Color	White
Density (g/cm^3)	1.06 – 1.08 g/cm^3
Content(vol)	100% ABS
Filament diameter(mm)	2.85 mm
Filament weight(kg)	750 gms per spool
Extruder temperature (^{0}C)	200 -220
Bed temperature (^{0}C)	65 – 85

In this study, the mechanical properties of ABS material is influenced by the various infill shapes was analyzed. The Ultimaker 3D Printer is used in the present work to print the ABS material of different shapes with an infill density of 20% and layer height 0.1mm as shown in Table 2.

Table 2: Parameter's selection in the process

Fixed parameter	Ultimaker Printer
Infill density	20%
Layer height	0.1mm
Filament material	ABS

Experimental work

The 3D printed samples were fabricated using Ultimaker S5 3D printer, which has a huge build capacity as shown in Figure 1. All the industrial-grade parts can be delivered within less time. The printer had a simple setup, reliable dual extrusion and high uptime. The volume of the printer is 330 x 240 x 300 mm. Various infill patterns like triangles, octet, lines, zigzag, grid, concentric, gyroid, tri-hexagon, cubic, cross 3D and Cross patterns were set from the infill function of Cura slicing software.

Figure 1: Ultimaker S5 3D Printer

Usually, the FDM process requires support structures results in wastage of the materials and also printing time. But during the printing of these samples, supports are not used as it is a flat surface. The tensile tests were done according to ASTM D-638 standards as shown in Figure 2. Mechanical testing like tensile strength testing, elongation, and elastic modulus was conducted according to ASTM D-638 standards. The sample design was done in design software Autodesk fusion 360 software.

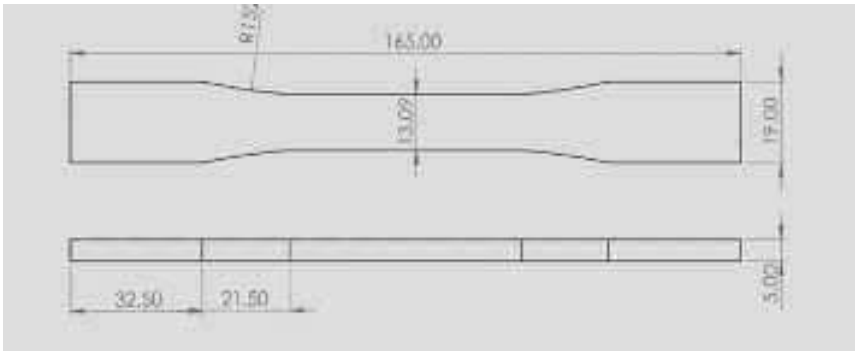


Figure 2: Tensile test specimen

3D Printing procedure

The specimen is modelled in "Auto desk Fusion 360 Software" according to the ASTM D-638 Specifications. 3D modelled (CAD) object is exported in Stereolithography (.STL) format and then uploaded in slicer program. Here the model is cross-sectioned into the specified height of individual layers, converts some settings like required height and a few others into G-Code, which is used to print the required specimen. ABS is the material that is used in the preparation of samples in the Ultimaker 3D-Printer. The design of the Specimen was done according to the ASTM D-638 specifications, as it measures various tensile properties.

The Ultimaker S5 used a slice height of 0.1mm and the printing temperature was held constant i.e., 240^0C. Build plate temperature was maintained as 85^0C during printing. Apart from the printing temperature and build temperature, slice height, nozzle size and color of the material were kept constant during the experimentation. Printing speed was 55mm/sec. All the specimens were modelled in the same way using other infill patterns. The thickness of the top layer and the bottom layer was 1.2mm. Wall thickness was 1.3mm, the top and bottom layers were each 12.

Tensile testing

The tests were performed on a Universal Testing Machine (UTM) as shown in Figure 3. The UTM powered by a 22kN load cell was utilized for tensile testing of the example. The specimen is placed perpendicular to the jaw faces. Specimen's tensile testing was done at a strain rate of 50mm/min. After loading the specimen in that fixture, the sample adjustment combination is secured by multiple clevis joints. At the first, a load of 10 N is applied, and the VIC-Snap software is used to take reference images on both sides of the sample. The software is set at 1 Hz, while on the other hand the test machine is set at a transmission rate of 1.5 mm/min. Both the components of the test equipment and the Digital Image Correlation have been in operation for some time and the testing is done with model failure. After the specimen has failed, the testing process is completed and repeated. After performing ten experiments, the appropriate structures are determined and the stress-strain curves of all types are analyzed.

Figure 3: Sample loaded in the UTM

Micro hardness

The hardness of various infill shapes of ABS material measured using hardness tester of model ECONOMET VH-1 MD with a testing force of 10gf to 1000gf as shown in Figure 4. The hardness tester consists of the Hardness Measuring Range 8-2900 HV with a resolution of 0.0625 Microns. The hardness of the ABS material with various infill shapes as shown in Table 3.

Figure 4: Micro Hardness Tester

Table 3: Hardness of various infill shapes

S.No.	Sample	Infill Structure	Micro hardness (25 Kgf)		
			Value 1	Value 2	Avg. Value
1	S-101	Triangles	6.4	7.3	6.85
2	S-102	Octet	6.0	4.9	5.45
3	S-103	Lines	8.5	9.2	8.85
4	S-104	Zigzag	4.9	5.6	5.25
5	S-105	Concentric	7.1	8.2	6.15
6	S-106	Gyroid	8.7	7.2	7.95
7	S-107	Tri hexagon	7.4	8.9	8.15
8	S-108	Cubic	8.0	8.2	8.1
9	S-109	Cross 3d	9.1	8.7	8.9
10	S-110	Cross	7.5	7.1	7.3

Microstructure Analysis

The microstructure of ABS material of various infill shapes and printing modulation in 3D printer is analyzed using 3D Microscope of HRM 300 model and make Huvitz, South Korea as shown in Figure 5.

Figure 5: 3D Microscope

RESULTS AND DISCUSSION:

It is found that infill shapes greatly influence the mechanical properties of the specimens as shown in Figure 6. The following mechanical properties are extracted from the current work:

- The least elongation of the specimen occurred at triangle infill which is 5.98%.
- Lines and Cross infill showed the same elongation values which are 6.76%.
- The Youngs Modulus of the infills were maximum at triangles infill structure with a value of 426.99 N/mm^2. The next maximum value occurred at the concentric infill structure with 416.46 N/mm^2. Whereas the least Youngs Modulus occurred in cubic infill structure with 388.56 N/mm^2.
- The Yield Strength of the specimen was maximum with Gyroid infill with 17.7 N/mm^2, second maximum value occurred at concentric infill structure with 17.47 N/mm^2. The lowest yield strength was observed at Cross 3D infill with 13.76 N/mm^2.
- The Ultimate tensile strength of the specimen was found to be maximum at triangle infill with 18.31 N/mm^2.
- There is not much variation in the printing time of the infill's. However, the printing time of the "concentric" infill pattern was the least.

The least Elongation occurred in the triangle infill pattern, which concludes that is the best infill pattern.

