DOCUMENTATION MANAGEMENT FOR ISO CERTIFICATION OF CONSTRUCTION INDUSTRIES IN KARNATAKA

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ABSTRACT

ISO quality certification needed for all types of industries to retain their competitiveness, image and standardness in the global market for the benefit and success of the project .For getting the ISO certification , the documentation management is highly required .It is needed to document the activities of the construction industries regularly. Hence dedicated staffs are needed to allot the documentation responsibility.The main objectives of research is to assess the problems, needs and solutions which are related to the documentation management. The questionnaire's are prepared and are distributed to the construction industries of Karnataka. The responses were collected and analysed. The main problems identified includes risk management and resource allocation. The suggestions or solutions includes creating the awareness among the employees , training of documentation etc. Training and allotment of responsibilities to dedicated staffs results in increase of productivity and efficiency of a industry. It is also suggested to use combined IT and paper based documentation system.

Keywords: *Documentation Management, ISO: 9001 Standards, Quality Management System, Quality of Construction, Documentation Quality.*

Introduction

Quality of construction is the prerequisite or main objective of a construction industries. Quality can be expressed in terms of both construction quality and quality in management. It also relates to the material quality. According to many researchers, quality in all stages of construction can be achieved by following the quality management systems. The International standard organisation (ISO) is one of the best quality management system adopted by all types of industries including construction firms. Proper Documentation management is highly required to get the ISO certification. All the actions, sequences and workouts of construction industries are needed to be documented regularly by the dedicated staffs. Documentation management results in the consistency of construction processes in all the stages of construction. It gives the history of the processes and procedures that helps in modifying the construction projects that saves the time and cost. It helps in minimising the future problems and complications. It also resulting in the early completion of the projects with required quality and avoids the loss.

Review of literature

According to many researchers the documentation management is helpful in periodic inspections related to the quality of materials, processes etc. It is also helpful in review of designs and to make proper change's in the designs. Misinterpretation and omission in the documentation results in loss and disputes. Improper maintenance or poor documentation results in delays in claims for the construction works. It is also observed that most of the construction industries are not maintaining the documents properly. Hence it is needed to adopt the QMS that leads to good quality and profit. The quality certification directly relates to the proper documentation management. A documentation is a format that contains information of processes, sequences, stages, cost flows, material consumption's, receipts of payments, designs and drawings of a construction projects, list of requirements etc. The Documentation management system reflects the culture of industries or organisation. It is observed that most of the

construction industries are facing the problem with IT based documentation system. The problem can be solved by the proper understanding of the documentation management system. The employees are trained for proper documentation. DM system achieved only when employees knows their importance. Industries should hire the respective expertised and dedicated staffs to maintain the proper documentation for ISO certification. The industries that opt for ISO certification should follow the QMS that comply with ISO standards. Many researchers quote that the ISO implementation results in the positive impact on construction industries. Many industries fail to get ISO certification, in other words they are unable to maintain the documents comply with ISO standards. Hence it is needed to identify the DM requirements, reasons of poor documentation and to find the solutions for the proper documentation in the construction industries. The quality system can be achieved in three levels, and are

- Preparation of the quality manuals for the construction projects.
- Procedures for to carry out the construction.
- Maintaining the several forms, formats or receipts of work etc.

Research Objectives

- To identify the present requirements for the proper documentation management system.
- To identify the reasons behind the poor DM in Karnataka.
- To arrive at the solutions or suggestions that overcomes the obstacles for QMS.

Research Methodology

A primary survey was conducted to know the present documentation management practices of the construction industries and to know the ISO requirements. The questionnaire's prepared by discussing with the industrial experts concentrating to the ISO document requirements for the quality certification. The questionnaire's covers both the background of management and documentation methods. It covers the major aspects given below.

- Requirements of the documentation management as per the ISO standards.
- The present documentation management activities of industries.
- The extent to which the industries met the standard requirements.
- The questionnaire's are also related to the reason behind not meeting the ISO requirements.
- It relates to the suggestions or solutions for the proper documentation practices for the ISO certification.

The questionnaire's were distributed to the 26 construction industries of Karnataka state . About 22 companies responded at the rate of 84%. The relative importance index (RII) statistical method used for the ranking of the factors. The responses were collected in 1 to 5 point scale. The questionnaire's are distributed to the project managers/ engineers/ quality engineers and they are asked to rank from 1 to 5 point scale to identify upto which the documents are required as per ISO standards to get the certification. The response with 5 being strongly agree and 1 being strongly disagree. It is also identified from the questionnaire's that upto what extent the industries met the requirements as per ISO standards. The difference between the requirement and the current practices of documentation shows the gap that represents the needed requirements for the ISO certification.

Research findings and discussions

The table 1, represents the management activities, documentation needs, present documentation practices and their ranks from findings.

Table 1: Documentation Needs, Present Practices and their Ranks.

Si. No	Documentation management activities of construction industries	Documentation needs	Present practices	Difference	Rank
1	Job nature description, allotment of responsibilities with respect to specialization and experience, Formulation of events, sequences and activities.	0.94	0.82	0.12	15
2	Documents for to review the expenditures or expenses (lender documents).	0.88	0.81	0.07	31
3	Description of construction stages and processes.	0.94	0.86	0.08	30
4	Documents related to the planning and management of the site activities to control the cost or expenses, and to control the quality.	0.84	0.76	0.08	29
5	Specifications that shows how, when, what, where the site records are entered and maintained.	0.82	0.79	0.03	38
6	Documents that shows the scheduling and monitoring processes of the construction activities at site.	0.90	0.78	0.12	16
7	Changes made in the design and drawings on a certain period of time.	0.91	0.86	0.05	35
8	Documents that shows the method's for preparing the project status reports, for to control the project proceedings.	0.89	0.77	0.12	17
9	Behavioural and discipline note for the site staffs.	0.82	0.69	0.13	11
10	Documents that shows the guidelines for the communication between the clients/consultants for to arrive at quality construction.	0.94	0.85	0.09	25
11	Exchange of knowledge, Ideas through the interpersonal communication.	0.93	0.80	0.13	12
12	Documents relating to the shop specifications and drawings.	0.87	0.72	0.15	7

13	Specifications that shows the qualification, skills, requirements for the respective staffs for specified jobs.	0.85	0.74	0.11	21
14	Documents related to the equipments and plants for proper functioning of the construction activities.	0.89	0.78	0.11	20
15	Specify the resource management problems and to identify the ways to resolve them.	0.80	0.68	0.12	18
16	Documents related to the training provided for the industry personals for the execution of quality work.	0.76	0.62	0.14	10
17	To specify the work to be carried out during the defect liability periods.	0.77	0.61	0.16	6
18	Documents related to the measures taken to protect the environment.	0.89	0.80	0.09	24
19	To specify the safety and health measures to be taken at site.	0.88	0.79	0.09	26
20	Documents related to the cost controlling and monitoring methods.	0.92	0.82	0.1	22
21	Documentation of expenditures of labours, equipments and materials at the site.	0.88	0.83	0.05	34
22	Time record documents of labours and usage of materials for a specific activity.	0.86	0.79	0.07	32
23	Documentation of risk management practices carried out at the site	0.88	0.65	0.23	1
24	To assess the quality of material suppliers.	0.87	0.76	0.11	19
25	Documents to monitor the selected labours, contractor's and subcontractors at the work site.	0.84	0.77	0.07	33
26	To assess the performance of the materials and labour suppliers.	0.91	0.73	0.18	3
27	Documents to assess the performance of a labours, contractor's, and subcontractors.	0.88	0.73	0.15	8
28	Documents related to the ordering and purchasing of	0.87	0.84	0.03	37

	the materials/equipments from suppliers (invoices).				
29	The documents related to the purchase of services from the contractor's or subcontractors	0.92	0.82	0.1	23
30	Documents related to the materials quality and nearby suppliers.	0.91	0.75	0.16	5
31	Documents for maintaining the components/materials supplied by a client's.	0.86	0.84	0.02	40
32	Documents related to choosing the right materials/equipments for a particular work to avoid usage of wrong materials for to save money and time.	0.92	0.79	0.13	13
33	Documents for tracing of origin of the materials/components that are supplied by a respective suppliers (for the quality inspection of materials).	0.85	0.70	0.15	9
34	Documents related to the tests and inspections that are carried out for the materials, equipments and for works that are not specified in the specifications.	0.91	0.82	0.09	28
35	Documents that mentions the procedures and periodic calibration requirements for the machines, instruments and testing equipments.	0.83	0.80	0.03	39
36	Documents related to the status of tests and inspections carried out for the materials/equipments and work.	0.83	0.78	0.05	36
37	Documents showing the actions to be taken during the unconformity defects arised during inspections and testings	0.84	0.75	0.09	27
38	Documents for identifying the root cause of defects or failure of materials/equipments and work.	0.81	0.68	0.13	14
39	Documents that shows the storing and handling procedures of materials and components.	0.89	0.68	0.21	2
40	Documents related to	0.85	0.69	0.16	4

	identifying and solving the problems of material purchases.				

The questionnaire's are prepared concentrating mainly on the management responsibilities, product realization and resource management. Twelve questions are based on the management responsibilities, eleven questions related to the resource management and seven questions relates to the product realization.

Construction requirements and the present industry documentation practices

According to the responses from the respondents, job nature description, allotment and distribution of responsibilities and powers to the respective staffs, planning of events and activities are highly recommended in the construction industries (0.94). The second priority is given to the exchange of knowledge, ideas through interpersonal communication among various departments (0.93). Proper description of construction stages and processes (0.94) are also highly required. Changes to be made in the design and drawings at certain period of time is also required. Documents that shows the guidelines for the communication between the clients/consultants for to arrive at quality construction, the documents related to the cost controlling and monitoring, documents related to assess the performance of staffs and material suppliers, records of material quality and nearby quality material suppliers are also highly required. The documents related to the use of right Materials for right job at a right time , tests and inspection documents, procedures for various activities are also highly required. From the study, it is observed that the documentation management is very poor in the risk management practices carried out at the sites. Other documents which are poorly maintained are listed below.

- Documentation management at site (with gap of 0.23).
- Storing and handling of materials and equipments(with gap of 0.21).
- Assessment of performance of materials and labour suppliers (with gap of 0.18).
- Documents of identifying and solving the problems of material purchases (with gap of 0.16).
- Maintainance of site records related to material quality (with gap of 0.16).

Problems and Solutions for the Documentation management systems

Themain objective of the research is to find the problems and solutions for the Documentation management system. For this both the quantitative and qualitative data's are collected. It is observed that the high initial cost to introduce the quality management system is the major problem faced by the construction industries. Lack of trained staffs or employees and less interest in filling the forms or formats for documentation are the other difficulties faced by the construction industries.

The following table 2 , gives the list of major problems faced by the industries.

Table 2: Major problems faced by the industries

Si. No	Major problems identified	RII Values	Ranks
1	High initial investment cost in the documentation management practices.	0.57	4

2	Lack of experts	0.72	2
3	Less interest in filling the formats or forms of documentation.	0.77	1
4	Difficulty in executing the procedures and guidelines provided in the documentation	0.66	3

Less interest in filling the forms or formats for the documentation ranked first with RII score of 0.77. Lack of experts for the respective jobs are ranked second with the RII score of 0.72. Difficulty in executing the procedures and guidelines provided in the documentation and high initial investment cost in the documentation management practices are ranked third and fourth respectively. The other problems includes shortage of staffs, delays due to the improper communication, partial project information. Staffs are unaware of computerised data entries that are necessarily made periodically. Employees are not encouraged to use the computer based data collection and maintainance(IT based data collection system). Employees are not willing to change from old to new system, and they are unaware of the scope and importance of the project. Problems arised while executing the projects, problems related with staff management and availability of less time are the problems faced by construction industries.

The solutions obtained from the research are shown in the table 3, below. The results are based on the qualitative, quantitative analysis and responses from the respondents.

Table 3 : The Solutions obtained from Research.

Si.No	Solutions identified	RII	Rank
1	Creating the awareness regarding the documentation	0.82	1
2	Give training and proper suggestions to execute the procedures and guidelines for the documentation management.	0.80	2
3	Tracing the site staffs and giving proper suggestions to site engineers/staffs.	0.71	3
4	Assign rewards or money for achieving proper documentation needs or motivate the staffs by giving rewards for achieving required accuracy in documentation.	0.60	4

The table 3 ,shows the major solutions from the research. Creating the awareness among the staffs, regarding the scope and importance of project has given the highest priority and it is ranked first with RII score of 0.82. Training the staffs and giving the proper directions to execute the project are given second priority with RII score of 0.80. Training the site staffs/ engineers and giving rewards for achieving the goals or required accuracy in documentation are ranked third and fourth with RII score of 0.71 and 0.60 respectively.

Table 4, shows some of the. Qualitative analysis solutions for better documentation. It is needed to adopt half computerised and half paper based documentation system rather than to adopt fully IT based documentation system. It is required to adopt short, simple and effective documentation procedures that are

related to the other activities and factors. It is also needed to take the feedback from the users of the documentation manuals (which contains guidelines, procedures for executing the work).

The system needs to be updated always as per the quality feedback obtained periodically. The activity and executing procedures were designed by taking the opinions and suggestions from the site experts. It is finalized by discussing with higher authorities for smooth and effective functioning of the system, which relates to the productivity and efficiency of construction industries. Other solutions include site based quality plans and periodic inspections of site records. Table 4, represents the suggestions of respondents to achieve the higher level of accuracy , productivity and efficiency.

Table 4: Solutions to improve the Quality, Productivity and Efficiency of a Construction Industries.

Si.No	Procedure related suggestions	Employee related suggestions	Training and awareness related suggestions	Allocation of funds and rewards related suggestions
1	Documentation of both IT based and paper based systems are preferable	Training has to be provided for the employees/staffs related to the IT based documentation management system.	Organize the industrial awareness documentation programs.	Amount or reward should not be limited.
2	Adopt the practical and inter connected procedures to control the documentation system	Employees/staffs are motivated by giving awards.	Employees are encouraged to attend the Trainings and awareness programs , in and around the industries.	Cost and time are allotted for proper or accurate documentation.
3	Feedback system is implemented.	Effective and dedicated staffs are allotted for the documentation process.		Estimate the documentation management system for the tendering process.
4	Follow the correct regulations, policies, guidelines and methods or procedures for the documentation.	Assign responsibilities of checking and maintaining the correct documentation system.		
5	Have a quality plan related to site execution. Do the periodic inspection to maintain the quality of construction.			

It is observed that most of the construction industry employees are unaware of the IT based (computer based) documentation system. Hence it is needed to provide training for the employees to increase accuracy of construction and documentation. The workshops and seminars are organised to train and to bring awareness among the employees. The employees are motivated by awarding for their accurate works. Documentation responsibilities are given to the well trained, experienced and dedicated staffs. It is needed to oversee the project requirements and allocate the staffs for respective jobs or activities, which inturn lessens the operation cost and maintainance cost. Periodic meetings, workshops, seminars, site visits, awareness programs are useful in increasing the quality of construction and documentation. The awareness program also includes trade fairs and technical exhibitions related to the construction and documentation. The results of literature review and survey results are compared to arrive at the final conclusions. Table 5, shows the priority wise rank (from 1 to 18) of documentation management needs. The table also shows solutions as per the respective requirements.

Table 5: Documentation Management Problems, Requirements and Solutions.

Si. No	Identified problems	Rank	Requirements of documentation management	Solutions
1	a. Not interested in filling the documentation forms.	1	Risk management during the construction work.	Conduction of awareness programs.
	b. Availability of less staff for documentation.	2	Mention how to prepare the shop drawings.	Motivating the staffs to attend the training programs and awareness programs in and around the industries.
2	Incomplete information and delays.	3	Mention the procedures to identify and solve the problems related to the resources.	Using of both IT based and paper based system for documentation.
3	Unknown documentation forms.	4	Specifying the respective training provided for the respective site staffs.	Interrelated and practical documentation methods or procedures are used.
4	Staffs are unaware of the DMS and are not motivated.	5	Identify and to check the material qualities and availability of nearby suppliers.	Introduce the feedback systems.
5	Lack of training in their respective fields.	6	Mentioning of the procedures related with the handling and storing of the materials.	Adopt good rules , regulations and practices.
6	Difficulty of DMS at the site level.	7	Mentioning of the additional skills and experience required for the employees.	Correct executing plans with periodic inspections.
7	Initial cost is high.	8	Distribution of works to be carried out during the defect handling period.	Training provided for staffs (related to IT based documentation system).

8	Problems related with the loss of information and availability of less time.	9	To assess the efficiency and performance of a material suppliers.	Employ dedicated staffs and motivate the employees by awarding prizes for accurate documentation.
9	Difficulty in complying with the rules and regulations of government.	10	Methods for to identify and tracing of the materials for usage.	Frame correct rules and regulations for documentation management.
10	Problems related with the poor quality and maintainance issues.	11	Methods used to identify the problems and solutions related to the material purchases.	Maintain the invoice records properly.
11	Labour related problems.	12	To assess the performance of labour subcontractors.	Create a harmonic atmosphere in the industry to get productive work. By interviewing the labours periodically to solve their problems. Maintaining the good relationship among all departments.
12	Problems with the behavioural aspects.	13	Mentioning of behavioural approach of staffs at site	Employ the staffs who are morally sound and have patience in solving and handling the problems at site. They should take spot decisions to solve problems.
13	Defects identifying methods.	14	Mentioning of the method's used to identify the defects	Well experienced and expertise staffs are allotted to assign important work charges.
14	Scheduling and monitoring problems.	15	Methods used for scheduling and monitoring of progress of the work.	Responsibility given to the experienced and dedicated staffs.
15	Problems related with the progress report of projects.	16	Methods used for preparing the progress report of projects or project status report.	Discussing with the senior staffs while preparing the documentation reports.
16	Communication problems	17	Methods of communication between the staffs/ subcontractors.	Use proper communication tools, avoid misunderstandings by conducting meetings , give direct and clear orders or cautions.
17	Problems with identification of right materials and equipments	18	Methods used to identify the correct materials/equipments for right projects.	Allot the responsibilities according to their field of expertise, to avoid wastage of materials and time.
18	Site planning and site	19	Procedures related to the	Allot responsibility for

	maintainance problems		guidance for proper site planning and plant maintainance.	experienced project managers at sites.

Conclusion

The main objective of the research is to find the problems, needs of a construction industries, and to arrive at the effective solutions related to the documentation management system. Several DM problems identified, the questionnaires are prepared concentrating mainly on problems and needs of construction industries. The questionnaire's are distributed to the industry staffs, the responses collected and analysed. The needs identified are as below

- Effective risk management in construction.
- In preparing the shop drawings.
- Problems related to the resource allocation.
- In assessing the efficiency and productivity of employees as well of activities.

Following solutions are identified from the research, and are listed below.

- Conducting the awareness programs in and around the industries.
- Motivate the employees to attend trainings and awareness programs.
- Adopt the combine method of both IT and paper based documentation system.
- Use feedback system in all stages of construction and follow practical methods or procedures for executing the work.
- Employ dedicated staffs, frame correct and flexible rules, regulations for to achieve accuracy of construction and documentation activities.
- Use effective tool for communication to avoid doubts and complexities, which further saves the time and resources.
- Allot responsibilities for well experienced and expert staffs.
- Conduct meetings and inspections periodically for to maintain the good quality of construction and documentation.

Future Scope

The research may be extended to a broader area. The research findings are compared with the findings of other researchers of same field or nature, for to substantiate the findings. Case studies of different regions are to be carried out to arrive at final conclusions.

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TRAVEL TIME AND DELAY STUDY TO IMPROVE TRANSIT SYSTEM IN DELHI NCR

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ABSTRACT

This analysis paper presents a travel time and delay study on the public transit system in Delhi NCR connecting Gaur City 1 to Axis house. The main objective of this study is to convince and attract the general public to use the public transit system for travel rather than exploitation of their private cars. If achieved, the subsequent benefits can be attained: reducing the congestion on the road particularly through peak hours, reducing the price of traveling, reducing the maintenance cost of the roads, improving traffic flow and traffic operations, and reducing air pollution to preserve the environment. Also, to check the delay due to using the public transit system, and variables affecting the delay to search best resolution to minimize this delay and reduce the trip period to minimum. The major difference was found in travel time between using the public transit system and using the private car and analysis was made using MATLAB. Delay and travel time are often reduced to a practical and affordable price by decreasing the amount of times that the bus stops for pickup and discharging the passengers, using small and newer buses. There should be never-ending improvement on the public transit systems so as to be ready to attract and convince more public to use it. And further recommendations were made.