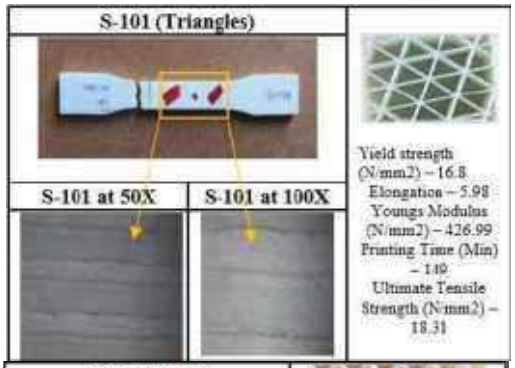
Triangle infill has a very low elongation. The deformation rate is low, they provide the best support structure behind the walls of the part. Printing time of the triangle infill is relatively quick due to the reason that the printhead travels mostly in straight lines across the part. A combination of strength and speed makes triangular infill one of the best infill choices for 3D printing. It may be due to the reason that it offers great strength and high lateral loads. This infill is used when good wall strength or long slender structures are needed. Strength is also in an equal amount in each direction in the triangle infill. It has great shear-resistance.

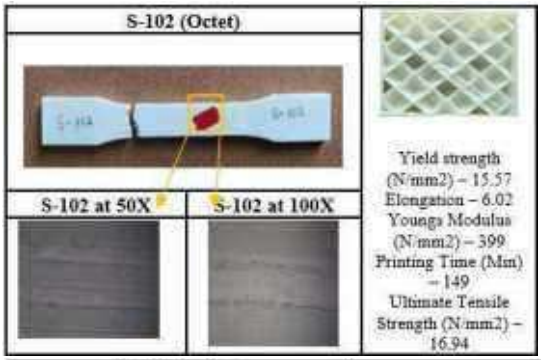
Triangle infill has trouble regarding flow interruptions. This is the reason that high infill densities have low relative strength. So preferably low infill densities are chosen with triangle infill. The triangle infill showed the best results not only for elongation but also for tensile strength and Young's Modulus.

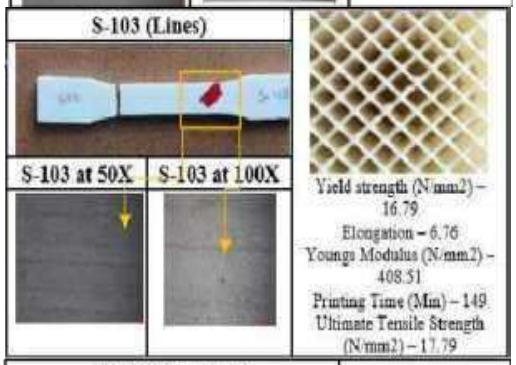
Gyroid infill has the maximum yield strength, as it is equally strong in all directions, even though it is not the strongest of all the infill patterns. It has good shearing resistance. This infill has a longer slicing time and creates large G-Code files.

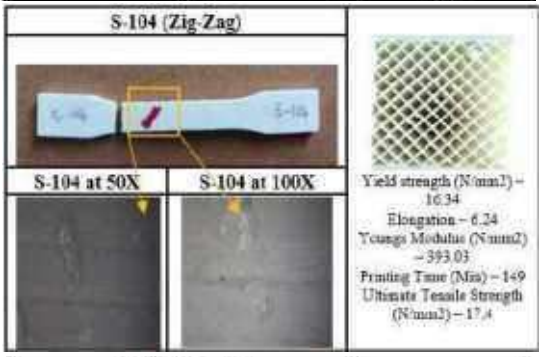
Microstructures of various infill shapes of ABS material are observed under the microscope of 3D printed material. Most of the printed material with various infill shapes during 3D printing process is not in order. The order of printing influenced with solidification time and temperature. The order may not be influenced much on the mechanical properties.

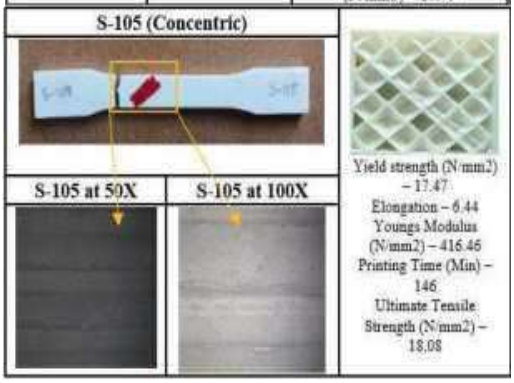
Microstructure and Mechanical properties triangle, Octet, Line, Zig-Zag, Concentric, Gyroid, Tri-hexagon, Cubic, Cross – 3D and Cross of infill shapes of ABS material.

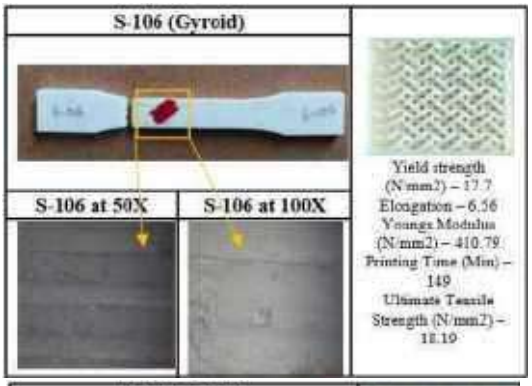

S-101 (Triangles)
S-101 at 50X
S-101 at 100X
Yield strength (N/mm2) – 16.8
Elongation – 5.98
Youngs Modulus (N/mm2) – 426.99
Printing Time (Min) – 149
Ultimate Tensile Strength (N/mm2) – 18.31

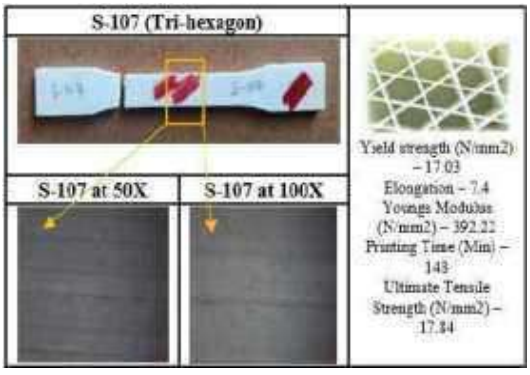

S-102 (Octet)
S-102 at 50X
S-102 at 100X
Yield strength (N/mm2) – 15.57
Elongation – 6.02
Youngs Modulus (N/mm2) – 399
Printing Time (Min) – 149
Ultimate Tensile Strength (N/mm2) – 16.94

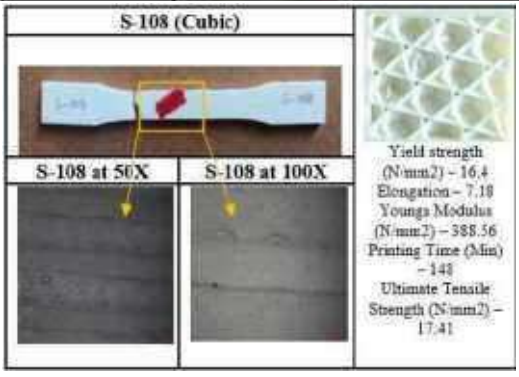

S-103 (Lines)
S-103 at 50X
S-103 at 100X
Yield strength (N/mm2) – 16.79
Elongation – 6.76
Youngs Modulus (N/mm2) – 408.51
Printing Time (Min) – 149
Ultimate Tensile Strength (N/mm2) – 17.79


S-104 (Zig-Zag)
S-104 at 50X
S-104 at 100X
Yield strength (N/mm2) – 16.34
Elongation – 6.24
Youngs Modulus (N/mm2) – 393.03
Printing Time (Min) – 149
Ultimate Tensile Strength (N/mm2) – 17.4


S-105 (Concentric)
S-105 at 50X
S-105 at 100X
Yield strength (N/mm2) – 17.47
Elongation – 6.44
Youngs Modulus (N/mm2) – 416.46
Printing Time (Min) – 146
Ultimate Tensile Strength (N/mm2) – 18.08