Keywords: *Air Pollution, Delay, Pickup and Discharge of Passengers, Public Transit System, Traffic Operations, Travel Time.*

Introduction

Transportation has fought a major part by working with exchange, business, and social collaboration, while overpowering an extensive bit of your time and assets. A few associations and offices exist to arrangement, plan, construct, work and keep up transportation frameworks. Consistently, a great many individuals leave their homes travel to a working environment, office, school, or inaccessible town. Public travel framework is one among the chief fundamental transportation frameworks. A travel time study decides the measure of time expected to go starting with one point then onto the next on a given course. In directing such an examination, information can be gathered from the areas, terms and reason for delays. When done the investigation is known as a travel time and delay study.

The data obtained from travel time and delay studies should be used in subsequent traffic engineering tasks.

- Assurance of the power of a course with respect to its capacity to hold traffic.
- Identification of areas with relatively high delays and likewise the foundations for those delays.
- Performance of when studies to inspect the viability of traffic activity upgrade.
- Determination of relative power of a course by creating adequacy appraisals or blockage files.
- Determination of travel times on explicit connections is to be utilized in trip task models.
- Compilation of travel time information that will be utilized in pattern studies to inspect the progressions in strength and level of administration with time.
- Performance of monetary examinations inside the investigation of traffic activity choices that reduction travel time.

Objective

- To make a comparison between the travel time by using the public transit system and by using private cars.
- To study the delay due to using the public transit system, and study the variables affecting this delay to find the best solution to minimize this delay in order to reduce the trip travel time to it's minimum.
- To provide suggestions to improve the public transit system.

Problem Statement

Trips can be classifiedas:

- Work trips
- Shopping trips
- Recreation trips
- Social trips
- School trips

Modes traveling are:

- Private car
- Carpool
- Bus and public transit
- Service
- Taxi cab

The most important of all is work trips. Work trips are thought as the largest generator for trips in urban areas. Work trips are responsible as the main reasons of traffic issues especially during the peak hours. There are 2 parts of individuals in the case of car owner. Those who don't own a car are forced to use the public transit system or other mode instead of using the private car. On the opposite hand, people who own private cars will either use the opposite mode listed above. Most people who use their own cars in traveling from one place to different instead of using the public transit system. This travel time and delay study will target on the delay and therefore variables affecting it.

Methodology

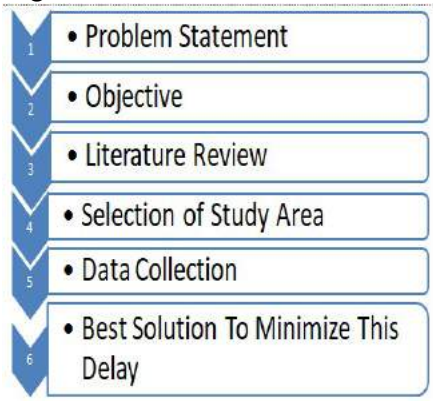


Figure 1: Flow Chart.

Study Area

Data was collected for **Gaur City 1,** sector-4, Greater Noida **to Axis House**, sector-128**, New Delhi NCR (16 km)** by using the public transit system and by using the private car. The collection of data was taken at the peak hours, the morning peak from **8:00 AM to 10:00 AM**, and the afternoon peak from **3:00 PM to 4:00 PM**. Data collection was on different days mainly on Mondays, Tuesdays, Wednesdays and Friday.

This line is an interrupted line which consists of 3 intersections with 1 traffic signal and 2 roundabouts. There are 18 buses, 15 of them are small and 3 buses are big. The data was collected for the two trip directions, from Gaur City 1 to Axis House and from Axis House to Gaur City 1.

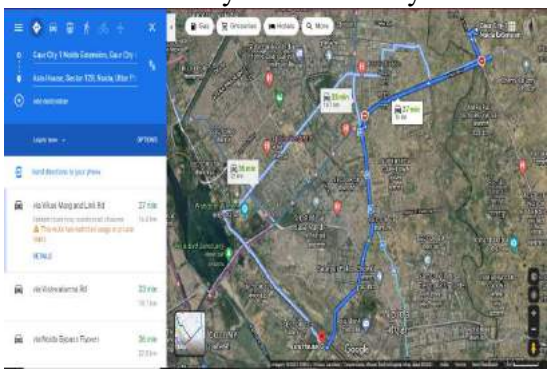


Figure 2: Study Area.

Data Collection Method

1. **Moving vehicle technique** is used, delay data is collected on selected alternate routes having same origin and destination.
2. **Fixed delay** information is recorded on the field whenever the vehicle is stopped because of existing control devices such as traffic signals, stop signs and other traffic control devices that requires the vehicle must make a stop before moving ahead.
3. **Variable delay data** is recorded on the field whenever delay is caused due to other traffic in the lane or an accident delay or other traffic related reasons not related to fixed delay.
4. The time at the start of delay and ending of delay are recorded in both cases.
5. Also, recorded the characteristics of the road such as number of lanes, number of signals, intersections and any construction activities on the survey routes.

For each trip by using the public transit system, the following travel time and delay data was collected and measured:

Table 1: Travel Time and Delay Data

TRIP NUMBER	Y1	Y2	X1	X2	X3	X4	X5	X6	X7	X8	X9
1	34	31.23	3	0	1	2.77	0.77	2	1	1	2
2	42	39.5	2	0	1	2.5	1.5	1	1	0	0
3	48	42.5	2	1	0	5.5	4.37	1.13	1	1	6
4	40	37.55	3	0	1	2.45	1.38	1.07	1	0	10
5	32	29.38	3	0	1	2.62	0.58	2.03	1	1	8
6	42	37.65	4	1	0	4.35	2.05	2.3	1	0	2
7	39	34.1	4	1	0	4.9	2.9	2	1	1	11
8	45	40.15	3	1	1	4.85	2.82	2.03	1	0	7
9	36	31.78	3	0	1	4.22	2.15	2.06	1	1	4
10	34	31.12	2	0	1	3.88	2.88	1	1	0	2

Where,

- Y1 = Travel Time (min).
- Y2 = Running time (min).
- X1 = No. of stopping for pickup and discharge of passengers.
- X2= Bus model: 1(new), 0(old).
- X3= Bus size: 1(small), 0(big).
- X4= Total delay time in (min).
- X5= Delay time for pickup and discharge of passengers (min).
- X6= Delay time at fixed interruptions (min).
- X7= No. of stopping at fixed interruptions.
- X8= Trip direction: 1 for Gaur City 1 to Axis House, 0 for Axis House to Gaur City 1
- X9= Waiting time in minutes.

For each trip by using private car the following travel time and delay data was collected and measured:

Table 2: Travel Time and Delay Data Private Car

Trip No.	Travel Time	Running Time	Delay Time	Direction
1	18	16.97	1.03	1
2	22	20	2	0
3	22	21.03	0.97	1
4	29	22.2	6.8	0
5	21	19	2	1
6	19	18.19	0.81	0

Data Calculation

Sample calculations for trip number 1 as shown in table 1.

1- Travel time = 34 min.

2- Running time = travel time-total delay time = 34 – 2.77 = 31.23 min

3- Total delay time = delay at fixed interruption + delay in pickup and discharge of passenger = 2 + 0.77 = 2.77 min

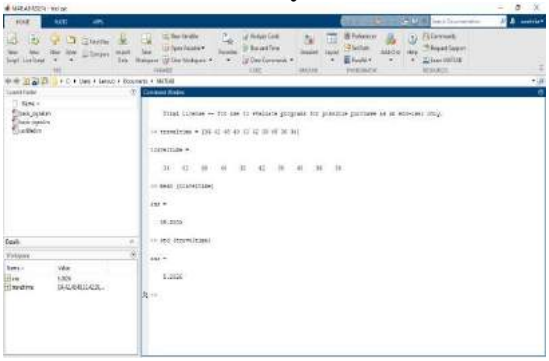
Descriptive Statistics for Trips by Using Bus

Table 3: Travel Time and Delay Data Statistic Data by Bus

Variable	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Y1	10	32.00	48.00	392.00	39.2	5.202
Y2	10	29.38	42.5	354.96	35.496	4.547
X1	10	2	4	56	5.6	0.737
X2	10	0	1	4	0.4	0.516
X3	10	0	1	7	0.7	0.483
X4	10	2.45	5.5	38.02	3.802	1.137
X5	10	0.77	4.37	21.4	2.14	1.318
X6	10	1	2.06	16.62	1.662	0.534
X7	10	1	1	10	1	0
X8	10	0	1	5	0.5	0.527
X9	10	0	11	52	5.2	3.765

Simple statistics for trips by using the public transit system shown in Table 4 is calculated by MATLAB.

Table 4: Travel Time and Delay Data Statistic Data by Bus



Sample calculations for trip number 1 as shown in table 2.

- Travel time = 18 min.
- Running time = travel time-total delay time = 18 – 1.03 = 16.97 min.

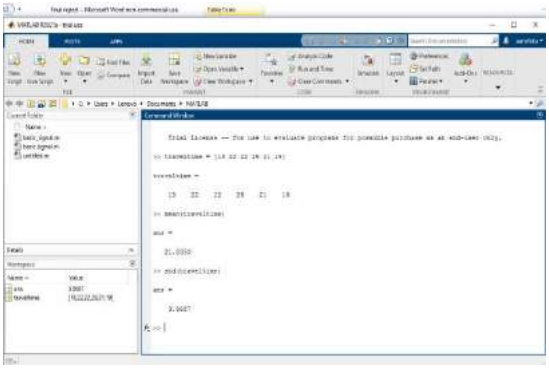
Descriptive Statistics for Trips by Using Private Car

Variable	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Travel Time	6	18	29	131	21.83	3.868
Running Time	6	16.97	22.2	117.39	19.565	1.9090
Delay Time	6	0.81	6.8	13.61	2.268	2.281

TABLE 4

Simple statistics for trips by using the private car are shown in Table 5 by MATLAB software.

Table 5



Analysis and Comparison

1. Analyzed mean travel time by using bus and car by MATLAB.

Value	Travel time by using the bus	Travel time by using the car
Mean value	39.2 min	21.83 min

Difference	17.37 min
% difference	79.56 %

By adding the mean waiting time, which is 5.2 min, to the mean travel time by using will be 39.2 + 5.2 = 44.4 min.

New difference	22.57 min.
New % difference	103.38 %

- The new difference is significantly high.

2. Analyzed mean running time by using bus and car by MATLAB.

Value	Running time by using the bus	Running time by using the car
Mean value	35.496 min	19.565 min

Difference	15.931 min
% difference	81.42 %

By adding the mean waiting time which is 5.2 min to the mean running time by bus, the total time will be = 35.496 + 5.2 = 40.696 min.

New difference	21.131 min.
New % difference	108 %

- By adding the mean waiting time for the bus to the mean travel time and the mean running time, the percentage difference is comparatively high.

3. Analyzed average travel speed by using bus and carby MATLAB.

-	Distance	Avg. Travel Time	Avg. Travel Speed
For the bus	16.00 km	39.2 min	24.49 km/h
For the car	16.00 km	21.83 min	43.97 km/h

It is clear that there is a major difference between the two travel speeds and that is due to the difference in travel time.

4. Analyzed average running speed by MATLAB

-	Distance	Avg. Running Time	Avg. Running Speed
For the bus	16.00 km	35.496 min	27.04 km/h
For the car	16.00 km	19.565 min	49.06 km/h

It is clear that the distinction in the average running speed is high. The distinction in average travel speed and average running speed between using the bus and the private car can be reduced to a minimum value and further recommendations are made.

Conclusion

- There is a significant difference between travel time by using the public transit system and by using the private car on Gaur City 1, sector-4, Greater Noida to Axis House, sector-128, New Delhi NCR line.
- The analysis show high difference in mean travel time and mean running time of public transportation and using car.
- The analysis show a significant difference in average travel speed and average running speed of using bus and car.
- The trip direction does not affect travel time.
- The waiting time for the public transit bus on Gaur City 1, sector-4, Greater Noida to Axis House, sector-128, New Delhi NCR line isn't too high. And can be reduced by:
    - Increasing the number of buses serving on the line; particularly through the peak hours.
    - By reducing the trip travel time.
    - By reducing the total delay time.
- It is clear that delay issue occur during peak hours, this can be solved by the spreading of peak period demand through the implementation of staggered work schedules.

Future Scope

- There should be continuous improvement on the public transit system in order to be able to compete with other modes of transportation, and to convince the public to use it. The improvements must include the:
    - Increasing the amount of buses to a reasonable number.
    - Using new models of buses.
    - Limiting and putting the bus stops in smart and safe locations.
    - Continuous review of the buses and bus drivers.
    - Using small and fast buses.
    - Improving bus drivers' scenario, in order to drive in a better mood and to do their work better.
- There must be continuous inspection and surveillance on bus drivers so as to be certain about they follow the traffic rules and laws. Also, there should be continuous checking of buses in order to be within specifications and safety laws.
- The authorities should verify fixed locations for bus stops for every line, and they should force the bus drivers to stop at pickups and discharge of passengers at the bus stops only.
- It is suggested to have bus priority treatment, such as: Exclusive bus lanes or the other priority in order to extend the capacity and efficiency and to reduce travel time and delay.
- Spreading of the peak hour demand through the implementation of staggering work schedule.

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EXPERIMENTAL STUDIES ON PARTIAL REPLACEMENT OF CEMENT AND SAND IN CONCRETE BY QUARRY DUST

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ABSTRACT

Due to the unavailability of natural sand nearby in the construction works and the needfor minimizing the concrete cost has madeto find out substitute material for fine aggregates or the sand. Quarry dust is a product which can act as substituting material for fine aggregate in the concrete. In developing country like India, where the utilization of quarry dust in concrete not only makes it economical one, but a environmental friendly material. From the past studies it has also been reported that some quantity of cement material in the concrete can be replaced by fine quarry dust without much change in the mechanical properties of concrete. In this thesis work, attempts have been made to replace fine aggregates partially with quarry dust and also cement partially replaced by fine quarry dust in the concrete. This thesis also reports the experimental studies undertaken to investigate some properties of quarry dust to be used as partial replacement material for fine aggregate or sand in concrete. Mechanical properties of partial replaced new concrete are compared to the conventional concrete. Here an attempt is made to replace the fine aggregates in the concrete by 0, 10, 20, and 30% quarry dust material. And also the same concrete material in which cement is replaced by 1, 2 3 and 4% by fine quarry dust. Such a concrete reduces the cost of production of concrete upto 6% for a cubic metre of concrete compared to the conventional concrete as reported in this thesis work.

Keywords: *Quarry Dust, Partial Replacement Of Sand, Partial Replacement Of Cement, Economical and eco-friendly concrete.*

Introduction

In this study cube specimens for compressive strength test, cylinders for split tensile strength test and beams for flexure strength test are prepared in the laboratory. Three samples for each set of percentages have been taken for conducting test and averages of results were taken. The samples were tested at the age of 7 days, 14 days and 28 days. The test on hardened concrete are destructive test which includes compressive strength test as per IS: 516-1959, split tensile strength test as per IS: 5816-1999 and flexure strength test as per IS: 516-1959.

Objectives

The objectives and scope of present study are –

1.To find the optimum percentage of replacement of natural sand with quarry dust at which maximum compressive strength is obtained.

2.Keeping the quantity of replacement for sand as constant which is obtained above and to replace the cement with little percentage of very fine quarry dust.

3.To conduct compressive strength test, split tensile strength test and flexural test.

4.To provide economical construction material.

5.Provide safeguard to the environment by utilizing waste properly.

Mix proportion

Mix proportion values are given in the following table 1.

Table 1: Mix proportion of M-25 grade concrete

Water	Cement	FA	CA
191.6 kg/m3	435kg/m3	846.6kg/m3	1070 kg/m3
0.44	1	1.946	2.46

For 9 cubes with replacement of 10% sand by quarry dust
Water =6.13 lts
Cement=13.92 kg
FA = sand(24.3kg) and QD(2.7kg)
CA=34.24 Kg
Similarly it is calculated for 20 and 30% replacement.

Experimental work results

The following tables 2 and 3 shows the compressive strength values for control concrete(CC000) as well as for other percentages of replacements. For example the notation CC420 indicates 4% of cement replaced by fine quarry dust and 20% of sand replaced by quarry dust.

Table 2: Compressive strength of cubes by replacement of fine aggregates by quarry dust

Cubes	CC000	CC010	CC020	CC030
7 days strength	31.85	30.14	36.92	28.44
14 days strength	38.51	36.96	38.81	33.33
28 days strength	39.85	38.14	39.85	38.45

Table 3: Compressive strength of cubes by replacement of fine aggregates and cement by quarry dust

Cubes	CC120	CC220	CC320	CC420
7 days strength	30.67	23.40	29.93	32.15
14 days strength	35.8	30.5	31.5	37.38
28 days strength	42.96	49.63	46.96	51.56

The following tables4 and 5 shows split tensile strength values and flexural strength values for control concrete as well as concrete with fine aggregate replaced by 20% quarry dust and cement replaced by different percentages of fine quarry dust respectively.

Table 4: Split tensile strength of cylinders by replacement of fine aggregates and cement by quarry dust

Cylinders	7 days Strength in N/mm^2	28 days strength in N/mm^2
CC000	2.56	3.80
CC020	3.39	3.92
CC120	2.26	3.58
CC220	2.97	3.07
CC320	3.54	4.48
CC420	2.78	4.20

Table 5: Flexural strength of beams by replacement of fine aggregates and cement by quarry dust

Beams	Max. load in kN	Max. displacement in mm	Flexural strength in N/mm^2
CC000	25.2	1.8	17.64
CC020	23.0	1.6	16.10
CC120	24.35	1.7	17.05
CC220	23.5	1.2	16.45
CC320	24.0	1.5	16.80
CC420	26.0	2.7	18.20

Figure 1 and 2 shows compressive strength of concrete cubes by replacement of fine aggregates and cement by quarry dust in the form of bar charts.

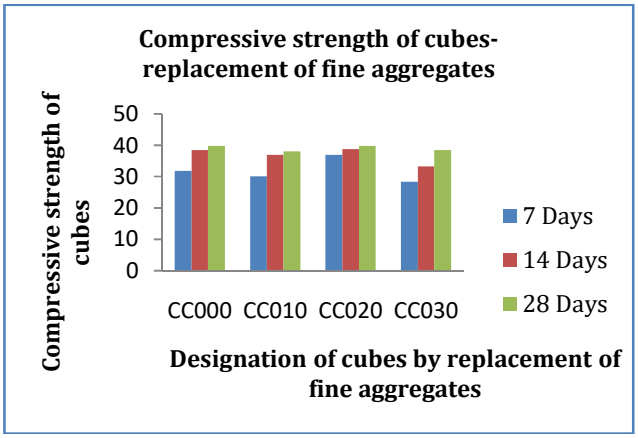

Figure 1: Compressive strength of cubes by replacement of fine aggregates

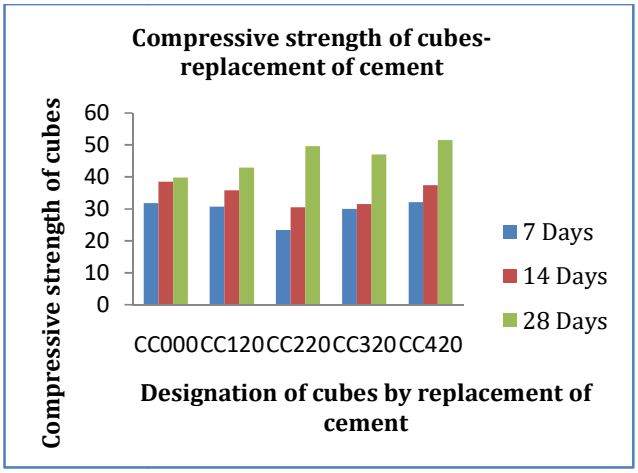

Figure 2: Compressive strength of cubes by replacement of cement

The following figures 4 and 5, shows variation of split tensile strength and flexural strength values of concrete cylinders and beams respectively by replacement of fine aggregates and cement by quarry dust in the form of linegraphs. Variation of maximum deflection is also shown for unreinforced beams in mm for all the specimens at 28 days. Split tensile strength of cylinders is calculated at 7 and 28 days. Flexural strength of beams is calculated at 28 days only.

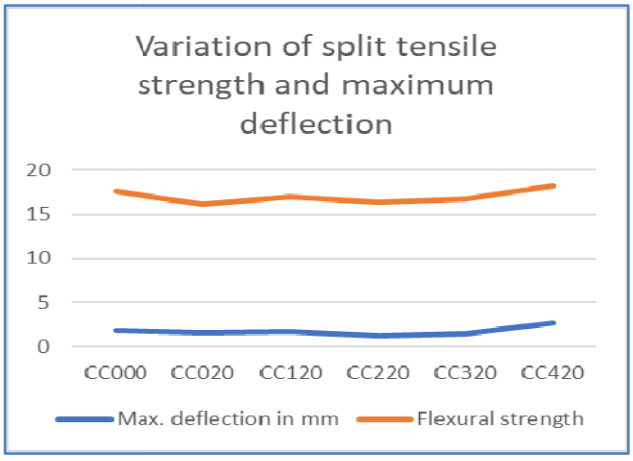

Figure 3: Variation of flexural strength and maximum deflection for various specimens

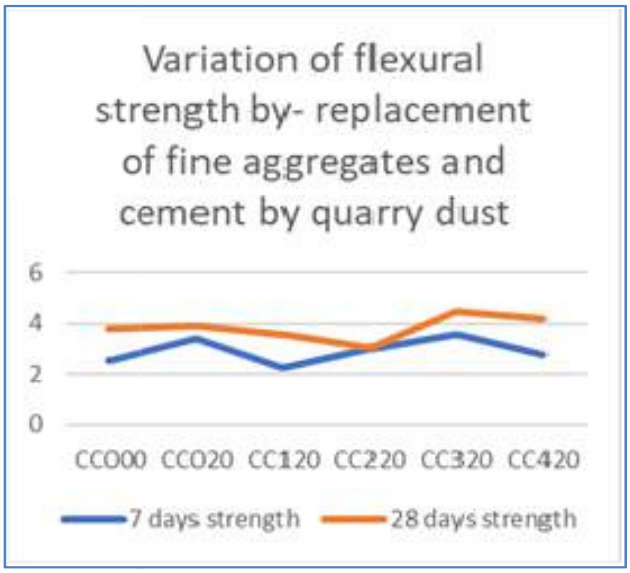

Figure 4: Variation of split tensile strength for various specimens at 7 and 28 days

Figure 5 shows a typical photograph taken during flexural strength of concrete beam testing.Unreinforced concrete beam is tested for flexure in the universal testing machine.

Figure 5: Flexural test of unreinforced concrete beams under Universal testing machine.

Conclusion

- Compressive strength of concrete cubes containing replacement of fine aggregates by 20% quarry is found to be maximum.
- Compressive strength of concrete cubes containing replacement of cement by 4% fine quarry dust and also fine aggregate replaced by 20% quarry dust is maximum.
- The other mechanical properties such as split tensile strength and flexural strength for replacing both fine aggregate and cement are also showing the higher values as compared to the concrete mix which has achieved maximum compressive strength by only replacement of fine aggregate.
- The cost of concrete with fine aggregate replaced by 20% quarry dust has been reduced by 4.58% compared to the conventional concrete.
- The cost of concrete with fine aggregate replaced by 20% quarry dust and cement replaced by 4% fine quarry dust has been reduced by 6.2% compared to the conventional concrete.
- The splitting tensile strength of concrete with fine aggregate replaced 20% quarry dust and cement replaced by 3% fine quarry dust is maximum.
- The flexural strength values are almost the same for all the mixes compared to the conventional concrete.
- By reduction in the cost and also by utilization of quarry dust as partial replacement in

concrete reveals that it is a economic and eco-friendly concrete.

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VIKKARAVANDI-PINALUR-SETHIYATHOPE SECTION ROAD OF NH-45C ANALYSIS AND DESIGN BY USING MXROAD

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ABSTRACT

Transportation plays a key role in our day to day life and geomentric design of highway plays a crucial role in the roadway design besides the pavement design and construction. Improper geomentric design leads to frequent conflicts and pose hazards to road users and also induce cost overrun .therefore it is necessary to plan and design the road with safe efficient , economic and easy for free movement of traffic. Geomentric design of highway involves the designing of cross sectional elements, horizontal alignmemt ,vertical alignment ,sight distance ,super elavation and other features. The purpose of this project is import roadway data with design standards in to the MXROAD Software. The object of this project is converting two lane to four lane with design of horizontal alignment and vertical alignment, super elevation ,sight distance and other Important features. And calculation of the pavement thickness of the road. The horizontal and vertical alignment was designed in MXROAD to achieve design precision and save time than being done manually.

Keywords: *AutodCAD MXROAD, Geometric Design, Horizontal Alignment, Vertical Alignment, Super Elevation.*

Introduction

Definition: Road transport means transportation of goods and people from one place to another place by roads. The transportation by the road is playing important role in our life. It provides door to door service by road transport. The economy of the country mainly depends on the road network. Highways are increases employment opportunities and ability to access education. There are different group of roads available in India such as nationals highways, states highways, major district roads, other district roads. The high quality road construction is increases the economy of the country. Proper geometric design will reduces the rate of accidents. The cost of project is mainly depend on the design of road structure. An alignment should be short, easy, safe, and economical. Geometric design consist various cross section components like lane width, shoulder width, curb width, median width, super elevation, etc. This project consist a complete geometric design of proposed road. In this project have explained in detail about the pavement thickness design. The detailed drawing is prepared for entire road. In this project we have designed geometric features and different components of road with help of MXROAD software.

Methodology

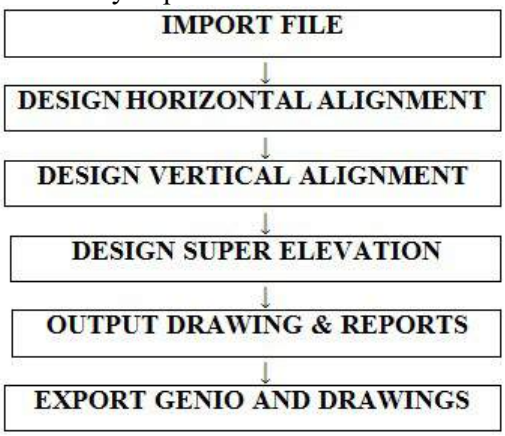

Figure 1: Flow Chart of MXROAD

Selection of Study Area

Part of expansion and upgradation programme, Reliance Infrastructure Ltd, Mumbai was granted to undertake improvement two lane to four lane from km 0.000 to km 60.250 from Vikkaravandi-Pinalur-Sethiyathope section road of NH-45C in the State of Tamil Nadu under NHDP IV by the National Highways Authority of India.

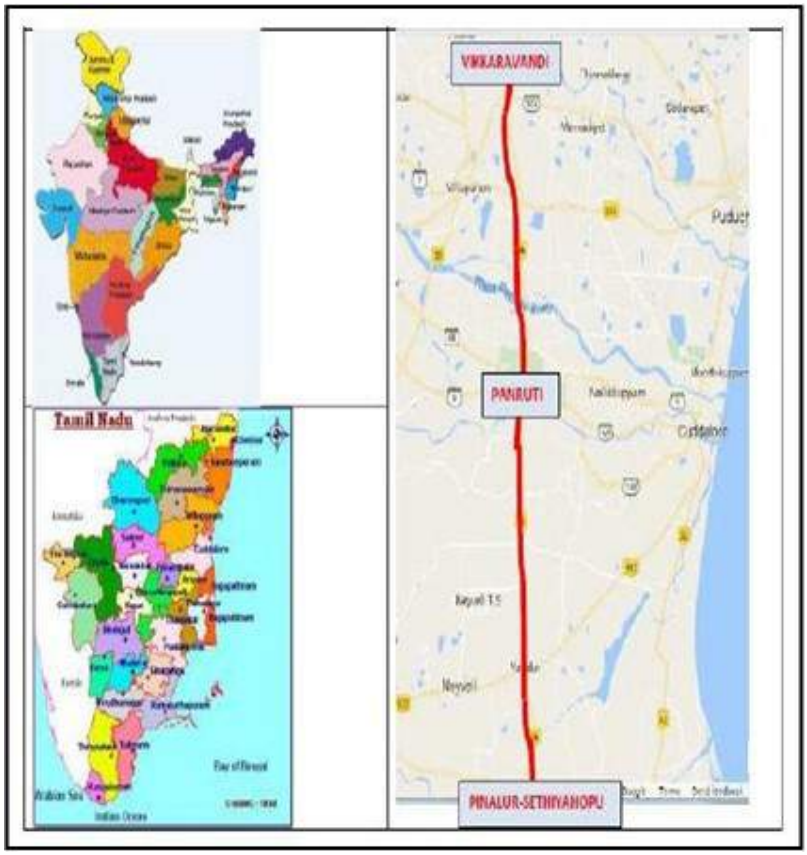

Figure 2: Selection of Study Area

Traffic Surveys

Traffic survey calculation of traffic characteristics and travel design following surveys were conducted.

- Classified Traffic Volume Count
- Turning Movement Surveys
- volume count of intersection.
- Axle Load Surveys
- Volume of pedestrian Surveys
- Speed and Delay surveys
- Opinion Surveys

Data Collection

The traffic survey have been done along the length of the road to set up base year traffic and travel features. The standard traffic attributes are significant for the evaluation of upcoming traffic and travel design.

a) Traffic Count

The following table shows traffic figures considered in CVPD (Commercialr Vehicle Per Days) for design process. Traffic growth rate is considered 5 % for further MSA calculations in accordance with traffic report and predicated forecast traffic figures.

Table 1: Traffic Figures

Vehicle Type	AADT (Both way)
LCV	943
BUS	476
2A	1201
3A	211
MAV	151
TRACTOR	156
TOTAL	3138

b) Axle Load

The axle load survey was conducted at site for two Sections to determine vehicle damage factor for flexible pavement design and loading group with axle load spectrum for rigid pavement design. The VDF obtained from axle load survey is presented below Table.

Table 2: Vehicle Damage Factor

Vehicle Category	VDF
LCV	0.5
BUS	1.2
2A	3.3
3A	4.3
MAV	4.6
TRACTOR	4.6

Design of Flexible Pavement as per IRC: 37-2001

Data

Number of commercial vehicles as per last count (P) =From table number 1

CBR Value = 10%

Annual growth rate of commercial vehicles (r) =5%

Lanea distribution factor (D) = 0.4

Vehicle damage factor (F) = From table number 2

Design life in years (n) = 15yeras

Initial traffic in the a year of completion of a construction in CVPD (A)=$A = P\ (1 + r)^x$

MSA calculation for pavement

$$N = \frac{365\ [\ (1+r)^n - 1]}{r} X\ ADF$$

By considering All vehicles the Total MSA (N) = 27 MSA

The total thickness of pavement is observed in design thickness chart From IRC 37-2001. Design a Bituminous layers are changed slightly to construction ease and as per regular practice. The detail of recommended crust is presented below Table.

Table 3: Pavement Composition

Sr. No.	Layer	Thickness (mm)
1	Bituminous concrete(BC)	40
2	Dense bituminous macadam (DBM)	85.5
3	Wet Mix Macadam (WMM)	250
4	Granular sub base(GSB) base	200
Total pavement thickness		575.5

Auto CAD Civil 3D

MXROAD is a software application made by Bentley Systems at first in the year 1996 and is developed year after year to achieve higher precision and conservation of assests. it utilizes the three dimentional input data for the generation and analysis of 3Dsurface.It creates the quick and accurate design of all the types of road. MX Command language uses simple repeatable command that can be recorded and replayed using wizards to save time and resources on iterations. MXROAD can be used in finalizing the most appropriate design alternative and can be used in developing the detailing processes in much easier and preservationist way. The database can be utilized by the to make and an notate 3D project models and the acquired outcome can be casted into other supporting arrangements

without the loss of any data. And the software can operate in Micro Station Windows, and Auto CAD graphics editor environment and thus indicates the it flexibility.

The following figures shows the design steps

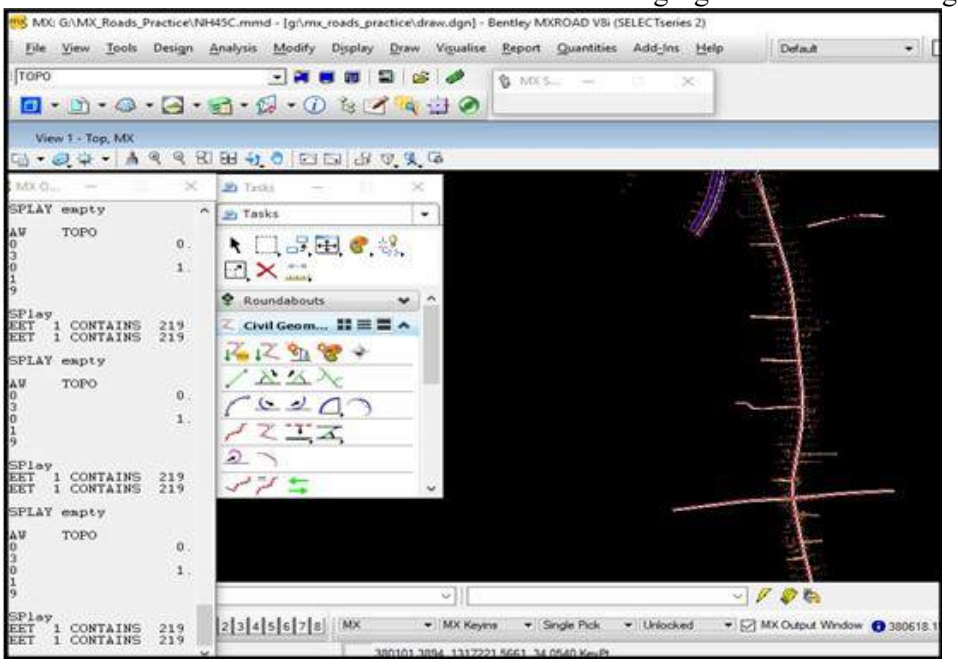

Figure 3: Import Topographical Survey Data

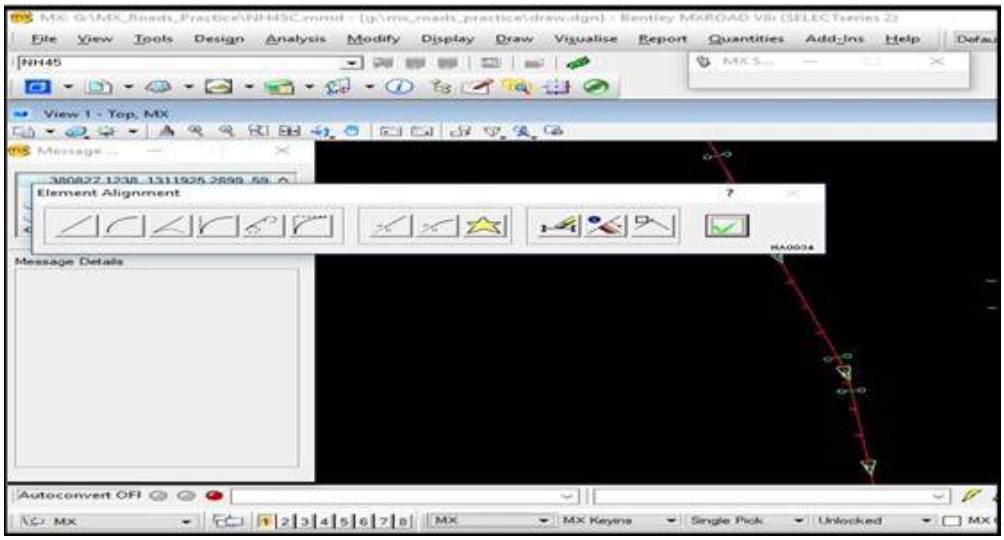

Figure 4: Horizontal Alignment

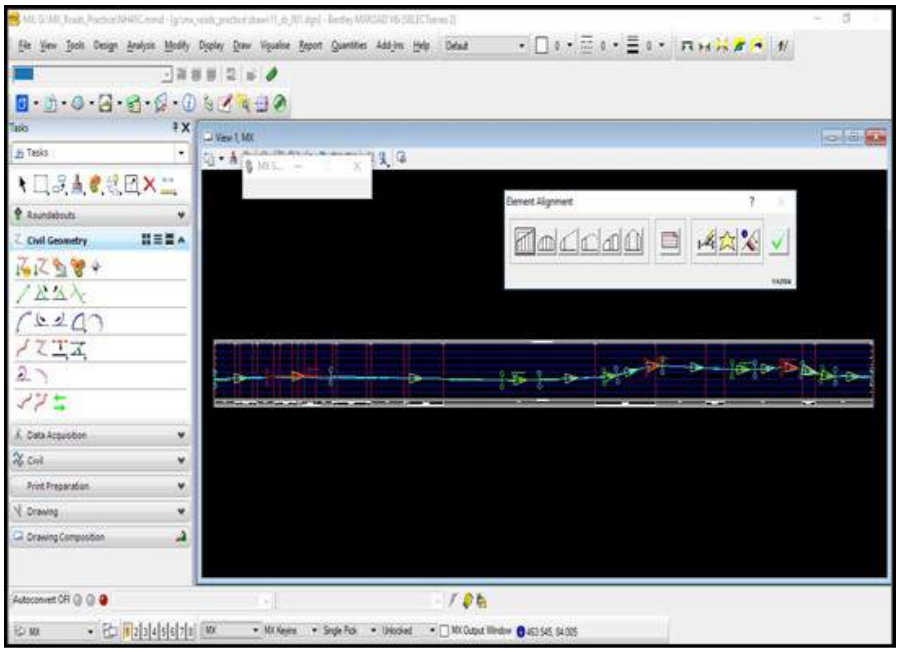

Figure 5: Vertical Alignment

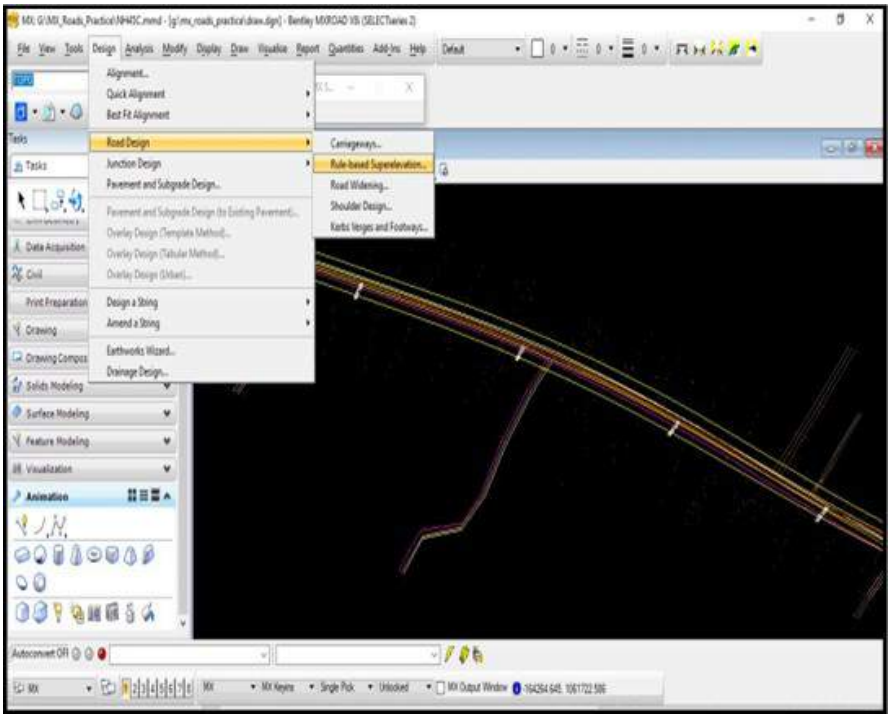

Figure 6: Super Elevation

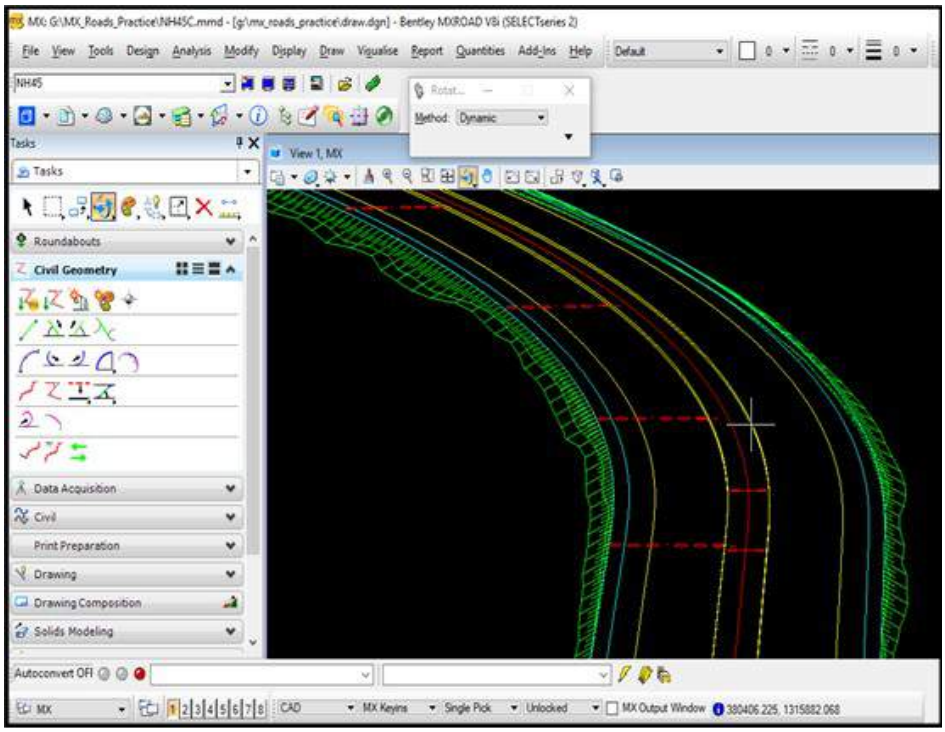

Figure 7: Roadway Generation.