S-106 (Gyroid)
S-106 at 50X
S-106 at 100X
Yield strength (N/mm2) – 17.7
Elongation – 6.56
Youngs Modulus (N/mm2) – 410.79
Printing Time (Min) – 149
Ultimate Tensile Strength (N/mm2) – 18.19


S-107 (Tri-hexagon)
S-107 at 50X
S-107 at 100X
Yield strength (N/mm2) – 17.03
Elongation – 7.4
Youngs Modulus (N/mm2) – 392.22
Printing Time (Min) – 143
Ultimate Tensile Strength (N/mm2) – 17.84


S-108 (Cubic)
S-108 at 50X
S-108 at 100X
Yield strength (N/mm2) – 16.4
Elongation – 7.18
Youngs Modulus (N/mm2) – 388.56
Printing Time (Min) – 143
Ultimate Tensile Strength (N/mm2) – 17.41

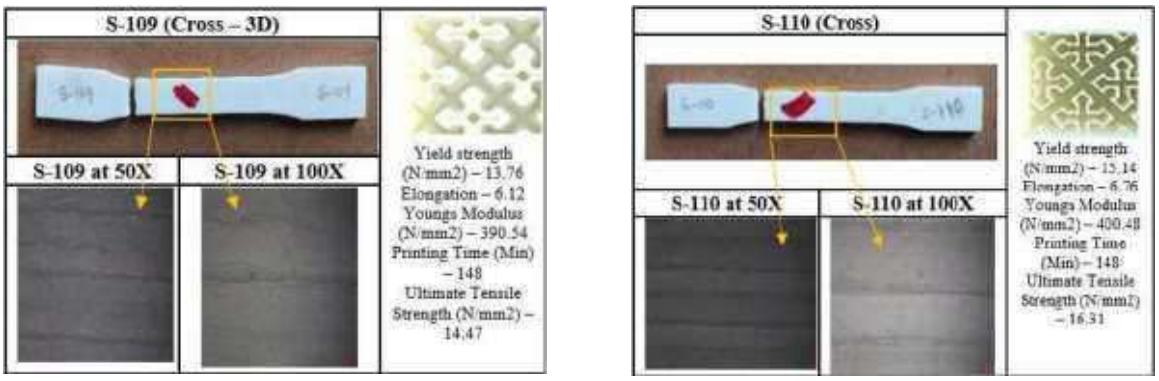


Figure 6: Microstructure and Mechanical properties of various infill shapes of ABS material

CONCLUSION

- The hardness of the ABS polymer material with Cross 3D infill shape shows maximum hardness and minimum Yield strength and Ultimate Tensile Strength.
- The ABS material also shows minimum hardness with zig-zag and triangle infill shapes and maximum elongation with Tri-hexagon
- The triangle infill shape showed minimum elongation and maximum young's modulus and Ultimate tensile strength
- The tri-hexagon infill shape showed maximum elongation and yield strength.
- Microstructures of various infill shapes of ABS material are observed under the microscope of 3D printed material. Most of the printed material with various infill shapes during 3D printing process is not in order.

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Shear Behaviour of Cement Treated Sand

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Abstract. Various boundaries e.g., concrete substance, concrete sort, relative thickness, and grain size dissemination and can impact the mechanical practices of established soils. In the current investigation, a progression of customary unconfined pressure tests and direct shear tests were led on an established ineffectively reviewed sand cement blend. Portland cement utilized as the solidifying specialist was added to the poor sand at 0%, 1%, 2%, and 3% (dry weight) of sand. Tests were set up at 70% relative thickness and tried. The examination work shows that treatment of concrete builds attachment and interior rubbing point. The restoring period assumes a significant job in an increment of attachment and inner rubbing point.

INTRODUCTION

It has for some time been seen that tree roots and vegetation successfully improve the shear strength of the soil. Early endeavors to build soil strength by blending it in with different materials go back 3000 years to the development of ziggurats. This pattern has proceeded to ongoing years with the use of geo-artificial materials. Methods, for example, grouting and counterfeit cementation have been broadly used to build the bearing limit of establishments and for ground improvement. Strength prerequisite is a fundamental reason in designing uses of geotechnical materials; in this way, assessment of the strongest attributes of geotechnical materials is critical. In this investigation, Unconfined pressure tests and Direct shear tests are led to survey the impacts of establishing specialist content on the shear strength of a material. Cementation happens because of the different land measures that make connections between soil particles like maturing, compound responses, carbonates, silicates, iron oxides, and characteristic establishing specialists.

METHODS AND MATERIALS

In this investigation, writings identified with this venture are gathered and examined. Tests, for example, sand and concrete are gathered. Form and test for direct shear test and unconfined pressure test are readied. Tests are set up with changing concrete substance, for example, 1%, 2%, 3% utilizing 7% refined water. 70% relative thickness is kept up for all the examples. 6 examples are arranged and tried for the unconfined pressure test and 9 examples are arranged and tried for the direct shear test. Form for unconfined pressure test is set up by utilizing lines and braces. Shape for the direct shear test is set up by utilizing pressed wood. Arranged examples are tried for 7 days and 21 days relieving. To discover the list properties of the gathered example, for example, explicit gravity, relative thickness, soil grouping, union, point of inner contact, unit weight, and so on, appropriate tests are directed. Direct shear and unconfined pressure tests are led to tests with changing concrete substances. Results are deciphered and the report is readied.

Soil

The soil is sieved (to size under 600 μm) utilizing strainer and afterward sundried to cut down the dampness substance to around 0 %, to blend in with concrete in a uniform way. The designing and record properties, for example, explicit gravity, strainer investigation, direct shear, unconfined compressive strength, relative thickness, and so forth of the specific soil chose for this examination are resolved in the lab. The properties of the soil were gotten.

Table 1: Characteristics Of Soil

Soil Classification	**Poorly Graded Sand**
Specific gravity	2.621
Unit Weight(kg/m^3)	1.573
The angle of internal friction	$35^0$36'
Relative density(%)	52.89

Cement

Standard Portland cement of 53grade is utilized in this examination. The cement is tried for different properties according to the Seems to be: 4031-1988.

Table 2: Properties of cement

Type	**OPC**
Grade of cement used	53 Grade
Standard consistency	32.5 %
Specific gravity	3.15
Initial setting time in minutes	30
Final setting time in minutes	600

MAKING OF THE SAMPLE

Unconfined Compression Test

The example is to be ready for the test. First relative thickness is resolved, from that mass of the sand to be given is distinguished to 70% relative thickness. The form that appeared in the figure is set up by utilizing pipes. The test is set up by blending the sand in with 1%, 2%, 3% concrete substance with 7% refined water. It is noticed that the tallness of the example utilized for the UCC in any event equivalent to twice the distance across of the example.

Fig 1. Mould for UCC

Fig 2. Sample for UCC

Direct Shear Test

The form that appeared in the figure is set up by utilizing pressed wood. The test that appeared in the figure is set up by blending the soil in with fluctuating cement substance utilizing 7% refined water. Ascertain the volume and weight of the compartment. Spot the example in the contraption and Weigh the soil holder, the distinction between these two is the heaviness of the soil. Compute the thickness of the soil. Make the outside of the soil plane. Put the upper grinding on stone and stacking block on top of the soil. Measure the thickness of soil example. Apply the ideal-typical burden. Eliminate the shear pin. Connect the dial check which quantifies the difference in volume. Record the underlying perusing of the dial measure and alignment esteems. Before continuing to test check all changes by seeing that there is no association between two sections aside from sand/soil. Turn over the engine. Take the perusing of the sheer power and record the perusing. Take volume change readings till disappointment. Add 5 kg typical pressure 0.5 kg/cm2 and proceed with the analysis till disappointment. Record cautiously all the readings. Set the dial checks zero, preceding beginning the trial.