Table 4

Four Lane Highway (0.000 to 60.2550)	
Carriageway	2×7=14m
Kerb shyness	2×0.5=1m
Median width in open country	1.5m
Median width in built up areas	1.5m
Width Paved shoulder	2.5
Width of Earthen Shoulder	1.5
Right of way	45 to 60m

Conclusion

- As per IRC standards, the ruling design speed suggested for state Highways in India with plain terrain is 100Kmph. And thus for this project under the prevailing conditions, the speed is maintained as 100Kmph throughout the design.
- Design of horizontal alignment, vertical alignment, intersections has been designed as per IRC
- For the projected traffic for 15years design period,and CBR 10%, the Flexible Pavement is designed as per IRC: 37-2012.
- A pavement crust thickness of 575.5 mm is calculated as per IRC 37-2001 and applied.
- The proposed alignment is designed to match the existing alignment at almost all locations.

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IDENTIFICATION OF CONSTRAINTS IN CONSTRUCTION PROJECTS TO IMPROVE THE PERFORMANCE

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ABSTRACT

In any construction project there are some factors which affects the duration of the project and total cost. Every project has some constraints. A constraint is a limiting factor that impedes the progress on an objective or goal. If the constraints are identified and understood in the initial stages, then the better performance of the project can be assured. The main aim of this project is to identify the constraints in the construction projects. Initially different literature reviews will be studied and identify the major constraints in the construction projects. The constraints are identified in different categories: (1) Economic constraints, (2) Technical constraints, (3) Environmental constraints, (4) Social constraints and (5) legal constraints. After the literature survey the questionnaire was prepared and the project details was collected. The data was collected by conducting questionnaire survey in the google forms sent to different project managers, clients, assistant engineers, site engineers, contractors etc. The collected data was by analysed Importance performance analysis method. The results shows the top constraints affecting the projects performance and suggest developing awareness in identifying in the initial stages of the project for improving the performance.

Keywords: *Constraints, duration, total cost, construction.*

1. INTRODUCTION

Constraints are present in every working environment. In current scenario of construction, constraints are major problems which reduce the chances of achieving goals. The limiting factors exists in all working environments. Although constraints are generally discussed in different literatures, there are little details on the study of construction project constraints. In the construction projects it demands multi party participation, which leads to bring complications in project management. With the bounded literature for the constraints in construction projects, it is necessary to identify the limiting factors in the projects, which helps to reduce the dropping of both time and money because of improper scheduling. The constraints should be controlled and managed in the early stages of the construction project.

A Constraint is defined as condition, agency or force that impedes progress on objective or goal. Every system will have atleast one constraint. Constraints narrates the relationship between objects and processes, also may cause undesirable outcomes or not supportive to the organizational goals in the projects. The constraints should be eliminated in order to reduce the wastage and make the work flow in well-organized manner. The proper managing of the constraints is necessary in the construction projects. In the construction projects identifying and reducing the constraints in the delayed activities helps to improve the project performance.

At present, our construction industries need to improve with new technologies and ideas. The major goal is the continuous development. Basically the working system is not proper, TOC helps in managing the constraints. TOC also helps in approaching in the new techniques to overcome delay. DrGoldratt introduced the management philosophy named Theory of Constraints in the book titled The Goal.

1.1 OBJECTIVES

1. To study the occurrence of constraints that caused and to determine the ways to eliminate them or the impact of the constraint.
2. To show the necessity of finding the constraints in the current scenario of the construction projects.
3. To develop knowledge in managing and controlling in the context of constraints in the current construction industry.

4. To find out the limiting factors in the particular commercial building project and study the delays and problems faced in different stages of the work and suggest the ways to overcome the issue.

2 LITERATURE REVIEW

Azar Izmailova, Diana Kornevab, ArtemKozhemiakinc (2016) has applied TOC (hypothesis of requirements for the disposal of the current conduct guidelines that are destructive in accomplishing the targets of the task. By applying the critical strides of TOC, there is a huge speed increase of the progression of work and culmination of the undertaking. This outcomes in diminishing the span of the undertakings i.e., fulfillment of more activities in a similar measure of time and expands the profit from interest in projects and the speed increase of the section.

PriyaBhagdewani, Prof. A.K.Kanase, Prof. R.D.Shinde (2017) has done the literature survey and classified different types of constraints based on surveys. Additionally done a contextual investigation on Ampco (Industrial Building at Chakan, Pune). The primary reason for the examination is to Increase the benefit, to improve the limit and to lessen lead times. This paper reasons that the administration should monitor the advancement at introductory stages and know about the imperatives and guarantee that enough assets are dispensed to diminish the limits from the limitations experienced at the execution stage as it were

Anjay Kumar Mishra, and Kailash Kumar Moktan (2019) has worked on the specified road construction project to identify the constraints in that particular projects and study the possibilities in Critical Chain and approach for effective scheduling. In this investigation of Road construction Project, the adjustment of plan and study report was found as significant requirement of the undertaking plan.

Tanaya Shinde1 Divyanshu Sachidanand2 Nikhil Sachdev3 (2019) has categorised different types of constraints and studied about these constraints by applying TOC to achieve high level performance in a project and to develop awareness in managing and controlling the working environment of the construction project in the context of constraints. This paper show the level of impact of constraints and suggests to know about these constraints at the execution stage management, keep track of progress and a note of constraints that encounter.

Utsav M. Bhavsar, Jayraj V. Solanki has done literature survey and the constraints have been divided into five major categories and prepared a questionnaire on these constraints. The data have been collected by distributing the questionnaire to different project managers, site engineers, clients, owners, contractors etc. The collected data has been analysed by Importance Performance Analysis (IPA). The final result shows the top constraints that are causing delay and cost overruns.

3 RESEARCH METHODOLOGY

In this research work, the following methodology was applied:

A questionnaire is prepared and sent to different individuals involved in any projects at any level i.e., site engineers, assistant engineers, contractors, project managers, clients, etc. The data has been collected on the basis of level of impact and performance level. In this study, the primary data and secondary data is also collected and analysed. The collected data has been analysed by using Importance performance analysis (IPA). A case study has been taken and studied for the better understanding of constraints and TOC has applied for removing the delays has happened.

A. PRIMARY DATA:

Personal observation: The project activities, its difficulties, landscape condition, communal issues were noticed. The informal meetings with project manager, site engineers was conducted to identify the issues faced during the construction of the project at different stages.

Questionnaire survey: A simple questionnaire was prepared based on the identified constraints and sent to different government bodies, private companies, clients, contractors and individuals involved in any construction works. The data has been collected on the impact level and performance level by using quantitate measurement. Questionnaire regarding financial issues, work flow, scheduling techniques, legal issues, resource allocation, limiting factors was asked to project managers, site engineers and contractors to realize their view point on the management of construction projects.

Desk studies: The project management characteristics of the project should be known by conducting many desk studies to identify the perception of project managers, stake holder and clients. Different desk studies was executed by consulting with local project members, Consultants

and clients to know different aspects of work, social, political & Environmental situation as well as economic situation of the work also for better understanding of the work flow methodology.

Case study: Progress reports, documents, close out report, legal documents & different payment certificates has been collected and examined and analyzed the work schedule of the project. For the commercial building, project constraints has known by questionnaire, content analysis and interviews has done for different individuals involved in the project. The counter measures for the problems faced in the project and elevating the system performance is given by applying the basic five steps of TOC. For the accomplishment of the project within the given time, some counter measures has identified and applied to the constraints to increase the performance level. This case study has been studied completely and discussed in-depth regarding limiting factors, scheduling techniques, monitoring the project for completing the project within time.

B. SECONDARY DATA:

1. Literature Review
2. Publications of various researchers on Project management.
3. Other available reports and journals.
4. Internet and websites.

C. DATA UTILISATION:

The data collected from the questionnaire was analysed by using Importance performance analysis method which gives the result of top limiting factors affecting the project plan. In the case study, the detailed work progress charts has collected and analysed to identify the major limiting factor in the construction project. Many interviews was done to know the perception of project managers, site engineers and stake holders. All the collected data was analysed to identify the limiting factor in the project plan and to apply TOC for the successful plan of the project.

4. MEASUREMENT OF DATA

1. Questionnaire survey:

The answers for the constraints disturbing the working environment of the construction was taken from 1-5. These numbers will indicates:

Scale	Each scale weight
1	Very low
2	Low
3	Medium
4	High
5	Very high

During literature study and interviews conducted for different experts in construction industry, we found 22 limiting factors. There are five major limiting factors (constraints) namely:

1. **Economic constraints:** The constraints regarding allocation of money and budget limit falls under economic constraints. If the economic constraints are not managed well, then it affects the performance and quality of the project. Improper allocation of the money is not the best option for achieving the project goal. The progress of the work may affect greatly due to the budget limit.

Ex: Improper allocation of money to different parties at the site, obtaining loan from financiers, financing the project by owner etc.

2. **Legal constraints:** Many rules and regulations are existing that are ruling the construction projects. Work law, safety regulations and supervision plans are the terms that are related to the legal constraints. On Sundays and public holidays there are certain works that should not be carried out in the construction work. The delay in project duration might happen during the planning stage if these legal formalities has taken seriously. If the government has implemented any new regulations then the schedule should be updated and the approvals has to be taken which comes under legal constraints. The impact of these legal constraints may lead to the delay in the project.

Ex: Permissions, approvals from NOC, land acquisition, safety regulations, approval for change in design etc.

3. **Environmental Constraints:** The project should run without causing any harm to the environment. The government should be on a responsible note during the planning and

design stage of project in granting the approvals. Air protection, noise control, tree preservation are the major government and public concerns for the healthy environment. One should be responsible and take the permission from the environment department before the execution of the project. This might take long time also affects the progress of the project.

Ex: Environmental clearance certificate, noise pollution etc.

1. **Technical constraints:**The problems faced during the execution of the project comes under technical constraints. These constraints generally refer to process in finishing the construction activities. Each activity must be finished prior to the next activity starts; each tasks acts as a limiting factor on the next activity. Technical constraints are more readily realised at design stage, but this does not helps to eliminate the constraints.

Ex: site congestion, access routes for site, storage availability, construction tolerances, etc.

4. **Social Constraints:** Local people's involvement greatly affects the construction working environment. For particular place or thing, one must be focused on people's emotions and sentiments. In some construction places, temples or church at the site create lot of problems to the progress of the project. These problems might be very small but are difficult to deal. These constraints will be seen in different forms: human resistance, emotional values, and ownership problems.

SNO	CONSTRAINTS	1	2	3	4	5
	ECONOMIC CONSTRAINTS					
1	COMPLETION OF THE PROJECT WITHIN TIME					
2	DIFFICULTIES IN OBTAINING LOAN FROM FINANCIARS					
3	IMPORPER ALLOCATION OF MONEY TO RELATED PARTIES					
	LEGAL CONSTRAINTS					
4	DIFFICULTIES IN OBTAINING WORK PERMITS					
5	LAND ACQUSITION					
6	APPROVALS FOR CHANGE IN DESIGN					
7	BUILDING REGULATIONS					
8	SAFETY REGULATIONS					
9	WORK LAWS OF CURRENT GOVERNMENT					
10	NOC'S FROM DIFFERENT DEPARTMENTS					
	TECHNICAL CONSTRAINTS					
11	INAPPROPRIATE PROJECT COST ESTIMATION					
12	DELAY IN SOLVING DESIGN PROBLEMS					
13	UNAVAILABILITY OF SKILLED ENGINEERS AND PROJECT MANAGERS					
14	RESTRICTED SITE AREA					
15	POOR PLAANNING AND SCHEDULING					
16	IMPROPER RESOURCE LEVELLING					
	SOCIAL CONSTRAINTS					
17	OWNERSHIP PROBLEMS					
18	ORTHODOX BELEIFS OF PEOPLE					
19	POLITICAL ISSUES					
	ENVIRONMENTAL CONSTRAINTS					
20	NOISE AND DUST POLLUTION					
21	WEATHER EFFECTS WHILE EXECUTING ACTIVITIES					
22	ENVIRONMENTAL CLEARANCE					

5. DATA ANALYSIS

From the questionnaire survey, 31 responses has received. The most important limiting factors affecting the working environment of the construction projects was identified by analyzing the collected data from the survey. The data was analyzed by using Importance performance method.

This method is a quantitative approach.

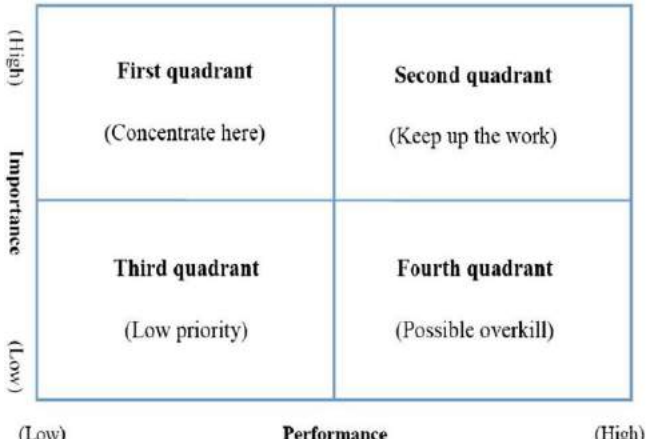
IPA Cartesian diagram was developed which consists of 4 quadrants.

1st Quadrant: Impact level is high, performance level is low

2nd Quadrant: Impact level is high, performance level is high

3rd Quadrant: Impact level is low, performance level is low

4th Quadrant: Impact level is low, performance level is high



IMPORTANCE PERFORMANCE ANALYSIS

	FACTORS	26	27	28	29	30	31	AVERAGE
4	COMPLETION OF THE PROJECT WITHIN TIME	3	2	2	1	2	3	2.166666667
5	DIFFICULTIES IN OBTAINING LOAN FROM FINANCIARS	3	1	1	3	2	2	2
6	IMPORPER ALLOCATION OF MONEY TO RELATED PARTIES	3	2	2	4	2	1	2.333333333
7	DIFFICULTIES IN OBTAINING WORK PERMITS	4	3	3	3	4	4	3.5
8	LAND ACQUISITION	5	4	5	5	4	3	4.333333333
9	APPROVALS FOR CHANGE IN DESIGN	3	5	4	5	3	5	4.166666667
10	BUILDING REGULATIONS	3	4	3	4	3	3	3.333333333
11	SAFETY REGULATIONS	4	5	5	4	5	3	4.333333333
12	WORK LAWS OF CURRENT GOVERNMENT	4	3	3	4	5	5	4
13	NOCS FROM DIFFERENT DEPARTMENTS	5	4	4	3	4	4	4
14	INAPPROPRIATE PROJECT COST ESTIMATION	4	3	4	3	4	4	3.666666667
15	DELAY IN SOLVING DESIGN PROBLEMS	4	4	3	3	3	3	3.333333333
16	UNAVAILABILITY OF SKILLED ENGINEERS AND PROJECT MANAGERS	3	3	3	5	5	5	4
17	RESTRICTED SITE AREA	4	5	5	4	4	3	4.166666667
18	POOR PLANNING AND SCHEDULING	3	4	4	4	3	4	3.666666667
19	IMPROPER RESOURCE LEVELLING	3	3	3	3	5	3	3.333333333
20	OWNERSHIP PROBLEMS	2	3	5	5	4	2	3.5
21	ORTHODOX BELIEFS OF PEOPLE	2	4	4	5	3	3	3.5
22	POLITICAL ISSUES	1	2	3	3	2	1	2
23	NOISE AND DUST POLLUTION	2	2	3	2	2	2	2.166666667
24	WEATHER EFFECTS WHILE EXECUTING ACTIVITIES	3	2	3	2	1	3	2.333333333
25	ENVIRONMENTAL CLEARANCE	1	1	2	3	3	2	2

AVERAGE VALUES OF IMPACT

3 FACTORS	PERFORMANCE	PERFORMANCE	PERFORMANCE	PERFORMANCE	PERFORMANCE	PERFORMANCE	AVERAGE
4 COMPLETION OF THE PROJECT WITHIN TIME	3	5	5	4	5	3	4.166666667
5 DIFFICULTIES IN OBTAINING LOAN FROM FINANCIARS	5	5	4	4	4	5	4.5
6 IMPORPER ALLOCATION OF MONEY TO RELATED PARTIES	4	4	4	5	4	3	4
7 DIFFICULTIES IN OBTAINING WORK PERMITS	2	2	1	2	1	2	1.666666667
8 LAND ACQUISITION	3	3	3	1	2	2	2.333333333
9 APPROVALS FOR CHANGE IN DESIGN	3	3	1	2	3	1	2.166666667
10 BUILDING REGULATIONS	3	2	3	1	1	3	2.166666667
11 SAFETY REGULATIONS	2	2	2	3	3	1	2.166666667
12 WORK LAWS OF CURRENT GOVERNMENT	2	1	3	1	2	2	1.833333333
13 NOC'S FROM DIFFERENT DEPARTMENTS	1	1	3	2	3	3	2.166666667
14 INAPPROPRIATE PROJECT COST ESTIMATION	1	2	2	2	2	2	1.833333333
15 DELAY IN SOLVING DESIGN PROBLEMS	3	3	2	1	1	3	2.166666667
16 UNAVALABLITY OF SKILLED ENGINEERS AND PROJECT MANAGERS	2	2	2	1	2	1	1.666666667
17 RESTRICTED SITE AREA	1	1	2	2	2	1	1.5
18 POOR PLAANNING AND SCHEDULING	2	2	3	3	1	2	2.166666667
19 IMPROPER RESOURCE LEVELLING	1	3	1	1	1	3	1.666666667
20 OWNERSHIP PROBLEMS	5	3	5	4	4	5	4.333333333
21 ORTHODOX BELEIFS OF PEOPLE	4	5	4	3	5	5	4.333333333
22 POLITICAL ISSUES	5	4	3	5	3	5	4.166666667
23 NOISE AND DUST POLLUTION	3	4	4	5	5	3	4
24 WEATHER EFFECTS WHILE EXECUTING ACTIVITIES	4	3	5	4	4	5	4.166666667
25 ENVIRONMENTAL CLEARANCE	4	5	3	3	4	4	3.833333333

AVERAGE VALUES OF PERFORMANCE

CONSTRAINTS	PERFORMANCE	IMPACT
COMPLETION OF THE PROJECT WITHIN TIME	4.241666667	1.891666667
DIFFICULTIES IN OBTAINING LOAN FROM FINANCIARS	4.4	2.075
IMPORPER ALLOCATION OF MONEY TO RELATED PARTIES	3.775	2.283333333
DIFFICULTIES IN OBTAINING WORK PERMITS	1.991666667	2.9
LAND ACQUISITION	2.033333333	3.983333333
APPROVALS FOR CHANGE IN DESIGN	2.241666667	3.866666667
BUILDING REGULATIONS	1.916666667	1.833333333
SAFETY REGULATIONS	3.516666667	2.183333333
WORK LAWS OF CURRENT GOVERNMENT	2.308333333	2.925
NOC'S FROM DIFFERENT DEPARTMENTS	2.116666667	4.025
INAPPROPRIATE PROJECT COST ESTIMATION	2.233333333	3.916666667
DELAY IN SOLVING DESIGN PROBLEMS	2.091666667	4.008333333
UNAVAILABILITY OF SKILLED ENGINEERS AND PROJECT MANAGERS	1.841666667	3.85
RESTRICTED SITE AREA	1.85	3.916666667
POOR PLAANNING AND SCHEDULING	1.991666667	3.991666667
IMPROPER RESOURCE LEVELLING	3.666666667	3.908333333
OWNERSHIP PROBLEMS	4.158333333	2.8
ORTHODOX BELEIFS OF PEOPLE	4.008333333	3.75
POLITICAL ISSUES	4.591666667	3.5
NOISE AND DUST POLLUTION	4.075	2.091666667
WEATHER EFFECTS WHILE EXECUTING ACTIVITIES	3.991666667	1.908333333
ENVIRONMENTAL CLEARANCE	3.983333333	2.025

AVERAGE VALUES OF IMPACT AND PERFORMANCE IPA CARTESIAN DIAGRAM:

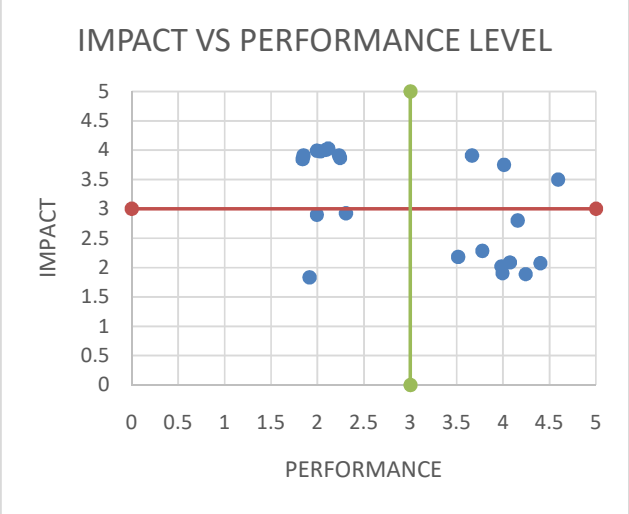
A four quadrant graph was plotted impact vs performance level by using the above calculations. The most important factors that leads to delay in the project can be identified by using the graph developed, Cartesian diagram of IPA. It gives the most important factors that are causing delays in the particular project.

We can identify the factors that are most vital for cost overrun & delays in the project by using the above Cartesian diagram of IMPORTANCE

PERFORMANCE ANALYSIS

- The highest priority will be considered as the factors that falls in 1st quadrant which shows the impact level is more and level of performance is low
- The lowest priority will be considered as the factors that falls in 3rd quadrant which shows the impact is low and performance is low
- The below table refers the impact level and performance level of each constraint.

From the graph developed by using the values of above tables, the impact level and performance has been found for each factor. These are shown in the below table



IPA CARTESIAN DIAGRAM

SNO	CONSTRAINTS	IMPACT	PERFORMANCE
	ECONOMIC CONSTRAINTS		
1	COMPLETION OF THE PROJECT WITHIN TIME	LOW	HIGH
2	DIFFICULTIES IN OBTAINING LOAN FROM FINANCIARS	LOW	HIGH
3	IMPORPER ALLOCATION OF MONEY TO RELATED PARTIES	LOW	HIGH
	LEGAL CONSTRAINTS		
4	DIFFICULTIES IN OBTAINING WORK PERMITS	LOW	LOW
5	LAND ACQUSITION	HIGH	LOW
6	APPROVALS FOR CHANGE IN DESIGN	HIGH	LOW
7	BUILDING REGULATIONS	LOW	LOW
8	SAFETY REGULATIONS		
9	WORK LAWS OF CURRENT GOVERNMENT	LOW	LOW
10	NOC'S FROM DIFFERENT DEPARTMENTS	HIGH	LOW
	TECHNICAL CONSTRAINTS		
11	INAPPROPRIATE PROJECT COST ESTIMATION	HIGH	LOW
12	DELAY IN SOLVING DESIGN PROBLEMS	HIGH	LOW
13	UNAVAILABILITY OF SKILLED ENGINEERS AND PROJECT MANAGERS	HIGH	LOW
14	RESTRICTED SITE AREA	HIGH	LOW
15	POOR PLAANNING AND SCHEDULING	HIGH	LOW
16	IMPROPER RESOURCE LEVELLING	HIGH	HIGH
	SOCIAL CONSTRAINTS		
17	OWNERSHIP PROBLEMS	LOW	HIGH
18	ORTHODOX BELEIFS OF PEOPLE	HIGH	HIGH
19	POLITICAL ISSUES	HIGH	HIGH
	ENVIRONMENTAL CONSTRAINTS		
20	NOISE AND DUST POLLUTION	LOW	HIGH
21	WEATHER EFFECTS WHILE EXECUTING ACTIVITIES	LOW	HIGH
22	ENVIRONMENTAL CLEARANCE	LOW	HIGH

2. CASE STUDY:

Project details:

1. Structure : 2B + G +16 Floors (Building height- 71.55 meter)

2. Built Up area: 16,71,357 Sqft
3. Floor Plate: 73,005 Sqft
4. Lifts Capacity: 24 Passenger Lifts (1600Kgs) + 04 No's Service Lifts (1350 kgs) + 3 No's Podium Lifts (1350kgs)
5. Start date: 1 September 2016
6. Finish date: 28 February 2019
7. Actual start date: 1 September 2016
8. Actual finish date: 30 June 2019

IT COMMERCIAL BUILDING, HYDERABAD

KEY PROJECT MILESTONE SCHEDULE:
PRE CONSTRUCTION PHASE:

S NO.	ACTIVITY	START DATE	COMPLETION DATE	ACTUAL START	ACTUAL FINISH
1	Appointment of PMC	01-Sep-16	01-Sep-16	01-Sep-16	01-Sep-16
2	Completion of General Excavation as per Dwg	01-Sep-16	30-Nov-16	01-Sep-16	10-Jun-17
3	Completion of Footing Excavation	15-Nov-16	14-Jan-17	01-Nov-16	30-Jun-17
4	Appointment of Civil Vendor	01-Sep-16	16-Sep-16	08-Aug-16	08-Aug-16

Reasons:

1. Delayed because the Labor hut was completely removed by 25 Feb 17 only, since parcel 3 structural woks were going on (Terrace & above terrace) and provided work front to excavation vendor.
2. Complete clearance including last 2 grids & pour 8 (STP & UG Sump) got by 25 Mar 17 due to site logistics towards batching plant.
3. Blasting not happening from 21 Apr 17 to till 5 may 17 due to non-clearance from commissioner.
4. Excavation of UG sump near T Hub for 1.5 m clearance got 20 3 June 17. (1 Month Delayed)

CONSTRUCTION PHASE:

S NO.	ACTIVITY	START DATE	COMPLETION DATE	ACTUAL START	ACTUAL FINISH
5	Foundation Works	30-Nov-16	29-Jan-17	07-Nov-16	04-Aug-17
6	Completion from Basement to Ground Floor - 2 slabs	30-Jan-17	10-May-17	28-Dec-16	16-Nov-17
7	Completion of FF to Terrace Slabs - 17 slabs	11-May-17	10-Jul-18	04-Sep-17	16-Oct-18
8	Completion of Glazing, Common Areas etc. including Masonry, Internal Finishes, Internal and External Plastering, Commissioning of MEP services & External Development	11-Jul-17	30-Dec-18	23-Jul-17	30-May-19
9	Handing Over to Tenant for fit Out	30-Sep-18		20-Oct-18	
10	Project Completion/ Ready for Move in	30-Dec-18		30-May-19	
11	Project Closeout (Administrative & Financial)	28-Feb-19		30-Jun-19	

During construction phase risk description will be done in different stages:

1. DESIGN
2. PROCUREMENT
3. CONSTRUCTION
4. QUALITY AND
5. SAFETY

Reasons:

1. Design stage:

- Delay in completion of finishes works
- delay in glazing & security kiosk completion
- delay in Stack Parking

2. Procurement stage:

- Frontek Tile cladding
- Boom Barriers

3. Construction stage:

- Delay in Shaft Handing over
- Delay Plastering at inner surface of lift masonry walls
- Delay in Hand over/ Takeover of all packages

4. Safety:

- Availability of deficit number of restrooms for working man force
- Common area lighting provision till work completion

Factors	suggestions
Delay in concrete work clearance	To be verified at the RMC plant to avoid delay
Delay in completion of finishes works	To propose during design stage
Delay in Stack Parking	Designers can think of making parking floor height of 5mts to overcome issue.
Frontek Tile cladding	Procurement of such imported long lead item (5months lead time) should be done along with façade package to ease coordination, execution & quality issues. To get such external cladding vendor on board along with façade

	vendor.
Boom Barriers	vendor should be get on board before appointment of common area finishes vendor for design coordination, clash detection to ease hassle free execution
Delay in Shaft Handing over	Precast wall panels as like Robotic/Aerocon to be used appropriately in order to reduce finishes materials lead/lift (blocks,sand,cement), debris generation & construction timelines too.
Delay plastering at inner surface of lift masonry walls	We should scope of works in common areas finishes BOQ
Delay in Hand over/ Takeover of all packages	During project commencement stage only we should seek HO-TO protocol from client & dedicated team details to ensure hassle-free HO-TO process. Formats for floor, asset list, and attic stock HO-TO to be shared with client's projects & FM team to avoid later date issues.
Availability of deficit number of restrooms for working manforce	A 3rd party to be deployed for this task & the expenditure of the same to be equally distributed & debited from all the vendors.
Common area lighting provision till work completion	Common area lighting scope to be put up in scope of electrical vendor to provide illumination post-civil vendor's lighting removal.

6 RESULTS

6.1 Questionnaire survey:

The factors falling in the quadrant one has more impact and less performance. These are the constraints that are disturbing the performance level of the project.

By doing IPA analysis, we recognized 8 out of 22 constraints have highest impact on the projects.

1. LAND ACQUSITION (L)
2. APPROVALS FOR CHANGE IN DESIGN (L)
3. NOC'S FROM DIFFERENT DEPARTMENTS (L)
4. INAPPROPRIATE PROJECT COST ESTIMATION (T)
5. DELAY IN SOLVING DESIGN PROBLEMS (T)
6. UNAVAILABILITY OF SKILLED ENGINEERS AND PROJECT MANAGERS (T)
7. RESTRICTED SITE AREA (T)
8. POOR PLAANNING AND SCHEDULING (T)

From the above results, TECHNICAL CONSTRAINTS was seen as the highest impact on the working environment of construction projects followed by Legal constraints.

6.2 Case study: Constraint of IT commercial Building, Hyderabad

This study was carried out to find out the delays happened and to apply TOC to reduce the impact of the constraint.

The actual time of completion of the project was 28 February 2019 but the actual completion of the project was on 30 June 2019. There was extension of 4 months.

The reasons behind the delays are:

- Lack of manpower (T)
- Delay in concrete work clearance (L)
- Non clearance from commissioner for blasting (L)
- Excavation of Sump (T)
- Delay in completion of finishes works (T)
- Delay in glazing & security kiosk completion (T)
- Delay in Stack Parking (T)
- Frontek Tile cladding (T)
- Boom Barriers (T)
- Delay in Shaft Handing over (T)

- Delay plastering at inner surface of lift masonry walls (T)
- Delay in Hand over/ Takeover of all packages (T)
- Availability of deficit number of restrooms for working manforce (T)
- Common area lighting provision till work completion (T)

In this IT commercial building project, Technical constraints has the greater impact on the delay.

7 CONCLUSIONS

From this research work, finding the constraints helps to improve the efficiency of construction activities by eliminating those constraints. In this study, the major constraints that are affecting the project progress are identified. From this research, Technical constraints are found to be the major ones.

In the project of IT commercial building, Technical constraints are found to be the major ones. So, the technical constraints should be taken care during the execution of the project.

8 RECOMMENDATIONS

Firstly one should notice the constraints in the project. The constraint should be known and the solution to overcome the issue should be found. In this project, some suggestion have been found to overcome the delays.

- To be verified at the RMC plant to avoid delay
- To propose during design stage
- Designers can think of making parking floor height of 5mts to overcome issue.
- Procurement of such imported long lead item (5months lead time) should be done along with façade package to ease coordination, execution & quality issues. To get such external cladding vendor on board along with façade vendor.
- Vendor should be get on board before appointment of common area finishes vendor for design coordination, clash detection to ease hassle free execution.
- Precast wall panels as like Robotic/Aerocon to be used appropriately in order to reduce finishes materials lead/lift (blocks,sand,cement), debris generation & construction timelines too.
- During project commencement stage only we should seek HO-TO protocol from client & dedicated team details to ensure hassle-free HO-TO process. Formats for floor, asset list, and attic stock HO-TO to be shared with client's projects & FM team to avoid later date issues.
- A 3rd party to be deployed for this task & the expenditure of the same to be equally distributed & debited from all the vendors.

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A STUDY OF TIME-COST OVERRUNS IN CONSTRUCTION PROJECTS

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ABSTRACT

In construction industry delay is quite common. Delay in any task or operation results in a time overrun which influence the completion of the work, thus it is essential to study cost and time overruns in construction. The present study is aimed at identifying the critical factors which affecting the time and cost overruns in the construction project. The data is gathered through online survey carried out by sending questionnaire to various stakeholders such as project engineers, site supervisors, contractors and academicians. A total 40 responses were collected and analyzed through Relative Rank Index (RRI) and critical factors are identified using Analytical Hierarchy Process (AHP). Based on the optimization 14 critical factors are estimated. These optimal factors include unavailability and failure of plant machinery, resource scarcity, rework due to errors in design, non-conformance of quality, low productivity, safety practices, site management, omission and errors in bill of quantities, material storage and precast yard, incomplete documentation, site investigation, delay in payments, geological surprises and ground condition, litigation, conflicts and disputes, price fluctuation. Then the case study of a residential building is carried out in Microsoft project (MSP) regarding cost and time overruns in the project and necessary suggestion is given to overcome the cost and time overruns in the construction project.

Keywords: *delay analysis, Relative rank index (RRI), Analytical hierarchical process (AHP), Microsoft project (MSP)*

1.0 Introduction

In construction industry, the completion of the project within the duration and budget is troublesome because of the poor management of stakeholders (ie, contractor, consultant, client etc.,). Delays are the foremost issues within the major progress of the work due to the resource scarcity, lack of technology, poor co-ordination between the parties etc., scheduling of activities is necessary to complete the project within the period of estimated duration and cost. Delay in the single activity which affects the duration of the project. Due to the delays actual cost becomes quite the estimated cost. These failures can lead to negative affections between the stakeholders involved in the project. therefore, there is a necessity for investigation on impacts of delays and the cost overruns.

Identifying the critical factors which impact on the project. The most favourable scores are given to the critical factors from that highest prioritized factors are undertaking to overcome the cost and time overruns in the construction project. Delay management is an important element in the construction project, as the delays accounts nearly 20-30% of the total cost of the project increases. Effective impact of delay management is the key to success of the projects.

The proper planning and scheduling the construction activities is the most important to estimate the duration and budget of the project. The project management is the main function in the construction. The scheduling and planning have been carried out in Microsoft Project (MSP) software.

1.1 Concept of Delay

There is a growing need for the project control and the management to the success of the project with needs and requirements. Every one of us are the project manager of projects of our own life with different task with deadlines, planning and scheduling. Delay analysis becomes the essential part of the project for the timely and economical completion of the project. besides a clear understanding of the general concept of delays in project, it helpful to classify the impacts of delays in different categories, to understand the wide range of possible actions for the prevention. Regarding the possibility to control the impacts on project with the acceptance level of delays, thus it is necessary to identify the factors which affects

the project by the contractor, consultants, clients etc.

Some of the common delay factors which affects the time and cost of the projects are as follows:

1. Timely unavailability and failure of plant and machinery
2. Resource Scarcity
3. Rework due to errors in design, execution, non-conformance of quality
4. Low productivity of labour and equipment
5. Non- compliance of safety practices leading of accidents
6. Poor site management (leading to wastages of materials & man hours)
7. Omission and error in bill of quantities
8. Unavailability of land for material storage and precast yard
9. Incomplete documentation of the project
10. Inaccurate site investigation
11. Delay in payments
12. Geological surprise, ground condition
13. Litigation, conflict and disputes
14. Price fluctuation

1.2 Objectives of the present study:

The main objective of the present study are:

- To find the various factors effecting Time and Cost Overruns
- To analyze and find the importance of each criteria using Relative Rank Index (RRI).
- To analyze and optimize the factors effecting Time and Cost Overruns using Analytical Hierarchy Process (AHP).
- To suggest the necessary measures for time and cost overruns in the construction sites.

1.3 Significance of study

Explored the strategies to identify the impacts of the delays on project by the stakeholders (contractor, consultants, owners, clients etc) involved in the project. Dealing with construction projects could use the results of my study for reducing cost overruns and schedule delays to improve the performance of future projects, construct profitable projects, and attract new customers for business growth and sustainability. Change orders add costs to projects, which have a negative effect on the total cost of building construction. Project managers can also adopt monitoring and controlling techniques for improving project success. Understanding and applying sustainability strategy has positive effects on productivity in the construction process.

2.0 Methodology

In this study integrating the Analytical Hierarchy process. The criteria factors studied and collected the necessary data from the questionnaire survey. The relative rank index is used to rank the criteria and analytical hierarchy process is applied to find out the optimal criteria factors..

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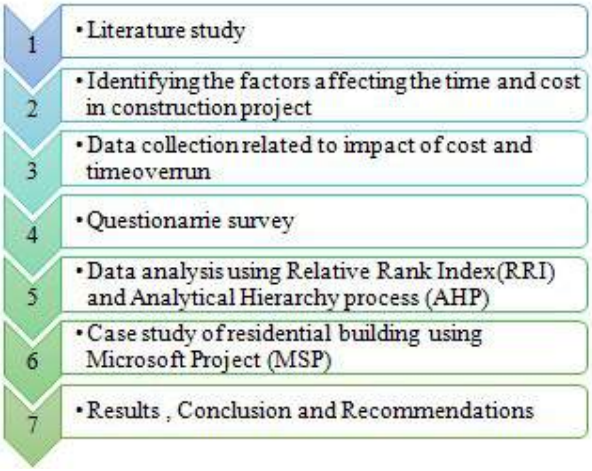

2.1 Relative Rank Index

The RRI technique is used for "comparison between the importance levels of variables and derived from the Likert scales which represents the level of importance of variables chosen by respondents which need to be transformed into Relative Rank Index that has a value of one or less". A five-point Likert scale is used in this study.

The RRI are often calculated using the subsequent equation;

$$RRI = \frac{1}{nN}\left(\sum_{i=1}^{n} lixi\right)$$

RRI : Relative Rank Index

n : The maximum Likert scale

N : The total number of responses

i : 1, 2….n

li: Likert scale (l1 is the least important and ln is the most important)

xi: The frequency of the i^{th} response

Table 1: five Likert Scale

s.no	Notation	Importance of criteria	Notation conversion into numerical value
1	PI	Poor Impact	1
2	LI	Low Impact	2
3	MI	Medium Impact	3
4	HI	High Impact	4
5	SI	Severe Impact	5

2.2 Analytical Hierarchy Process (AHP)

One of the most important useful methods for optimizing the critical factors which affects the cost and time overruns in the construction project. Analytical Hierarchy Process (AHP) is a mathematical decision-making technique which allows the considerable aspects of decision in both qualitative and quantitative. This technique helps in providing a series of comparison between one by one with the different alternatives of optimal criteria factors. It also helps in the judgement for the best alternatives of criteria choice.

The process of AHP was developed by Thomas L Saaty in 1970. According to Saaty, Analytical Hierarchy Process deals on three fundamental assumptions deduced from the words of the technique:

Analytic: mathematically the optimal alternative criteria are described analytically. Different optimal alternative criteria are assigned numerically scored with reasoned independently.

Hierarchy: the score for each criteria are calculated from its sub criteria arranged in a hierarchy and numerically ranked to each level. From the pair- wise comparison the scores of each level are identified.

Process: in the decision making the process is required to gather all the information, arrangement and alter. AHP guides the decision maker to most important and more information needed.

AHP calculations can be done in three main stages they are as follows:

(i) Construction of hierarchy

(ii) Evaluation of pair -wise comparison matrices (tables) and assessment for their consistency.

(iii) Calculation of the relative priorities of pair -wise comparison tables and final composition of priorities.

Table 2: Saaty's 1-9 scale pair- wise comparisons

1	Equal Importance
2	Weak or Slight
3	Moderate Importance

4	Moderate plus
5	Strong Importance
6	Strong Plus
7	Very Strong
8	Very, Very Strong
9	Extreme Importance

- Consistency Index

$CI = \frac{(\lambda \max \quad)}{(n-1)}$ where n is the matrix size

λmax is the weighted average sum matrix

- Consistency Ratio

CR =CI/RI where RI = Random consistency

3.0 Data Analysis and Results:

The factors impact on the time and cost overruns in projects are listed from the study of previous literature and discussions. These effects are categorized into 4 main categories are listed below,

Table 3 Causes for Delay

Contractor category	Consultant category	Client category	Miscellaneous category
Lack of requirement specification in tender document	Delay in finalizing the detailed drawings	Land acquisition	Non-utilization of professional construction\ contractual management
Timely unavailability and failure of plant and machinery	Delay in furnishing and delivering the site	Delay in payments	Political intervention
Resource scarcity	Poor communication and co-ordination between parties	Law and order problems	High inflation , interest rate and insurance
Under estimation of original cost	Incomplete documentation of the project	Delay in permits, approvals and inspection	Price fluctuation
Lack of technology	Lack of consultant experience	Ambiguous contractual clauses	Amendment in government taxation scheme
Financing by contractor during construction	Slow decision making	Excessive bureaucracy in project owner operation	Change in government regulation and law
Rework due to errors in design, execution, non-conformance of quality	Inaccurate site investigation	Geological surprises, ground condition	Weather effect
Low productivity of labour and equipment		Litigation, conflicts and disputes delay in handling over the site	Poor organization of the contractor or consultant
Non- compliance of safety practices leading of accidents		Delay in handling over the site	Application of quality control based on foreign specification
Controlling subcontractors by main contactor in the execution of work			
Unskilled operations			
Cost incurred for rehabilitation measures			
Poor site management			
Lack of skilled labour and operation			
Omission and error in bill of quantities			

Unavailability of land for material storage and precast yard			

To the above factors the Relative Rank Index is calculated based on the respondents are tabulated as below.