Fig 3. Sample preparation for direct shear

Fig 4. Sample for direct shear test

RESULTS AND DISCUSSION

Unconfined Compression Test

Test 1,2 and 3 arranged with 1%,2%& 3% concrete separately. Length of the test is 200 mm, region of test 2543 Sq.mm, the examples are restored for 7 days and tried and other arrangements of tests are relieved for 21 days and tried.

Table 3: Unconfined Compression Test for 7 days curing with 1% cement content

Unconfined Compression Test (UCS)								
Sample	**1**	**Length**	**200**	**Initial Area of Sample**			**25434.00**	**Sq.mm**
Cement	**1%**	**Distilled water**	**7%**	**Curing period**			**7**	**day(s)**
S.No	**Compression Dial Reading, ΔL**		**Proving ring dial**		**Stress**	**1 - Є**	**A' = A/ 1-Є**	**Strain (Є)**
	Div	**mm**	**Div**	**P**				
1	50	0.5	29	36.25	0.001425	0.9975	25497.7444	0.0025
2	100	1	49	61.25	0.002408	0.995	25561.809	0.005
3	150	1.5	30	37.5	0.001474	0.9925	25472.21	0.0075
4	200	2	27	33.75	0.001327	0.99	25467.11	0.01
				Unconfined Compressive Strength			**0.002408**	**N/mm^2**
						Cohesion	**0.001204**	**N/mm^2**

Table 4: Unconfined Compression Test for 7 days curing with 2% cement content

Unconfined Compression Test (UCS)								
Sample	**2**	**Length**	**200**	**Initial Area of Sample**			**25434.00**	**Sq.mm**
Cement	**2%**	**Distilled water**	**7%**	**Curing period**			**7**	**day(s)**
S.No	**Compression Dial Reading, ΔL**		**Proving ring dial**		**Stress**	**1-Є**	**A' = A/ 1-Є**	**Strain Є**
	Div	**mm**	**Div**	**P**				
0	0	0	0	0	0	0	0	0
1	50	0.5	55	82.5	0.003244	0.9975	25497.7444	0.0025
2	100	1	100	150	0.005898	0.995	25561.809	0.005
3	150	1.5	120	180	0.007077	0.9925	25626.1965	0.0075
4	200	2	140	210	0.008257	0.99	25690.9091	0.01
5	250	2.5	245	367.5	0.014449	0.9875	25755.9494	0.0125
6	300	3	330	495	0.019462	0.985	25821.3198	0.015
7	350	3.5	357.5	536.25	0.021084	0.9825	25887.0229	0.0175
8	400	4	357.5	536.25	0.021084	0.98	25953.0612	0.02
9	450	4.5	357.5	536.25	0.021084	0.9775	26019.4373	0.0225
10	500	5	350	525	0.020642	0.975	26086.1538	0.025
				Unconfined Compressive Strength			**0.021084**	**N/mm^2**
						Cohesion	**0.010542**	**N/mm^2**

Table 5: Unconfined Compression Test for 7 days curing with 3% cement content

Unconfined Compression Test (UCS)								
Sample	**3**	**Length**	**200**	**Initial Area of Sample**			**25434.00**	**Sq.mm**
Cement	**3%**	**Distilled water**	**7%**	**Curing period**			**7**	**day(s)**
S.No	**Compression Dial Reading, ΔL**		**Proving ring dial**		**Stress**	**1-Є**	**A' = A/ 1-Є**	**Strain Є**
	Div	**mm**	**Div**	**P**				
0	0	0	0	0	0	0	0	0
1	50	0.5	11.5	17.25	0.000678	0.9975	25497.7444	0.0025
2	100	1	27	40.5	0.001592	0.995	25561.809	0.005
3	150	1.5	36	54	0.002123	0.9925	25626.1965	0.0075
4	200	2	36	54	0.002123	0.99	25690.9091	0.01
5	250	2.5	36	54	0.002123	0.9875	25755.9494	0.0125
6	300	3	36	54	0.002123	0.985	25821.3198	0.015
7	350	3.5	36	54	0.002123	0.9825	25887.0229	0.0175
8	400	4	36	54	0.002123	0.98	25953.0612	0.02
9	450	4.5	40	60	0.002359	0.9775	26019.4373	0.0225
10	500	5	41	61.5	0.002418	0.975	26086.1538	0.025
11	550	5.5	75	112.5	0.004423	0.9725	26153.2134	0.0275
12	600	6	145	217.5	0.008552	0.97	26220.6186	0.03
13	650	6.5	175	262.5	0.010321	0.9675	26288.3721	0.0325
14	700	7	210	315	0.012385	0.965	26356.4767	0.035
15	750	7.5	260	390	0.015334	0.9625	26424.9351	0.0375
16	800	8	325	487.5	0.019167	0.96	26493.75	0.04
17	850	8.5	390	585	0.023001	0.9575	26562.9243	0.0425
18	900	9	515	772.5	0.030373	0.955	26632.4607	0.045
19	950	9.5	675	1012.5	0.039809	0.9525	26702.3622	0.0475
20	1000	10	650	975	0.038335	0.95	26772.6316	0.05
				Unconfined Compressive Strength			**0.039809**	**N/mm^2**
						Cohesion	**0.0199045**	**N/mm^2**

Table 6: Unconfined Compression Test for 21 days curing with 1% cement content

Unconfined Compression Test (UCS)								
Sample	**5**	**Length**	**200**	**Initial Area of Sample**			**25434.00**	**Sq.mm**
cement	**1%**	**Distilled water**	**7%**	**Curing period**			**21**	**day(s)**
S.No	**Compression Dial Reading, ΔL**		**Proving ring dial**		**Stress**	**1-Є**	**A' = A/ 1-Є**	**Strain Є**
	Div	**mm**	**Div**	**P**				
0	0	0	0	0	0	0	0	0
1	50	0.5	15	22.5	0.000885	0.9975	25497.7444	0.0025
2	100	1	65	97.5	0.003833	0.995	25561.809	0.005
3	150	1.5	135	202.5	0.007962	0.9925	25626.1965	0.0075

4	200	2	200	300	0.011795	0.99	25690.9091	0.01
5	250	2.5	270	405	0.015924	0.9875	25755.9494	0.0125
6	300	3	350	525	0.020642	0.985	25821.3198	0.015
7	350	3.5	330	495	0.019462	0.9825	25887.0229	0.0175
				Unconfined Compressive Strength			**0.020642**	**N/mm²**
						Cohesion	**0.010321**	**N/mm²**