Example: calculation of RRI for A1 factor,

Likert scale	1	2	3	4	5
Respondents (no =40)	0	5	10	18	7

RRI $=\frac{1}{nN}(\sum_{i=1}^{n} lixi)$

= 1/(5*40) ((0*1)+(5*2)+(10*3)+(18*4)+(7*5))

=0.735

Table 4. factors and Relative Rank Index (RRI) value

F	Factors	RRI
A1	Lack of requirement specification in tender document	0.735
A2	Timely unavailability and failure of plant and machinery	0.755
A3	Resource scarcity	0.765
A4	Under estimation of original cost	0.695
A5	Lack of technology	0.7
A6	Financing by contractor during construction	0.675
A7	Rework due to errors in design, execution, non-conformance of quality	0.84
A8	Low productivity of labour and equipment	0.765
A9	Non- compliance of safety practices leading of accidents	0.77
A10	Controlling subcontractors by main contactor in the execution of work	0.63
A11	Unskilled operations	0.75
A12	Cost incurred for rehabilitation measures	0.65
A13	Poor site management	0.765
A14	Lack of skilled labour and operation	0.745
A15	Omission and error in bill of quantities	0.765
A16	Unavailability of land for material storage and precast yard	0.945
B1	Delay in finalizing the detailed drawings	0.730
B2	Delay in furnishing and delivering the site	0.695
B3	Poor communication and co-ordination between parties	0.725
B4	Incomplete documentation of the project	0.78
B5	Lack of consultant experience	0.745
B6	Slow decision making	0.695
B7	Inaccurate site investigation	0.765

C1	Land acquisition	0.730
C2	Delay in payments	0.77
C3	Law and order problems	0.705
C4	Delay in permits, approvals and inspection	0.740
C5	Ambiguous contractual clauses	0.66
C6	Excessive bureaucracy in project owner operation	0.695
C7	Geological surprises, ground condition	0.755
C8	Litigation, conflicts and disputes delay in handling over the site	0.780
C9	Delay in handling over the site	0.745
D1	Non-utilization of professional construction\contractual management	0.685
D2	Political intervention	0.685
D3	High inflation, interest rate and insurance	0.725
D4	Price fluctuation	0.75
D5	Amendment in government taxation scheme	0.665
D6	Change in government regulation and law	0.665
D7	Weather effect	0.715
D8	Poor organization of the contractor or consultant	0.715
D9	Application of quality control based on foreign specification	0.685

The RRI value >0.74 from the RRI analysis are taken for the further analysis of Analytical Hierarchy Process (AHP) using Saaty's 1-9 scale of pair -wise comparison.

Table 5: factors RRI> 0.74

Criteria	factors	RRI
C1	A16	0.945
C2	A7	0.84
C3	C8	0.78
C4	B4	0.78
C5	C2	0.77
C6	A9	0.77
C7	B7	0.765
C8	A15	0.765
C9	A13	0.765
C10	A8	0.765
C11	A3	0.765
C12	C7	0.755
C13	A2	0.755
C14	D4	0.75

A 14*14 pair-wise comparison matrix is constructed for the above criteria factors using Saaty's scale. The Eigen values, Priority vector and sorted weights are found and the consistency index and consistency ratio (CR) got from the matrix< 0.1, hence the matrix constructed is consistent. Thus, the AHP results showed that the chosen factors are the main factors impact on the time -cost overruns in the construction project.

Considering the above study of impacts criteria factors, a case study is carried out for a residential building.

3.1 Case study

The building is approved for a construction of residential building G +3.

- Site area of the building is cumulative of

35*20sqft.

- Location: Vikramaditya road, Lakshmipura , Bangalore
- Built up area: ground, first, second, third floor = 700sqft

  Terrace floor = 50sqft
- Expected Construction Time: 13months
- Project start date: June 2019
- Expected project completion date: Nov 2020

3.2 Estimation of quantities:

Estimation includes the quantities of the work carried out in the project. Help us to maintain the cost according to the work to complete within the budget and time.

Table 6: Estimated quantities

Sl .no	Items	Quantity	unit
1	Earth Work Excavation	2100	CFT
2	P.C.C Foundation Works	225	CFT
3	Footing Concrete	730	CFT
4	Soil Refilling	1145	CFT
5	R.C.C 1:2:4 for Column	350	CFT
6	Cement concrete block	3540	CFT
7	R.C.C 1:2:4 for Lintel	185	CFT
8	R.C.C 1:2:4 for Staircase	65	CFT
9	R.C.C 1:2:4 for Slab	1400	CFT
10	R.C.C 1:2:4 for Beam	720	CFT

In construction, the proper planning and forecasting of duration and the budget is most important. The scheduling of the project is done to complete the project within the period of estimated cost and time. In the present case study the estimation and scheduling of the project have been done using Microsoft Project (MSP).

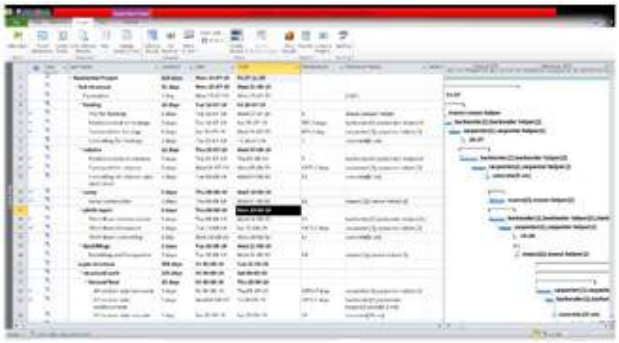

Fig. 1 MSP planning and scheduling

Table 7 estimated cost and time

Delay	Start date	Finish date	Duration	Cost (in RS)
Before delay	June 2019	Nov 2020	410days	79,44,500
After delay	June 2019	Feb 2021	483 days	83,92,300
			73 days	4,49,800

Table 8 reasons for delay

Activities	Delay days	Reason for delay
PCC for footing	1	Requirement of Dewatering and compaction due to rain
GF roof slab concrete	2	RMC delay
Tile work and painting	60	Pandemic covid crisis
External painting	7	Delay in payments
Compound and main gate	3	Delay in materials
Total delay and cost overrun (days and Rs)	73days	4,49,800

4.0 Conclusions:

The objective of the study was to identify the critical factors which impacts the time and cost overruns in the construction project. In the present study it is found that 14 out of 40 are the main causes of time and cost overruns, the most optimal factors are identified by using Analytical Hierarchy Process. The case study has been carried out to study the delay impact due to 14 criteria's using Microsoft Project (MSP) for more effective tracking of the project. In the current case study, the planned duration was 410 days but there was increase in duration by 73days by which total construction project was completed in 483 days. The causes behind this delay has been study and the reasons found are as following :

- Delay in payments by client to the contractor

There was delay in payments from the client due to personal issues during the pandemic.

- Resource scarcity due to improper transport

Due to lockdowns through-out the area there was delay in arrival of material to the site

- Fluctuations in price due to rise in material cost.

Sudden rise in steel price by 12 % per kg and cement price by 50% per bag there was increase in planned budget.

- Low labour productivity and equipment

The migration of labour to their hometown in the situation of pandemic have impacted badly on construction work progress there was difficulty in equipment transporting due to strict lockdown rules.

To specify the best successful project, contractor should always consider the critical factors in the construction project. The criteria's being varied from one to another contractor. Proper scheduling and needs to be done to decide how to allocate the limited resource to the projects.

5.0 Recommendations

- Though the findings from the study suggest the slight possibility to overcome the optimal criteria factors impact on delay, it would be appropriate to develop a common set of criteria for different types of construction project.

- An important area for further work would be develop a feedback process for criteria delay factors in terms of the degree of project success so that the selection system performance can be improved continuously

- The factors which have been studied more work can be done to overcome these factors to have a successful project completion.

- Case studies can be carried out using other software such as primavera.

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ASSESSMENT OF WATER QUALITY IN THE PREMISES OF SELECTED INDUSTRIAL AREA IN BENGLURU CITY

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ABSTRACT

The paper presents the investigation conducted to examine the water quality of selected industrial areas in Bengaluru city. A total of nine samples were collected from nine sites in the Peenya and Yeshwantpur Industrial Area, in which 3 were surface water and 6 were groundwater samples. Physiochemical parameters were analyzed for the calculation of the water quality index. The parameters are pH, Total Hardness, Colour, Odour, Taste, Turbidity, Dissolved Solids, Chlorides, Calcium, Magnesium, Iron, Fluoride, Nitrate, Sulphate, Nickel, Lead, Zinc. Comparing the physicochemical parameters results with the WHO and ICMR limits and the BIS standards and the guidelines for safe portable water shows that the total hardness, magnesium, fluoride, nitrate was present more than the permissible limit, and the rest of the parameters were within the limit. The groundwater and the surface water were found to be contaminated and account for human health

Keywords: *physiochemical parameters, WHO and ICMR limits, BIS guidelines*

Introduction

Water is most essential component for survival of human life of Earth, which contains minerals, important for human beings and all other living things. The availability of water both in terms of quality and quantity is very essential for the existence of mankind. There are different sectors where water is essential like domestic (drinking, bathing, washing, etc), fisheries, and agriculture and in industries. Lack of awareness and civic sense, use of inefficient methods and technology lead to more than 50% of water wastage in the domestic, agriculture & industrial sectors. According to the recent survey conducted by the National Institution for Transforming India (NITI), a government-run think tank, nearly 70 percent of all of the country's fresh water in the ground or on the surface is contaminated. Water from India's prominent rivers, lakes, and aquifers found to be more polluted than the waters of other nation. In India, around 20% of population is dependent on surface water as the only source of drinking water supply and rest 80% use groundwater for both drinking and irrigation. The groundwater is believed to be comparatively much clean and free from pollution than surface water, but due to rapid industrialization and urbanization prolonged discharge of industrial effluents, domestic sewage and solid waste dump cause the groundwater to become polluted and created health problems. A water quality index based on some very important physiochemical parameters provides a single indicator of water quality. The World Health Organization (2006) reports mentioned that approximately 36% of urban and 65% of rural Indian's were without access to safe drinking water. The availability of water in an area influences the settlement of communities and even today, the evolution of public water supply systems is tied directly to the growth of cities and towns. Less than 1% of fresh water is available on earth surface. The water quality index main purpose is to convert the results of parameter into the information which can be used and understand by public.

The present study was conducted to define the quality of water samples with special reference to physicochemical properties to decide its WQI. The analysed data were compared with standard values recommended by BIS & ICMR. Bengaluru is India's fastest-growing cities, so many industrialists plan to setup their industries in the city. Peenya is one of the oldest industrial belts in south Asia, which was established in 1970's and expanded rapidly now this belt include industrial area like Rajajinagar, Jalahalli and Yeshwantpura Sub urban area. Today 7500 industries are being registered in this industrial area, most of them are engineering, textile and agro-tech industries. Many industries do not have Effluent Treatment Plant in their premises and

they discharge the waste water without any effluent treatment and this is the major source of surface and ground water pollution. The industrial effluent contains suspended solids, toxic chemicals, non-biodegradable materials and other hazardous compounds.

Objectives

1. Identification of baseline conditions in the water-bodies and sources of water pollution in industrialarea.
2. Identification of any contaminated area.
3. Estimation of the pollution load carried by a water-course system orsubsystem.
4. Evaluation of the effectiveness of a water quality managementintervention.
5. Development of regulations covering the quantity and quality of waterdischarges.
6. Development of a water pollution control program.

Methods

Peenya Industrial Area is the oldest industrial belt in South Asia and is situated on coordinates. Yeshwanthpura Industrial Area is an extended part of the Peenya Industrial belt and is situated on coordinates. Around 7500 industries are being located in these areas. The area consists of many lakes and a river called Vishwabhavati river whih now has been dried up and its existence is now at danger.

Study Area

Region i: Peenya industrial area

Established in the early 1970's, the Peenya Industrial Complex is the biggest and one of the oldest industrial estates in the South East Asia, located in the northern part of Bangalore. This complex comprising of the Peenya Industrial Area formed by KIADB and the Peenya Industrial Estate formed by the KSSIDC, which was started with a few industries, is now spread over an area of about 40 sqkms. housing about 5000 small-scale industries and a few large and medium scale industries..

Fig 1: Map of Peenya Industrial Area

REGION II:YESHWANTHPURA INDUSTRIAL AREA

Yeshwanthpura Industrial Suburb, Yeshwanthpura is a Locality in Bangalore City in Karnataka State, India. It is belongs to BangaloreDivision.Goutham Nagar,ModelColony,MahalakshmiLayout, Mahalakshmipuram, L N Colony are the nearby Localities to Yeshwanthpura Industrial Suburb Yeshwanthpura. In this industrial area around 2500 small, medium and large-scale industries are being located.

Fig 2: Yeshwanthpura Industrial Area

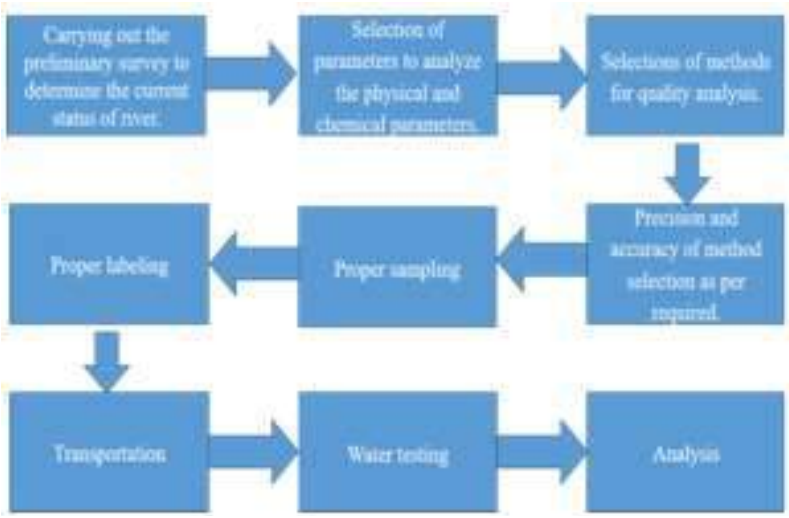

Fig 3: Strategic Methods

A preliminary survey was conducted in order to analyze the current situation and location of water bodies and sampling sites in these two areas. The physiochemical parameters were selected to analyze the physical and chemical properties of the water. For quality analysis proper methods were selected and then the precision and accuracy in those method was checked. Then the sampling was conducted following the proper rules and regulation and then the sampling container were labelled and then transported to the lab where the testing ahs to be done, the tests wee conducted within the 24 hours of sampling and then the calculation were done to get the results. On the basis of results obtained proper analysis was made. Fig 3 show the proper flow chart of the above-mentioned steps.

From region 1 Peenya Industrial area total 7 samples were collected out of which 4 were the ground water samples collected from the borewells situated on roads or inside industrial premises and the rest 3 were the surface water sample collected from the lakes in this area, the areas have been highlighted in Fig 1. From region 2 of Yeshwanthpura Industrial Area 2 samples were collected and those were the groundwater samples taken from the handpumps and the borewell.

Sampling Method:

For the sampling the containers were prepared. The containers used here for sampling were the plastic bottles which were washed and clean properly and then dried for 24 hrs. After this the containers were again rinsed with the distilled water and was kept

for drying for 24 hrs. while collecting the samples the containers were again rinsed with the sample water 2 to 3 times and then the sample was collected and the container was closed immediately.

For the groundwater Grab Sampling Method was adopted and water from the borewell or handpump were taken. For the surface water Dip Container Sampling Method was adopted where, the container was attached with the string and then then thrown toward the center of the water body for the sample collection. Just after collection each container were marked properly.

Results:

The results here show how much the water from these two industrial areas are contaminated on comparing them with the standards given by the BIS and ICMR. Here the following physiochemical parameters were analyzed pH, turbidity, Total Hardness, Magnesium, Fluoride, Nitrate, Sulphate, Nickel, Lead, Zinc, Iron to find out the water quality index of the region. Table 1 shows the parameter value obtained from all nine sites.

Table 1: Results at different sample sites

Parameter	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	SITE 6	SITE 7	SITE 8	SITE 9
pH	7.9	7.86	7.06	7.13	6.89	7.05	6.92	7.98	6.79
Turbidity	1.9	2.22	2.36	2.55	3.3	4.82	3.76	4.06	3.87
Total Hardness	742	684	606	526	670	602	590	645	598
Magnesium	109	122	89	93	85	78	72	68	76
Fluoride	2.9	2.75	3.19	2.98	2.48	2.69	2.12	2.35	2.05
Nitrate	64	60	54	49.2	47.9	50.9	58.1	62.1	67.9
Sulphate	60.2	55	62	68	54	72	69	66.3	58.8
Nickel	Absent	Absent	0.01	0.01	0.11	0.02	0.01	0.01	0.01
Lead	Absent	Absent	0.28	0.22	0.18	0.13	0.17	0.19	0.16
Zinc	3	3.5	4.33	4.1	6.45	5.45	4.98	4.23	5.56
Iron	0.22	0.22	0.28	0.25	0.2	0.27	0.29	0.24	0.21

Discussion:

From the above result obtained we found out that the parameters like total hardness, magnesium, fluoride, lead, nitrate were not available within the limit and due to this water in this area are not fit for direct consumption. In region 1 of Peenya Industrial Area the surface water was found with proper total hardness but with excess fluoride, nitrate and lead. The groundwater in region 1 was found with excess total hardness, fluoride, nitrate and lead. For region 2 it was found that the nickel and lead were absent whereas the total hardness, magnesium, fluoride, nitrate were present in excess amount. For both the region same treatment can't be given. For the surface water first the solid removal process should be done followed by the sludge processing and then the last process of disinfection and mild chlorination should be done. For the groundwater coagulation and flocculation followed by the filtration and
chlorination should be done.

The major problems that we found out due to which the water contamination rate was high is because of the direct discharge of industrial effluents into the water bodies. The industries

present in those areas must have the Effluent Treatment Plants within their premises and they should treat each effluent according to the guideline given by the authority. With wide variety of industries situated in these areas each industry should check the effluent and should setup a proper treatment plant for it. On the surface water layer of plastic and garbage was found this also contaminates the water. Regular discharge of the industrial effluents changes the soil characteristics and make it unfit for use and it also penetrate inside and contaminate the groundwater

Table 2: Parameter status at first region

SL NO.	PARAMETERS	ANALYSIS
1.	pH	Within the limit
2.	Turbidity	Within the limit
3.	TOTAL HARDNESS	More than the permissible limit
4.	MAGNESIUM	Within the limit
5.	FLUORIDE	More than the permissible limit
6.	NITRATE	More than the permissible limit
7.	SULPHATE	Within the permissible limit
8.	NICKEL	Within the permissible limit
9.	LEAD	More than the permissible limit
10.	ZINC	Within the permissible limit
11.	IRON	Within the permissible limit

Table 3: Parameter status at second Region

SL NO.	PARAMETERS	ANALYSIS
1.	pH	Within the limit
2.	Turbidity	Within the limit
3.	TOTAL HARDNESS	More than the permissible limit
4.	MAGNESIUM	More than the permissible limit
5.	FLUORIDE	More than the permissible limit
6.	NITRATE	More than the permissible limit
7.	SULPHATE	Within the permissible limit
8.	NICKEL	Within the permissible limit
9.	LEAD	Absent
10.	ZINC	Absent
11.	IRON	Within the permissible limit

Conclusion:

For the region 1 the surface water was found not fit for drinking purpose and it requires some basic treatment as solid removal treatment and the groundwater is also not fit for the domestic purpose, it requires basic filtration to make it fit for the domestic purpose.In region two the groundwater was not portable for the drinking purpose and in this region, it was less contaminated as compared to the region 1. With proper boiling also it can be used for the domestic purpose. Also, the population living near by the surface water should not throw their waste in the water bodies. Only the treatment before the use is not the solution, but each and every industry should trat their waste before disposal in order to reduce the contamination rate.