Table 7: Unconfined Compression Test for 21 days curing with 2% cement content

Unconfined Compression Test (UCS)								
Sample	**4**	**Length**	**200**	**Initial Area of Sample**			**25434.00**	**Sq.mm**
Cement	**2%**	**Distilled water**	**7%**	**Curing period**			**21**	**day(s)**
S.No	**Compression Dial Reading, ΔL**		**Proving ring dial**		**Stress**	**1-Є**	**A' = A/ 1-Є**	**Strain Є**
	Div	**mm**	**Div**	**P**				
0	0	0	0	0	0	0	0	0
1	50	0.5	15	22.5	0.000885	0.9975	25497.7444	0.0025
2	100	1	65	97.5	0.003833	0.995	25561.809	0.005
3	150	1.5	135	202.5	0.007962	0.9925	25626.1965	0.0075
4	200	2	200	300	0.011795	0.99	25690.9091	0.01
5	250	2.5	270	405	0.015924	0.9875	25755.9494	0.0125
6	300	3	350	525	0.020642	0.985	25821.3198	0.015
8	400	4	370	555	0.021821	0.98	25953.0612	0.02
9	450	4.5	300	450	0.017693	0.9775	26019.4373	0.0225
			Unconfined Compressive Strength				**0.021821**	**N/mm²**
			Cohesion				**0.0109105**	**N/mm²**

Table 8: Unconfined Compression Test for 21 days curing with 3% cement content

Unconfined Compression Test (UCS)								
Sample	**3**	**Length**	**200**	**Initial Area of Sample**			**25434.00**	**Sq.mm**
Cement	**3%**	**Distilled water**	**7%**	**Curing period**			**21**	**day(s)**
S.No	**Compression Dial Reading, ΔL**		**Proving ring dial**		**Stress**	**1-Є**	**A' = A/ 1-Є**	**Strain Є**
	Div	**mm**	**Div**	**P**				
0	0	0	0	0	0	0	0	0
1	50	0.5	6.5	9.75	0.000383	0.9975	25497.7444	0.0025
2	100	1	30	45	0.001769	0.995	25561.809	0.005
3	150	1.5	75	112.5	0.004423	0.9925	25626.1965	0.0075
4	200	2	142.5	213.75	0.008404	0.99	25690.9091	0.01
5	250	2.5	235	352.5	0.013859	0.9875	25755.9494	0.0125
6	300	3	340	510	0.020052	0.985	25821.3198	0.015
7	350	3.5	400	600	0.02359	0.9825	25887.0229	0.0175

8	400	4	520	780	0.030668	0.98	25953.0612	0.02
9	450	4.5	640	960	0.037745	0.9775	26019.4373	0.0225
10	500	5	715	1072.5	0.042168	0.975	26086.1538	0.025
11	550	5.5	890	1335	0.052489	0.9725	26153.2134	0.0275
12	600	6	1085	1627.5	0.063989	0.97	26220.6186	0.03
13	650	6.5	1240	1860	0.07313	0.9675	26288.3721	0.0325
14	700	7	1320	1980	0.077849	0.965	26356.4767	0.035
15	750	7.5	1310	1965	0.077259	0.9625	26424.9351	0.0375
					Unconfined Compressive Strength		**0.077849**	**N/mm^2**
						Cohesion	**0.0389245**	**N/mm^2**

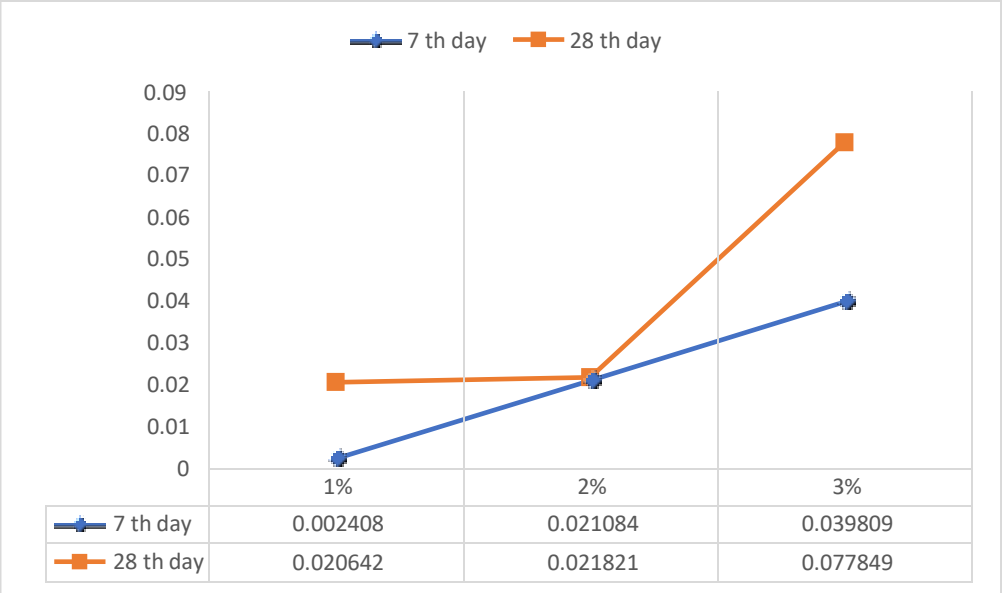

Fig 5. Unconfined compressive strength Chart

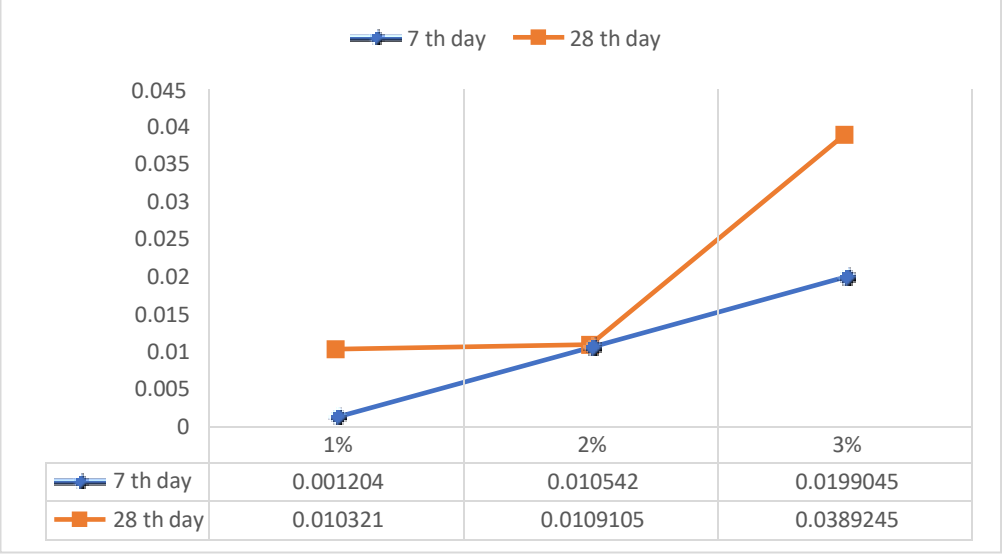

Fig 6. Cohesion Chart

Direct shear Test

Test 1,2 and 3 arranged with 1%,2%& 3% concrete separately the examples are restored for 7 days and tried and other arrangements of tests are relieved for 21 days and tried. The point of inside rubbing is determined.

Table 9: Direct shear test with 1% cement content

Normal stress kg/cm^2	Shear Load		Shear stress kg/cm^2
	Div	Kg	
0.5	254	31.75	0.882
1	361	45.125	1.253
1.5	465	58.125	1.615

Table 10: Direct shear test with 2% cement content

Normal stress kg/cm^2	Shear Load		Shear stress kg/cm^2
	Div	kg	
0.5	255	31.875	0.885
1	396	49.5	1.375
1.5	554	69.25	1.924

Table 11: Direct shear test with 3% cement content

Normal stress kg/cm^2	Shear Load		Shear stress kg/cm^2
	Div	kg	
0.5	321	40.125	1.115
1	476	59.5	1.653
1.5	615	76.875	2.135

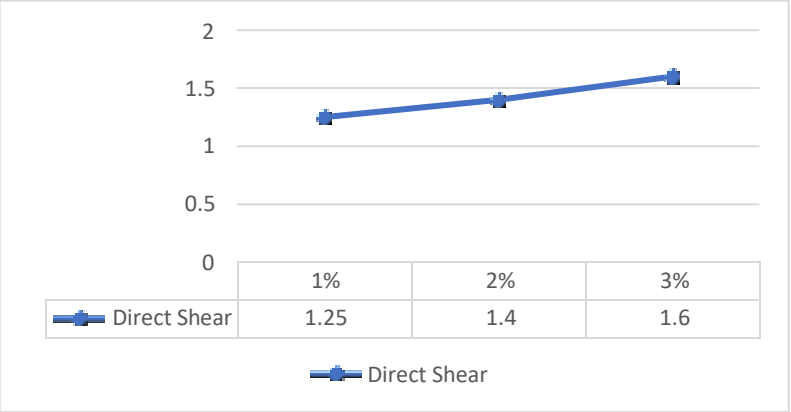

Fig 7. Direct Shear Chart

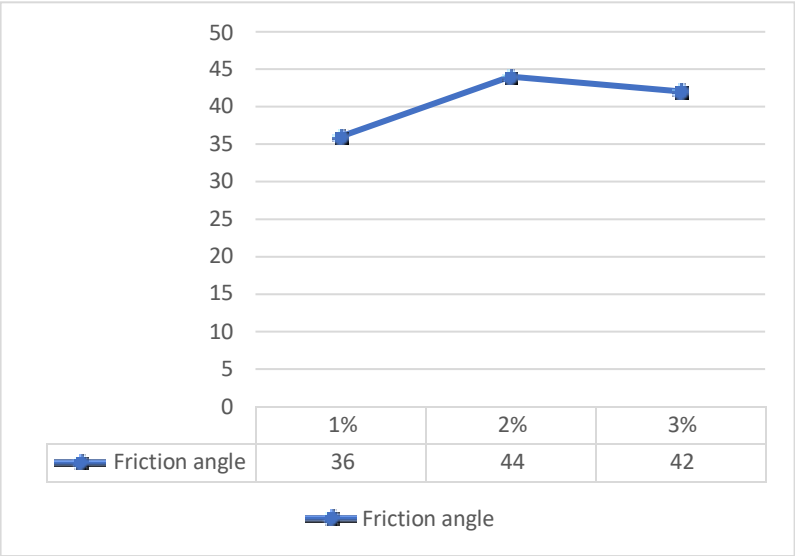

Fig 8. Internal Friction Angle Chart

CONCLUSION

The current examination manages the designing attributes of established inadequately evaluated sand blends. The accompanying ends can be drawn depending on the test outcomes:

- The expansion of portland concrete even in modest quantities can essentially improve the dirt strength. The unconfined pressure strength expanded roughly directly with an expansion in the concrete substance.
- Increasing the relieving time expands the UCS, yet the impact of restoring time on the most extreme UCS is more articulated for higher measures of concrete.
- The balanced-out soil displays fragile conduct during the UCS test. Critical reductions in the resistance disappointment happen with the expansion of portland concrete.
- The shear strength boundaries, to be specific, union and interior erosion point increment with expanding portland concrete substance. The considerable expansion in the union is obvious than the inner rubbing point.
- There is an extensive expansion in attachment and interior grating point in examples containing portland concrete with expanding restoring time, yet the impact of relieving time is more moderate than concrete substance.

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Theoretical Determination Of NLO, Chemical Reactivity And TD Parameters Of (1S*,4R*,7S*)-(E)-7-(2,5 Dimethoxyphenyl)-3,3-dimethoxy-5-(2nitrovinyl) Bicyclo[2.2.2]oct-5-en-2- One Using DFT Method

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Abstract. FMO (Frontier molecular orbital) method was used to understand the stability of the (1S*,4R*,7S*) - (E)-7-(2,5-Dimethoxyphenyl)-3,3-dimethoxy-5-(2nitrovinyl)bicycle [2.2.2] oct-5-en-2-one (DNB) molecule. Non-linear optical properties like dipole moment and hyperpolarizability were calculated, and common thermodynamic parameters also estimated for DNB.

INTRODUCTION

(1S*,4R*,7S*)-(E)-7-(2,5-Dimethoxyphenyl)-3,3-dimethoxy-5-(2nitrovinyl)bicycle [2.2.2] oct-5-en-2-one (DNB) molecule was synthesized by Sharma et al [1]. It belongs to hypervalent iodine chemistry, and acts as good reagents in synthesis of organic molecules [2]. To generate the masked o-benzoquinones and benzoquinone monoamines, hypervalent molecules plays a vital role [3]. Diels-Alder reaction of o-benzoquinones and benzoquinone monoamines is identified as key step of producing biologically dynamic molecules [4] and many natural products [5-6]. However, the calculations of Non-linear optical properties, chemical reactivity and thermodynamic parameters are yet to appear in literature. We computed such quantum chemical calculations recently [7-15] and now extended the investigations to the selected molecule DNB, in this article.

COMPUTATIONAL INFORMATION

Computational quantum chemical estimations carried out by using DFT, incorporated in 09 Gaussian window package [16,17] with 6-311++G (d,p) basis set. NLO properties of the DNB calculated by DFT method of finite field [18]. The Chemical reactivity of the selected molecule also determined using the methods [19-23]. By assuming a rigid-rotor harmonic approximation [24], we estimated the thermodynamic parameters for the chosen molecule.

RESULTS AND DISCUSSIONS

Molecular geometry

DNB molecule is optimized with above said method. The geometry parameters were excellent agreement with the experimental values [1]. By the calculation the DNB molecule has been belongs to C_1 symmetry and its optimized molecular structure as shown in figure.

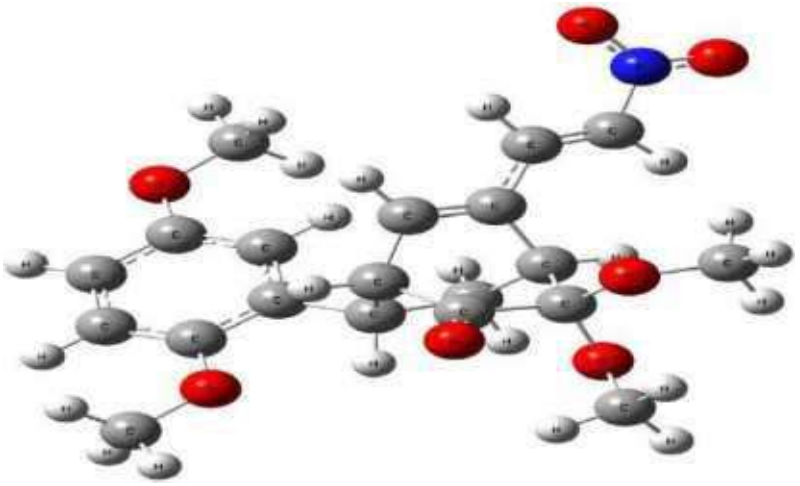

Fig 1. Optimized structure of DNB

NLO properties

When Electromagnetic radiation interacts with NLO material, then change occurse in phase, amplitude, frequency, or gives the new propagation field characteristics [25]. If this change is significant then the NLO material used in signal processing, optical inter-connections telecommunications and optical memory [26-29]. Using DFT techniques, expansively investigate organic NLO materials [30-34].