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CRITICAL FACTORS AFFECTING LABOUR PRODUCTIVITY AND MEASUREMENT OF LABOUR PRODUCTIVITY IN CONSTRUCTION PROJECTS IN NEPAL

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ABSTRACT

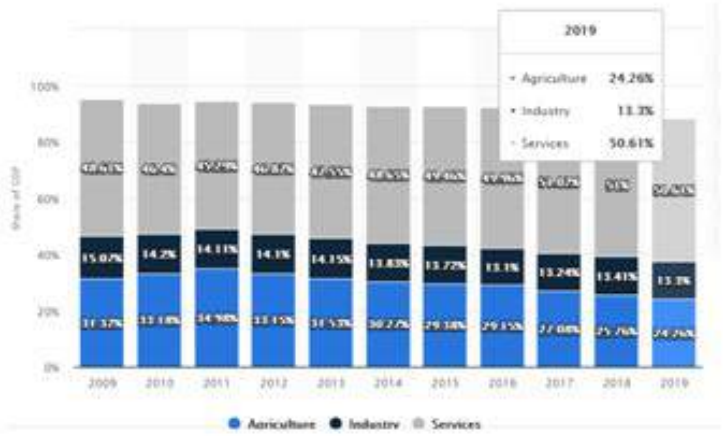
Construction productivity and labour productivity are key focus areas for any developing or developed countries. The present research is meant to identify the critical factors which are affecting the labour productivity and to propose a tool to measure labour productivity in construction projects in Nepal. The data is gathered based on an online survey carried out by sending questionnaires to various stakeholders such as project engineers, contractors and academicians. A total of 40 responses were collected and analysed through the Relative Importance Index (RII) technique. The classification factors that mainly affect labour productivity are evaluated. The five main ranking factors include 1. The Clarity of Technical Specification, 2. Site Layout, 3. Skill of Labour, 4. Construction Method and 5. The Degree of Consistency Between Disciplines. Also, some of the remedial measures to improve labour productivity are listed in this paper. From the Work-Study Method, it was also found that measuring labour productivity helps save time as well as the project cost.

Keywords: *Construction Productivity, Labour Productivity, Relative Importance Index, Rank, Measurement of Labour Productivity, Nepal*

1.0 Introduction

The construction industry is one of the largest industries in the country and has played a crucial role in socio-economic development and reducing unemployment. Productivity is one amongst the prime facets of companies within the construction industry. Industrial productivity is seen as an important contribution to the GDP (Gross Domestic Product). According to Iyer and Iha 2005 [1], the construction industry is the growth engine of each country, accounting for about 8-10 % of GDP on average. Employ the commonalty and make flows of assistances and goods with other departments. Important steps need to be taken to resolve critical and worrying issues.

In 2019, the gross domestic product (GDP) of Nepal germinate atop 50 percent from the service industry, while agriculture was the second-largest contributor with 24 percent, and industrial industry germinates 13 percent including the construction industry. In rural areas, most of the Nepalese population is dependent on agriculture for their livelihood. The gross domestic product (GDP) of 2019 Nepal is shown in figure 1.



(source: Statista.com)

Figure 1: GDP of Nepal 2019

The annual demand for the construction materials such as cement, bricks, iron rods, paints, galvanized sheets, etc is very probable to see an increment of up to 30 to 40 percent

in the construction industry for the next few years in Nepal. This means the manufacturers of construction materials are going to see good growth in their business.

In Nepal, despite the significant improvement in overall performance and operational levels, construction delays and defects in construction projects are still common. Nepalese construction clients are often unable to fully achieve their projects goals. This largely depends on the quality of the workforce. According to Prachi R., 2016 [2], it is very important to understand the factors that affect labour productivity, because construction productivity is directly related to labour productivity.

The main theme of any project, to achieve this goal, needs to focus on project management, including skills, work methods, education and training of workplaces and managers to solve problems, especially in the construction industry.

Therefore, to face the challenges particularly in the building construction industry to improve labour productivity, this paper articles introduces the factors that affect labour productivity and solutions to eliminate these factors in Nepal's construction industry. Henceforth, to find the measurement of labour productivity using work-study and time-study methods, the methodology was adopted used by Prachi R. Ghate, 2016 [2].

1.1 Research objectives

The main objective of this research is to realize the subsequent points:

- To identify the factors affecting labour productivity in Nepal's construction sector.
- To rank the factors supported the Relative Importance Index (RII).
- To suggest ways to boost factors supported the Relative Importance Index (RII).
- To find the measurement of labour productivity in the construction industry in Nepal.

1.2 Review of Literature

In order to have an excellent financial framework and excellent growth, a country must be high productivity. However, in the construction industry, labour productivity is a major issue, so labour productivity has become a crucial issue for the profitability of construction projects. Therefore, on the topic of labour productivity, many studies have been conducted to determine the factors that affect labour productivity in construction projects. Some of the past research based on construction labour productivity are under-mentioned.

In 2016, Prachi R [2].carried out a questionnaire survey in the Mumbai region. As a result, it showed the skilled labour and availability of material were the most influencing factors for labour productivity, concluding the skilled labour as a highly important factor for saving time as well as the cost of the project by using the work-study method.

A questionnaire survey with 350 professionals working in different firms and organizations all over the Indian construction industry was carried out by Saurav D. et al. (2019) [3]**,** concluded that productivity can be improved by changing the work culture, reviewing performance management processes, and for execution and proposing best practices and motivations.

According to Ambika S. et al. (2015) [4] management group factors are the most influencing factors to labour productivity in Bangalore, Karnataka. As factors are divided into six main categories: Labour, Management, Design/buildability, Tools and Equipment, Natural and Miscellaneous. Similarly, Mistry Soham (2013) [5], identified and ranked, delay in payment and high/low temperature as the most crucial factors using the Relative Importance Index (RII) and Analytic hierarchy process (AHP) respectively intheSouth Gujarat region of India.

M.R. Abdul Kadir et al. (2005) [6], the identified material shortage at the project site as the top factor which affects labour productivity in Malaysian residential projects. Rabia A. (2020) [7], divided all the 30 productivity factors into three primary categories: (1) Management, (2) Technological, (3) and Human/labour. As a result, lack of labour supervision was identified as a factor affecting labour productivity in Libya. As a conclusion and

recommendation, a training plan was developed for workers to adapt to the necessary measures to reduce the impact of unemployment and the use of local surplus labour.

Emmanuel E. et al. (2011) [8],created analysis over time and labour productivity relationship at a construction sites in Lagos, Nigeria. As a result, inadequate project funding, inadequate planning before project started, insufficient equipment and machinery, and delayed delivery of materials. The main causes of over time are important factors of low productivity, such as inappropriate construction methods, inappropriate building materials, and incorrect construction sites drawing/specifications.

Hickson and Elliset al. (2014) [9] conducted a questionnaire survey among the members of the Trinidad and Tobago Contractors Association (T&T). The lack of labour supervision was identified as the most affecting factors for construction labour productivity. Therefore, it is recommended to provide training/education personnel opportunities in T&T, personnel to improve their wage formation, incentives, and benefits, and improve supervision/management.

According to Mostafa E. (2011) [19], there is no standard definition of productivity concluding that state-of-the-art methods and productivity measurement techniques are very important while completing as many tasks as possible or maximizing work-load, work-output, and work-hours without following the work-plan is not the key point for productivity improvement. Durdyev S. (2011) [20] used multi-attribute techniques to find key curbs that hinder local productivity and improvement measures. As a result, it concluded that internal curbs like reworks, level of skills, poor supervision and coordination have more negative impacts on-site productivity than the external factors.

From the previous literature studies, it absolutely was observed that the researchers had identified several factors which are categorized into different groups. Thus, for this paper, a long list of several factors is shortened to 27 factors that are mostly influencing labour productivity in the construction industry/projects. These factors are divided into four categories: 1. Technological, 2. Personnel/Labour, 3. Management, and 4. External.

From the above literature [2,3,7,9] it is assumed that the productivity may simply be represented by a combination of an output and an input. Productivity is often described as a measure of the results of inputs. In mathematical form it may be shown as follows:

Productivity = Output ÷ Input

= Total output ÷ Total work hour

Different productivity measures are used for different purposes. Various aspects of the steps are outlined by Thomas et al. [10] are as follows:

a) Economic Model: Total Factor Productivity (TFP)

$$(TFP) = \frac{\text{Total Output}}{\text{Labour+Material+Equipment+Energy+Capital}}$$

b) Project Specific Model:

$$\text{Productivity} = \frac{\text{Output}}{\text{Labour+Material+Equip}}$$

c) Activity Oriented Model:

$$\text{Labour Productivity} = \frac{\text{Output}}{\text{Labour Cost}}$$

Or

$$\text{Labour Productivity} = \frac{\text{Output}}{\text{Work hour}}$$

Other individuals that measure partial or individual productivity factors include capital, employment, and productivity of equipment. Therefore, PFP can be determined as indicated in the following equations [7]:

d) $\text{Average labour productivity} = \frac{\text{Output}}{\text{Labour Employed}}$

e) $\text{Average capital productivity} = \frac{\text{Profit}}{\text{Capital Invested}}$

f) $\text{Equipment plan productivity} = \frac{\text{Output Quantity}}{Equipment}$

2.0 Study methodology

This paper's main purpose is to determine the key issues affecting labour productivity and measure labour productivity in Nepal's construction sector/industry. To attain this goal questionnaire survey was done by collecting data from small to large private

construction firms, government construction firms, and Institutes that are based in Nepal. According to related to previous productivity research and the opinions of local industry professionals and practitioners; a total of 27 factors affecting labour productivity in Nepal's construction industry were shortlisted and pre-selected. These factors are divided into four categories: 1. Technological, 2. Personnel/Labour, 3. Management, and 4. External. The target audience is civil engineers, contractors, academic instructors.

2.1 Questionnaire Design

The scoping study used E-mail technology to send questionnaires to respondents/participants across Nepal. The structured questionnaire was composed of two sections.

a) Section A: Respondent details

At this stage, the details of the respondents were obtained. The list of questions includes:

- Name of respondent
- Respondent designation together with Company name and address
- Respondent E-mail address

b) Section B: Factors that affect productivity of labour within construction industries

At this stage, all 27 factors were shortlisted that have an effect on labour productivity in the construction industry. These factors were divided into 4 groups and are:

- Technological
- Personnel/Labour
- Management
- External

2.2 Data Collection

A structured questionnaire was prepared from the previous analysis studies and suggestions of native industry specialists and practitioners that was circulated between response participants. To realize the specified research objectives data were collected through Online mode. A structured questionnaire was prepared in google sheet form and it had been circulated by e-mails to the participants. From the date of questionnaire circulation, I used to be able to get a total of 40 responses from the participants within one and half months.

Finding the statistical proportional sample size of a population, the subsequent equation are used (Hogg and Tanis 2009; Mistry Soham 2013; Ambika Sreenivasan 2015)[11,5,4]:

$$n = \frac{m}{1+\frac{(m-1)}{N}}$$

Where,

n = limited population size

m = unlimited population size

N = accessible population size

Now m is calculated by subsequent equation:

$$m = \frac{z^2 \times p \times (1-p)}{e^2}$$

where,

z = usedconfidence level statistic value, i.e., 1.645, 1.96, and 2.57 for 90, 95, and 99% level of confidence, respectively;

p = the degree of variance between population elements

e = the sampling error of the target to be calculated

However, since the value of p is unknown sincich et al. (2002) counsel the conservative value of 0.50 to be utilized in sample size.

Using 90% as confidence level, a value level (e) of 0.05, and the value of p as 0.5, the value of m often calculated as follows:

$$m = \frac{(1.645)^2 \times 0.50 \times (1-0.50)}{(0.05)^2}$$

$$m = 271$$

Hence, considering the N value as 182 of obtainable population size that was verified construction consulting firms based mostly in Nepal. n (effective sample size) is often calculated by using formula as follows:

$$n = \frac{271}{1+\frac{(271-1)}{182}}$$

$$n = 109$$

109 is obtained as effective sample size. So the sample is accurate and representative. During this survey total of 40 responses had been received out of 109 sample size that is 36.6% of the prescribed sample size.

2.3 Data analysis approaches

This study uses a 4-point rating system (1-less important - 4-very important) to determine the most important factors affecting the productivity of Nepal's construction projects. For analyzing data and to rank factors affecting labour productivity,

the RII value-related indicator process has been used based on the subsequent formula (Mistry Soham 2013; Hickson and Ellis 2014) [5,9]:

$$\text{RII (\%)} = \frac{4(n4)+3(n3)+2(n2)+1(n1)}{4(n4+n3+n2+n1)} \times 100$$

Where: n1, n2, n3, and n4, = number of respondents chose: 1- means less important; 2- somewhat important; 3- important; 4- very important respectively.

n is the weight assigned to each factor by the respondent (from 1 - 4), The RII value is between 0 to 4 (0 not included), RII value is higher, most importantly the factors that affect labour productivity.

In order to find an index to measure labour productivity, this study chose erection and column reinforcement binding. Skilled labour, skilled labour together with semi-skilled labour, and as well as change in site construction are the factors that are considered in the context of inclusive change.

For data assortment, work-study technique is used. Work-study can be defined as those techniques with particular study technique and the measurement leading serially to the investigation of all the factors for improvement of potency and economy. It aims to enhance employees' productivity to eliminate wastage with excellent working method increasing production with minimal fatigue. The work-study is additionally utilized in determining the quality time that a professional worker ought to go for operate once performing at a standard place.

Use the time polling method to collect the location data needed to perform the analysis. Time reading can be a work-in-progress method to record the time to complete a specific job or application in a specific environment (Prachi R. Ghate, 2016) [2].

Table 1: Time record of a column before applying for change

Sr. No.	Detail	Personnel used	Time duration (min)	Comment
1	Placing stirrups and steel bars to designated position	2	25	Time may vary
2	The assembly and complete overlap of the rebar	2	30	Time may vary
3	Selecting and placing of stirrups	2	25	Time may vary while selecting and placing properly
4	Stirrups binding atposition with binding wire	2	90	Time may vary accordingly with labours
Total			170	

Similarly, data is collected after redesigning the site structure and exchanging semi-skilled labour with skilled labour and Skilled labour together with semi-skilled labour.

3.0 Results and Discussion

The manual calculation was carried out for the Relative Importance Index (RII) technique to rank the factors which affect labour productivity in the construction

industry in Nepal. The following table (Table 2) exhibit the ranking of factors.

Table 2: Sort the factors affecting labour productivity according to the RII method

Sr. No.	Categories	Factors	RII	Rank
1	Technological	The clarity of technical specification	0.9437	1
2		The degree of changing during operation/the order of change	0.7562	12
3		The degree of consistency between disciplines	0.90	5
4		Complex design level	0.8087	7
5		Rework	0.6187	26
6		Site Layout	0.9375	2
7		Inspection delay or stringent by the engineer	0.7875	10
8		Limited site access	0.8375	8
9	Personnel/Labour	Personnel motivation	0.8937	6
10		Skill of labour	0.9187	3
11		Physical fatigue	0.7625	11
12		Lack of experienced personnel	0.7062	15
13	Management	Type-A (Human Resource Management)		
14		Lack of guidance from on-site supervisors	0.6937	17
15		Lack of personnel supervision	0.6875	18
16		Overtime work	0.6437	23
17		Crew size and composition	0.7500	13
18		Inadequate warehouse facilities	0.6312	24
19		Accidents caused by on-site safety plan	0.7937	9
20		Type-B (Material Management)		
21		Proportion of outsourced work	0.7437	14
22		Unrealistic plan and expected work results	0.675	20
23		Lack of materials	0.6937	16
24		Construction method	0.9125	4
25		Delay in payment	0.675	21
26	External	Bad weather conditions	0.6812	19
27		Delay in approvals by authorities	0.6687	22
28		Frequent changes in regulations	0.6125	27
29		Unstable local economy	0.625	25

The top five ranking factors which are mostly affecting labour productivity in Nepal are 1. The clarity of technical specification, 2. Site layout, 3. Skill of Labour, 4. Construction method, 5. The degree of consistency between disciplines.

3.1 Clarification of technical specification (RII = 0.943)

Clarification of technical specifications was hierarchic initial because of the most crucial factor that affect labour productivity in Nepal's construction industry. Technical specifications are written requirements and instructions used in construction drawings to complete significant construction projects. Therefore, the details provided with technical details and construction drawings are completely different. Technical specifications provide details regarding community projects not provided in the construction drawings.

Engineers/contractors should give the labours the correct information, clear instructions, adequate safety and training, and an appropriate level of supervision. So, they can work safely and take steps to protect

themselves from hazards and they will be also aware of their works and role. This is not only a legal duty but also contributes to the success of their projects.

3.2 Site layout (RII = 0.937)

The second most factor affecting labour productivity is site layout with the relative important index of 0.937. A well-designed site layout ends up in a productive, effective, and economical construction method and ultimately ends up in project success. If not properly designed it will have a negative impact on resources such as time, money, materials, personnel, and equipment.

Therefore, when designing the site structure, the available space, safety, site and entertainment facilities, site use rights, material storage, waste disposal, and service such as water supply, sewer, engineer/utility, etc. should all consider these factors also consider the construction site and maximize the efficient work environment and safe construction.

3.3 Skill of labour (RII = 0.918)

The skill of labour has been identified as the third critical factor of labour productivity. As in the construction industry, labour skill is very important to operate work. In the construction industry if they are lack skill quality of work will not be achieved which means a decrease in productivity and it will also have a negative impact on time and money.

So, to increase labour productivity in the construction industry engineers/contractors should focus on the skill of labour. To improve their skills engineers/contractors should provide proper training and seminars contents in the direction of standardization and modernization. Government should also pay more attention to their policies relevant to labours which encourage them to learn formal secondary technical education and learning programs.

3.4 Construction method (RII = 0.910)

The construction method ranked fourth because the most crucial factor that affect labour productivity. Construction methods are procedures and techniques that are used throughout the construction process. If the workforce is not familiar with the construction process, significant interruptions may occur. Experience is the key role in selecting methods to construction and run the system (Hickson and Ellis 2014) [9].

Therefore, to improve productivity proper planning and design should adapt to each project to reduce the construction time, cost and maintain overall sustainability.

3.5 Coordination level among design disciplines(RII = 0.90)

Coordination level among design disciplines was rank as the fifth critical factor which affects labour productivity. Coordination problems pose a major hindrance to work progress. The common coordination problems such as late issuance of revised construction/drawings, last-minute change of clients, poor resource allocation.

To improve coordination level there should be proper communications between engineering and architecture disciplines. They should always work together. Important changes need to be made in advance.

4.0Site Details

For the study, we tend to use the number G+2 to consider the column reinforcement binding and erecting of column, so the size of the column used was 300 mm × 300 mm. It was a running project of a residential building in Saptari district, Nepal.

4.1The impact in site layout change

It turned out that the steel bars and the stirrups were cumulated far from the construction site, which was not placed properly. Rebars and thus the stirrups should be well placed properly and individually aligned according to their diameter and size to minimized search time.

Result:

Let's say the common time taken for the column reinforcement binding and the erecting of column without site layout change = 155 minutes/column

The common time is taken for the column reinforcement binding and the erecting of column with site layout change = 140 minutes/column

Saving of time = 155 – 140 = 15 minutes/column

4.2 The impact of site layout changes by assigning skilled labour instead semi-skilled labour and skilled labour together with semi-skilled labour.

It has been observed that the workers used to prepare the column reinforcement are semi-skilled labour, and in some respects this is considered to be the result of reduced work quality and reduced time required. Without compromising work quality, time can be reduced by using skilled labours instead of semi-skilled labours.

As same skilled labour along with semi-skilled labour also can be used which also seemed reduction in time and quality of work was also not hampered. Actually, it's not always possible to use skilled labours only. So at that time, one can use skilled labour together with semi-skilled labour.

Result:

The common time is taken for the column reinforcement binding and the erecting of column without changes in semi-skilled labours =155 minutes/column

The common time is taken for the column reinforcement binding and the erecting of column with labours change with skilled labours = 110 minutes/column

Saving of time = 155 – 110 = 45 minutes/column

The common time is taken for the column reinforcement binding and the erecting of column with changing of labours with one skilled labour along with one semi-skilled labour =133 minutes/column

Saving of time = 155 – 133 = 22 min/column

After site layout changes, semi-skilled labours were replaced by skilled labours, and skilled labours together with semi-skilled labours, the changes were large; considering the impact of these changes, we analysed that the data to analyse the data for each floor and the entire building save time and cost.