The NLO behavior of selected compound is judged by comparing the related quantities of Urea. For Urea, hyper polarizability (β_t) and dipole moment(μ_t) are 372.8 × 10^{-33} $cm^{5/}$esu and 1.3732 Debye, respectively. For DNB, these values are β_t = 8272.174 × 10^{-33} $cm^{5/}$esu and μ_t = 2.415 Debye. The estimated values are very high compared with that of Urea; hence DNB is a sturdy contender for the enlargement of novel NLO materials. β_t components are very helpful to identify the delocalization of charge in the DNB.

Chemical reactivity

The parameters of FMO were calculated for the molecule DNB. From the calculations we observed that the energy gap, linking the LUMO and HOMO orbital energies is 2.340 eV. It is comparatively small, worth to characterize a conjugated molecule. The chemical potential (μ) is negative for DNB, and is stable [35, 36].

Thermodynamic parameters

Thermodynamic parameters such as entropy, C_v, C_p were determined (183.955, 101.541 and 103.526) in cal mol^{-1} K^{-1}. ZPV energy and TT energy (256.040 and 273.100 kcal mol^{-1}), SCF energy -1357.486 Hartree were calculated for chosen molecule. Further, the rotational constants were A, B and C also calculated as (0.201, 0.138 and 0.088 GHz) for the selected molecule.

CONCLUSION

The following inferences are drawn from the calculations:

1. DNB molecule has the non-planar structure acquiring point group of C_1 symmetry. Theoretically calculated geometric parameters of DNB are excellent agreement with the values of experimental.
2. DNB is a good candidate for NLO materials.

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Analysis of NMR and UV-Visible spectra, thermodynamic parameters and FMO characteristics of (1R*, 2S*, 4R*)-5-Bromo-8, 8-dimethoxy-1-methyl-7-oxobicyclo [2.2.2] oct-5-en-2-yl cyanide using DFT techniques

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Abstract. ^{1}H and ^{13}C Nuclear magnetic resonance (NMR) and UV-Visible spectra were measured for (1R*,2S*,4R*)-5-Bromo-8,8-dimethoxy-1-methyl-7-oxobicyclo [2.2.2] oct-5-en-2-yl cyanide (BDM). ^{1}H and ^{13}C NMR chemical shifts were generated using Gauge Independent Atomic Orbital (GIAO) approach and compared with its corresponding experimental chemical shifts for BDM. Frontier molecular orbital (FMO) approach was used to understand origin of UV-Vis spectrum and chemical reactivity of the molecule. Molecular electrostatic surface potential (MESP) surface was drawn to locate reactive sites of BDM. Various thermal energy parameters were also estimated for BDM. DFT/B3LYP/6-311++G (d,p) level of theory was used for calculations of BDM.

INTRODUCTION

(1R*,2S*,4R*)-5-Bromo-8,8-dimethoxy-1-methyl-7-oxobicyclo[2.2.2]oct-5-en-2-yl cyanide (BDM) is the compound prepared under the reaction of Diels-Alder cycloaddition [1]. This compound comes under the category of (MOBs) masked o-benzo-quinones [2]. A Cycloaddition reaction plays a vital role in preparation of antiglaucoma compounds [3] and many natural products [4, 5]. Such biologically active molecules were studied in our recent DFT calculations [6-14]. Hence, we undertook this work with the following objectives.

6. Calculate NMR shifts (^{1}H and ^{13}C) and examine their relationship with measured [1] values,
7. Simulated UV-Visible spectrum and,
8. FMO, MESP and common thermodynamic parameters to make the investigation comprehensive.

COMPUTATIONAL ASPECTS

Using DFT/6-311++G(d,p) level of theory and implemented in Gaussian Window 09 program package [15, 16] simulated NMR [17] and UV-Vis spectrum [18-20]. We determined Chemical reactivity [21-26] and by assuming a rigid-rotor harmonic approximation [27] and estimated common thermodynamic parameters for (BDM).

RESULTS AND DISCUSSIONS

Most Stable Conformer

Structure of the chosen sample is optimized with the above-mentioned method. The estimated (DFT: 179.37º, 123.70º, 1.90Å) geometry parameters like dihedral angles, bond angles and bond lengths were in good agreement with the XRD values (179.65º, 124.10º, 1.88Å) [1] and its minimum energy is -8717.774 X 10^{-3} k $Jmol^{-1}$. Structure of BDM belongs to C_1 symmetry point group and is depicted in figure 1.

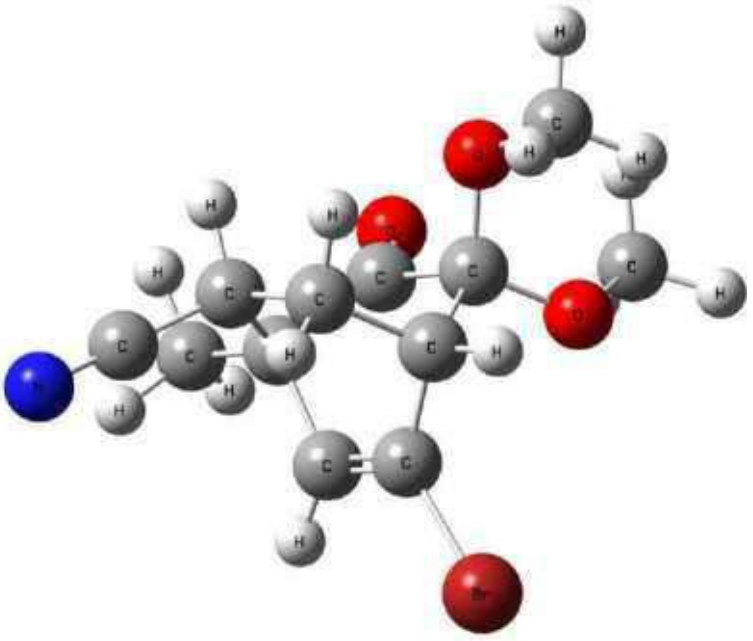

Fig 1. Optimized geometrical structure of BDM (E_{BDM} = -8717.774 X 10^{-3} k J mol^{-1})

NMR Signals

To verify the correlation between the calculated and experimentally observed NMR shifts, we drawn the graphs of observed chemical shifts verses computed chemical shifts for BDM. These are straight lines as shown in figure 2 and 3 for ^{13}C and ^{1}H NMR spectra. The coefficient of correlation r^2 is extremely close agreement to unity for ^{1}H and ^{13}C NMR spectra of chosen molecule. It is clear that the theoretical and experimental chemical signals are well agreed, and can be evidenced from figure 2 and 3.

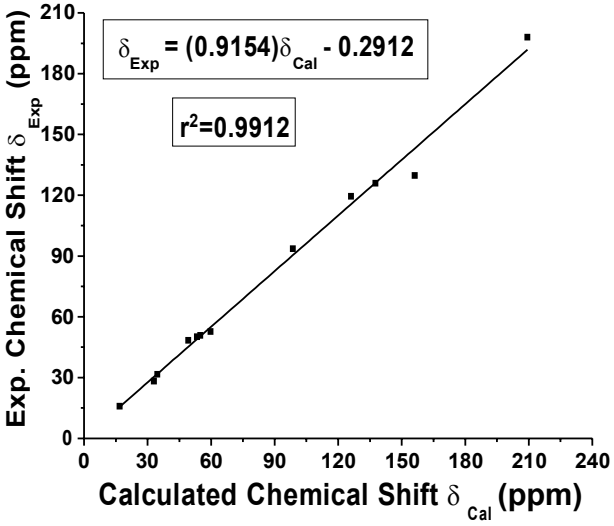

Fig 2. Linear regression curve for carbon signals

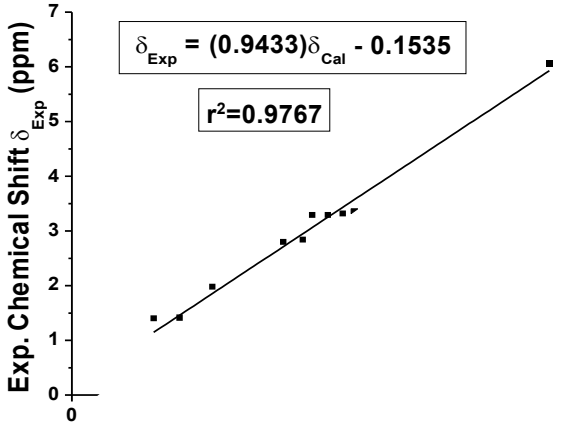

Fig 3. Linear regression curve for proton signals

UV-Visible Peaks

Computed UV-Vis absorption peaks obtained in the computations are due to the electronic transitions. The frontier molecular orbitals are known as highest occupied molecular orbital (HOMO) and (LUMO) lowest un-occupied molecular orbital, and they determine the reactivity of the selected compound [28]. Electron donor is HOMO and acceptor is LUMO [29, 30]. The calculated peaks at λ_{max} = 250.51 nm, its oscillator strength, f = 0.052 and another one observed at λ_{max} = 325.21 with f = 0.008, and are shown in figure 4. The origin of the signals is mainly due to the transitions of H→L and H-1→L for BDM.

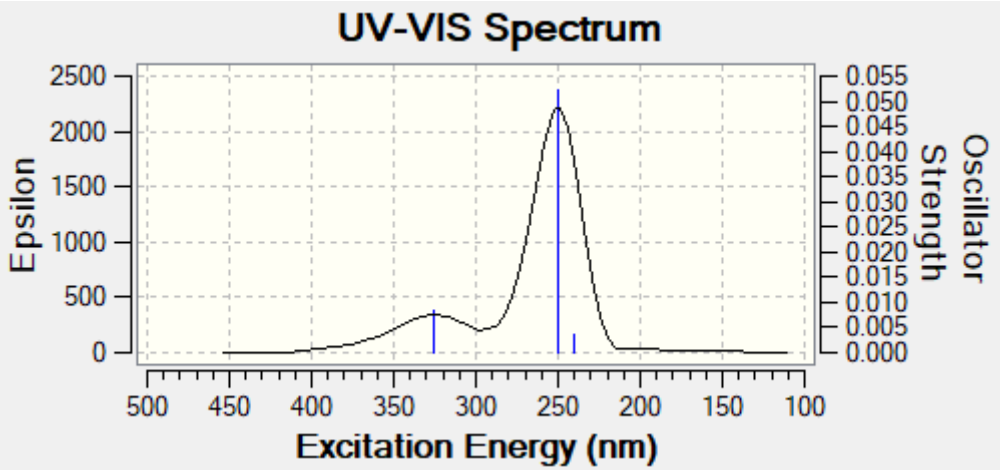

Fig 4. UV-Vis peaks

Chemical Reactivity Of the Molecule BDM

Frontier molecular orbital energy gap plays vital role in understanding the chemical reactivity such as reactants kinetic characteristics and chemical reactions of the molecule. The calculated energy gap between the H and L is 3.96 eV (figure 5) and the chemical potential (μ = -7.126 eV) is negative for BDM, and is chemically stable [29, 30]. These parameters describe aspects like drug design and toxicological behavior of eco system.

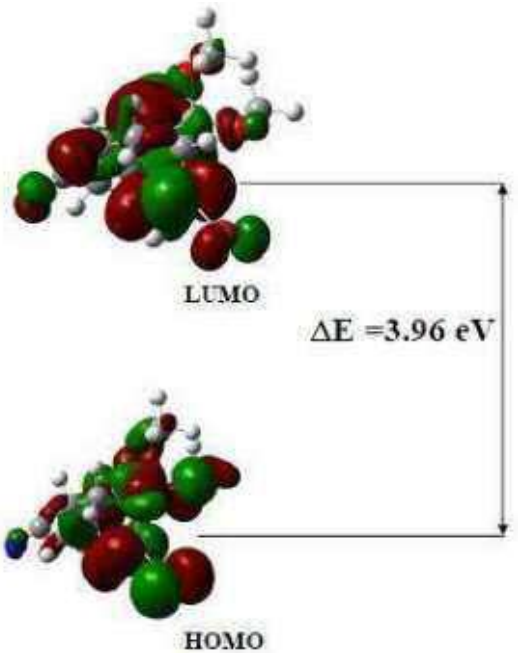

Fig 5. HOMO and LUMO plots of BDM

Thermal energies

The thermodynamic energies (thermal energies) were calculated in gas phase as per thermodynamics second law [31] with DFT method adopted for these computations Cv, Cp and entropy (S) were estimated at 63.75, 65.73 and 133.14 in cal mol^{-1} K^{-1}, respectively. Total thermal, ZPV energies were found 163.15 and 152.34 kcal mol^{-1}, respectively. The SCF energy was determined as -3320.41 Hartee. Further, we also estimated rotational constants A, B and C as 0.404, 0.362 and 0.255 GHz, respectively for chosen molecule BDM.

Molecular Electrostatic Surface Potential of BDM

The total electron density plot of BDM (see figure.6) shows the difference between charge distributions among various parts of a given molecule [32]. In figure 5, relatively negative regions are shown in red and relatively positive region is shown in green. The negative region, indicated in red is primarily over the N and O atomic positions, caused by the donation of lone-pair electrons of oxygen and nitrogen atoms, whereas the positive section designated in green is over the remaining atoms.

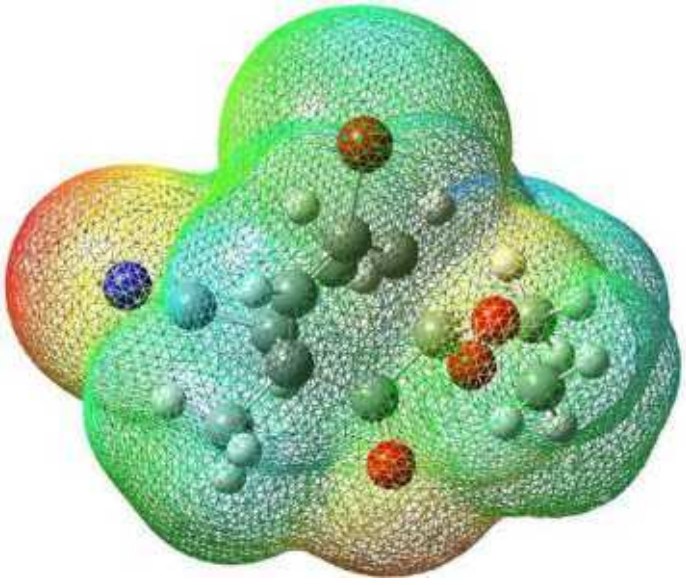

Fig 6. Total electron density plots of BDM

CONCLUSION

The following implications are drawn from the computations:

1. BDM molecule has the non-planar structure acquiring point group of C_1 symmetry. Theoretical computed geometric parameters of BDM are good in agreement with the values of XRD.
2. Good correlation between the theoretical and experimental NMR signals.
3. Theoretical UV-Vis peaks identified.
4. Electron density plot was drawn and thermal energies were also estimated for BDM.

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