4.3Calculation of Productivity

In order to find equation of the activity-based productivity model, use the following formula:

$$\text{Labour Productivity} = \frac{\text{Output}}{\text{Work hour}}$$

4.4Before each position and change in labours:

The total number of completed columns was 3 per day indicating that in 8 hours of operation 139.17 kg of steel reinforcement was used for erection and binding. In this case the productivity was calculated as:

$$\text{Productivity} = \frac{139.17}{8} = 17.39 \text{ kg/work hour}$$

4.5After application of the change in labours:

The total number of completed columns was 4 per day indicating that in 8 hours of operation 185.56 kg of steel reinforcement was used for the erection and binding of the column replacing semi-skilled labours with skilled labours. In this case the productivity was calculated as:

$$\text{Productivity} = \frac{185.56}{8} = 23.19 \text{ kg/work hour}$$

It shows an increment in labour productivity for reinforcement binding.

Again the number of columns completed were three and a half (3.5) per day in 8 working hours by changing labours with skilled labour along with semi-skilled labour. And 162.36 kg of steel reinforcement were used for the erection and binding of the column. From this the productivity will be calculated as:

$$\text{Productivity} = \frac{162.36}{8} = 20.29 \text{ kg/work hour}$$

Although we used skilled labour together with semi-skilled labour, it also shows an increment in labour productivity for reinforcement binding compare to semi-skilled labour only.

It can be seen from the following calculations that improving labour productivity can also save time and cost.

4.6Saving Time and Cost by making changes

The time-study method was used to sort data, so it can save a lot of time when site layout and labour costs changes, which means time can be saved for indirect cost-saving activities. The time and cost saving are calculated as follows:

4.6.1Save Time

4.6.1.1 Beforethe Change:

300 × 300 mm columns size per layer = 25 (no. of columns)
Number of columns completed before conversion = 3 per day
Total number of column completion days = 8.33 ≈ 9 days
Column unchanged time = 25 × 155 = 3875 minutes

4.6.1.2 After Installing Changes:

25 column time after changing site layout and transitioning from semi-skilled labour to skilled labour = 25 × 110 = 2750 minutes
Time saving per floor = (3875 - 2750) = 1125 minutes
This time is equivalent to (1125/110 = 10.22) (i.e 10 additional columns).
The time for each column is 110 minutes, each work is 8 hours per day, and the number of columns completed in each day = 4 columns
The time required to finish 25 columns = 25/4 = 6.25 ≈ 6 days
Time saved after change = 3 days

4.6.1.3 Again Installing Change:

25 column time after changing site layout and transitioning labour to skilled labours together with semi-skilled labour = 25 × 133 = 3325 minutes
Time saving per floor = (3875 - 3325) =550 minutes
This time is equivalent to (550/133 = 4.13) (i.e 4 additional columns).
133 minutes per column, 8 hours per working day, number of columns finished per day = 3.5 columns
The time required to finish 25 columns = 25/3.5 = 7 days
Time saved after the changes = 2 days

4.7.2 Cost Saving

4.7.2.1 Before theChange:

Semi-skilled labour daily wages = Rs. 800/- (In the context of Nepal)
Labours number = 2
The number of days required to finish 25 columns before the change = 9 days
If the site is not carried out any change, the cost of days for each layer/floor of semi-skilled labour = 9 × 800 × 2 = Rs. 14,400 /-

4.7.2.2 After Installing Changes:

Skilled labour daily wages = Rs. 1,000 /- (In the context of Nepal)
Labours number = 2
The number of days required to finish 25 columns before the changes = 6 days
If the site is not carried out any changes, the cost of days for each layer/floor of skilled labour= 6 × 1000 × 2 = Rs. 12,000 /-
Savings per Floor = 14,400 – 12,000 = Rs. 2,400 /-

4.7.2.3 Again Installing Changes:

Skilled labour daily wages = Rs. 1,000 /-
Semi-skilled labour daily wages = Rs. 800
Labours number = 2
The number of days required to finish 25 columns before the changes = 7 days
Cost of one skilled labour and one semi-skilled labour per layer/floor, if the site is not carried out any changes = 7 (1 ×1000 + 1 ×800) = Rs. 12,600 /-
Savings per Floor = 14,400 – 12,600 = Rs. 1,800 /-

4.8Building Cost Saving:

Floors/layers number = G + 2 = 3
Skilled labour saving per floor = Rs. 2400 /-
Entire building net saving = 2400 × 3 = Rs. 7200 /-
Again, saving cost per floor using skilled labour together with semi-skilled labour = 1800 /-
Entire building net saving = 1800 × 3 = Rs. 5400 /-

4.9Comparison

Comparison between skilled labour along with semi-skilled labour and skilled labours.
As we got the saved time data for erection and binding of 25 columns for skilled labour along with semi-skilled labour = 3325 minutes
And for the skilled labours time saved data for erection and binding of 25 columns = 2750 minutes
Time saving per floor = 3325 – 2750 = 575 minutes
This time is equivalent to = 575/110 = 5.22 (i.e 5 extra columns)
As for cost per floor for skilled labour along with semi-skilled labour = Rs. 12600

And for the skilled labour cost per floor = Rs. 12000
Saving cost per floor = 12600 – 12000 = Rs. 600/-
Entire building net saving = 600 × 3 = Rs. 1800/-

Hence from the comparison between skilled labours and skilled labour along with semi-skilled labour, the most preferable labours are skilled labours to save time and as well as cost. But it's not always possible to use skilled labours only so in that situation we can use skilled labour along with semi-skilled labour too in comparison to semi-skilled labours only, to save time and as well cost and quality of work also will not be minimized.

5.0 Conclusion and Recommendation

In this paper, a total of 27 factors were identified which are divided into 4 groups that are most affecting labour productivity in construction projects in Nepal were analyzed with the RII technique. According to the questionnaire survey in Nepal and after analyzing it, there are 5 factors which are mostly affecting the labour productivity, they are: a) The clarity of technical specification, b) Site layout, c) Skill of labour, d) The degree of consistency between disciplines, e) Construction method.

The results are expected to help Nepal's construction industry by educating all parties about the positive and negative effects of relevant factors, it can help them save time and cost on construction projects, reduce projects delays and keep them in the country.

In order to improve the country's labour productivity, according to research, it is recommended:

1) In the construction industry, technical specification clarification is very important so engineers/contractors should give the labours the correct information, clear instructions, adequate safety and training, and an appropriate level of supervision. So, they can work safely and take steps to protect themselves from hazards and they will be also aware of their works and roles.
2) As for site layout, it should be very properly designed so that there won't be any negative impact on resources like time, money, material, labour, and equipment by considering factors like space available, security, site accommodation and welfare facilities, access to the site, storage of materials, waste management and recycling areas, and temporary services such as water, drainage, power.
3) In the construction industry skill of labour is also very important to operate work to achieve a quality of work. So engineers/contractors should focus on labour skills and improve their skills should provide proper skill training and seminars contents in the direction of standardization and modernization.
4) In the construction industry in Nepal, the construction method is still the same old-school construction technique. So, government, expertise should change their ideas, perspectives through the time of modernization and standardization.
5) Most importantly to reduce hindrance to work progress there should not be any conflicts or coordination problems between design disciplines, contractors, and labours.

The skill of labour is major factor affecting labour productivity. From the study, it was observed that using skilled labour instead of semi-skilled labour, helps in saving time and cost without affecting work quality. It also helps in the increment of labour productivity.

But it's not always possible to use skilled labours only. So at that time, we can use skilled labour along with semi-skilled labour too. In comparison to semi-skilled labours only, skilled labour along with semi-skilled labour is much more helpful in saving time and as well cost too without minimizing the quality of work.

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DEVELOPMENT OF CYCLE TRACK FROM CALL TEX CIRCLE TO KUNIGAL CIRCLE, TUMAKURU

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ABSTRACT

The Indian subcontinent is going through a phase of rapid Urbanization. In India alone it is expected that 50% of its population will live in urban centres by the year 2030. This urbanization is mostly on account of the growth of smaller towns and cities into major urban centers. The road development in these areas focuses mainly on improvement of existing infrastructure as land acquisition poses difficulties and restrictions for widening. This often results in road functions associated with wider stretches imposed on narrower right-of-way (ROW). To make this possible provisions for motorized vehicles are prioritized over pedestrians, cyclists and other Non-Motorized Vehicle users, who are often neglected and compromised.

Although there are many ways to improve Non-Motorized Transport (NMT) facilities, there are also several barriers to overcome; for example, insufficient technical staff/design expertise. In addition, some people consider walking and cycling outdated, unsophisticated, unsafe and unexciting compared with motorized modes, or even to be symbols of poverty and failure. NMT has tended to be ignored by policymakers in the formulation of infrastructure policy and positively discouraged as a service provider. On recognizing this Tumakuru City Corporation, Urban Development Department, Government of Karnataka has decided to take up the work of constructing cycle track under AMRUTH funding. Since Tumakuru city is also listed in SMART city where in NMT works have also being proposed under SMART cities funding, the consultants in consultation with the city authorities have selected two major roads under AMRUTH scheme for developing cycle tracks such that in future it interlinks the proposed cycle network under SMART city..

Keywords: *Cycle Track, Call Tex Circle, NMV*

Introduction

Tumakuru city is hub for various educational institutional namely the likes of Siddaganga Institutions, Siddhartha Institutions etc., therefore the population within the city are young and vibrant. The city also has Amanikere Lake situated within the heart of Tumakuru city and is being developed as a recreational hub for the city inhabitants.

Since Tumakuru is being developed as a Smart City, the area for development that has been selected for it is the central business district (CBD). The surrounding areas along the CBD have a greater potential for various developments one the most prominent is the Pedestrian and Cycle track along the two roads of the city. One along the Shivkumar Swamiji Circle to Amanikere Lake (DC office) i.e. along the old NH4 and the other is along the Caltex Circle to Kunigal Road Circle along

the Tumakuru-Kunigal Road. Surrounding areas along the two proposed cycle track incorporate mixed development mainly residential along with educational centers.

The Cycle tracks are selected based on its connectivity and proximity of Schools and colleges with the residential layouts and parks/ green spaces/tree canopy and space availability. This report is with respect to the proposed cycle Track from Call Tax Circle to Kunigal Circle along Tumakuru-Kunigal.

Study Area

The proposed cycle track is proposed along the Tumakuru-Kunigal road, passing via Sri Siddhartha Institute of Technology. Currently, the road is developed by TUDA.. The entire stretch is about 2.8 kms. The road has prominent land marks like Sri Siddhartha Institute of Technology, Sate bank of Mysore etc. Its existing 4 lane divided road with good availability of footpath space on either side of the road. The advantage of this selected corridor is that it has enough space for developing footpaths and cycle tracks, the only disadvantage is the presence of Railway underpass were in the carriage width is too narrow and hence the cycles need to be ply along with the other vehicles. This corridor has the advantage of planning the cycle track on either sides of the road or one side of the road where the trees exist. After the site reconnaissance surveys it was decided to take the entire cycle track on both the side from call tax circle to Siddhartha college intersection and

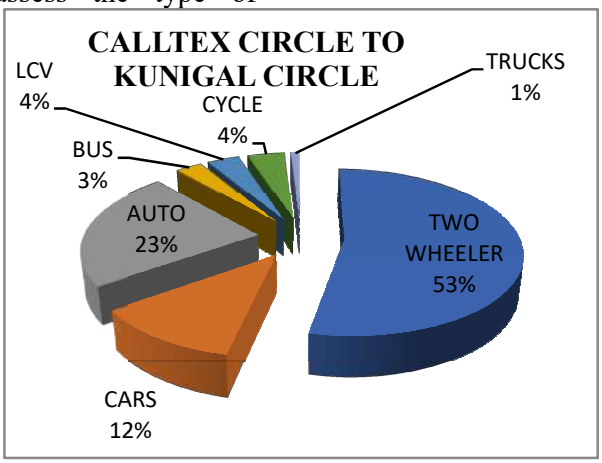
then thereafter the entire cycle track will be shifted towards the Siddhartha college compound wall where the green cover exists till the Kunigal circle.

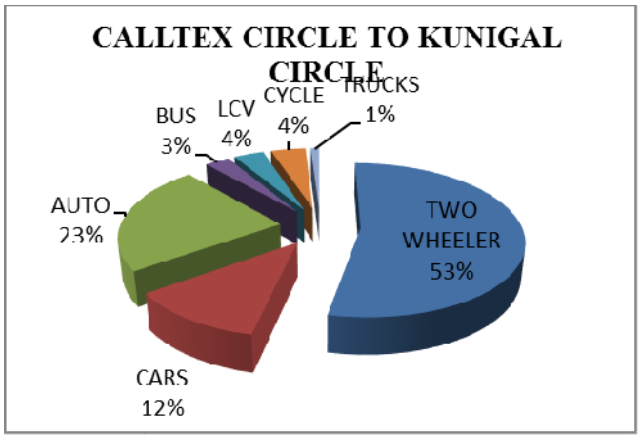
Map showing study area

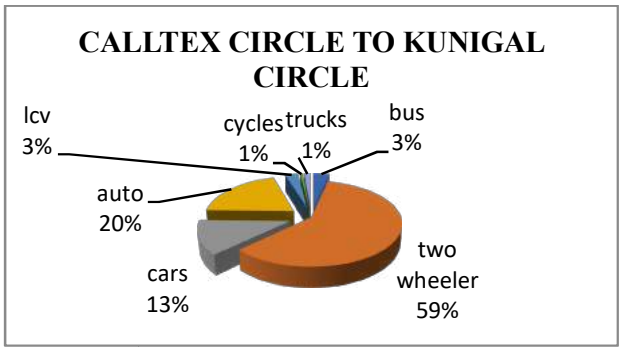
Inventory Survey

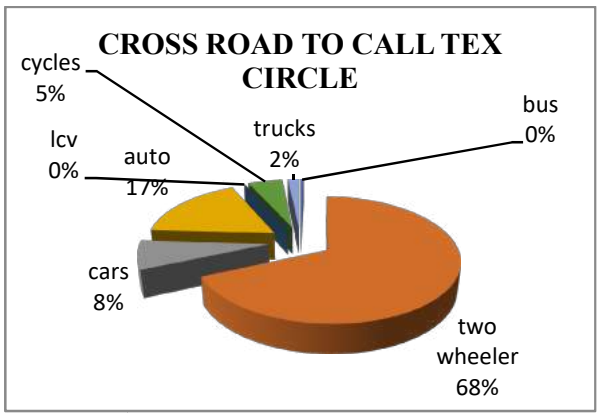
As part of the study, inventory survey was carried out on the selected roads. The details such as carriageway width, footpaths, drains, street furniture, adjacent land use, junctions etc, were noted down for each road. These details are used to assess the type of improvements needed as part of the project improvements.

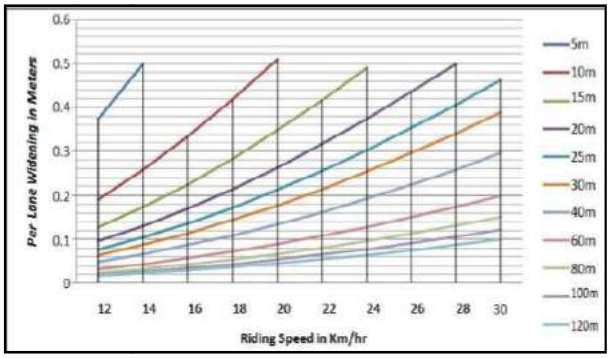
GRAPHICAL REPRESENTATION OF CLASSIFIED VOLUME TRAFFIC COUNT











Cycle lane widening requirement on bends, in relation to bicycling speed and bend radius

Analysis And Results

Vissim

Transportation today plays an important role in the economic and physical development of any modern city. Today, many micro-simulation software have been made available on the market and used as tools for the evaluation of traffic management and control. Released in 1992, VISSIM is a microscopic, time step and behaviour based simulation model developed to model urban traffic and public transit operations. It is regarded today as a leader in the arena of micro-simulation software. The applications of VISSIM are

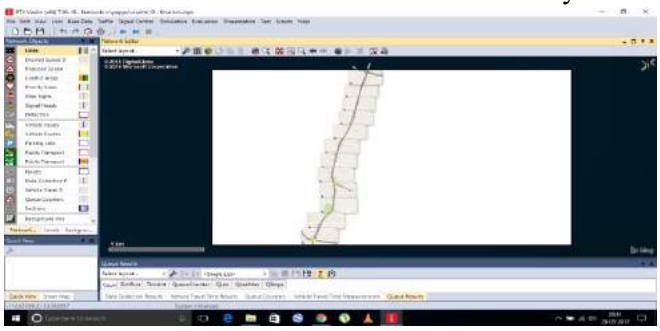
VISSIM can be used for following studies

- ✓ Freeway and arterial corridor studies
- ✓ Sub-area planning studies
- ✓ Freeway management strategies
- ✓ Traffic calming schemes
- ✓ Light rail/bus rapid transit studies
- ✓ Public transport signal priority evaluations
- ✓ Railroad grade crossing analyses

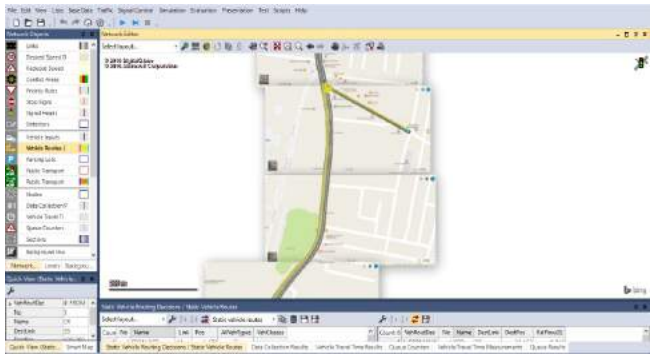
- ✓ Toll plaza evaluations
- ✓ Intelligent Transport System (ITS) assessments
- ✓ Current and future traffic management schemes
- ✓ Airport studies for landside and airside traffic
- ✓ Environmental impact studies
- ✓ Multi-modal public transport interchanges
- ✓ Pedestrian modelling in any built environment including evacuation planning

Base Model

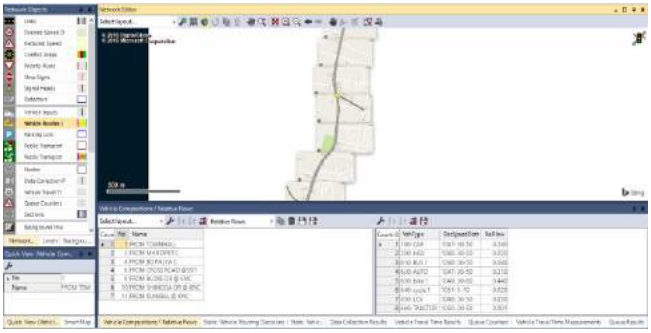
Vehicle representation is done by defining the number of approaches, width of each approach, and turning space, the space occupied by each turning movement in the intersection. The static and dynamic characteristics of every vehicle type in terms of length, width, acceleration and deceleration and speed ranges are defined as per the present circumstances. Traffic signals are symbolized using signal control systems. The representation includes the cycle time, green time, and red time for each movement group, amber time and phase sequence. Traffic illustration involved identifying the local characteristics of the traffic and fine tuning the elements of networks so that the traffic in the simulation behaves similar to the one in the reality.



Base Model of the study corridor

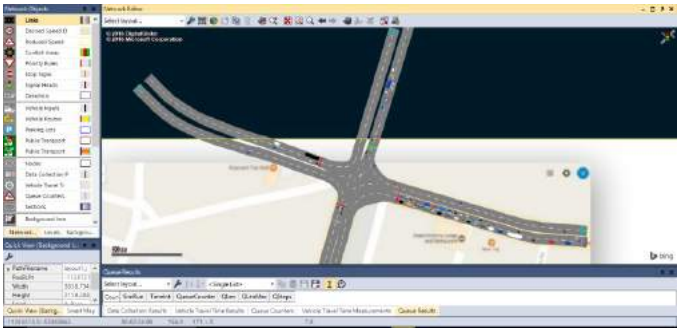


Vehicle routing



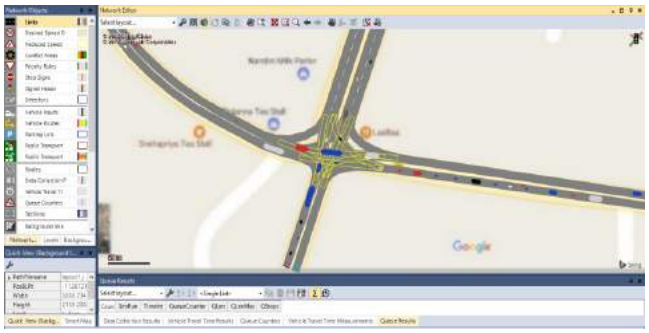
Vehicle compositions

Signal timings



Vehicles in Call Tex circle

Vehicles in SSIT junction



Vehicles in Kunigal circle

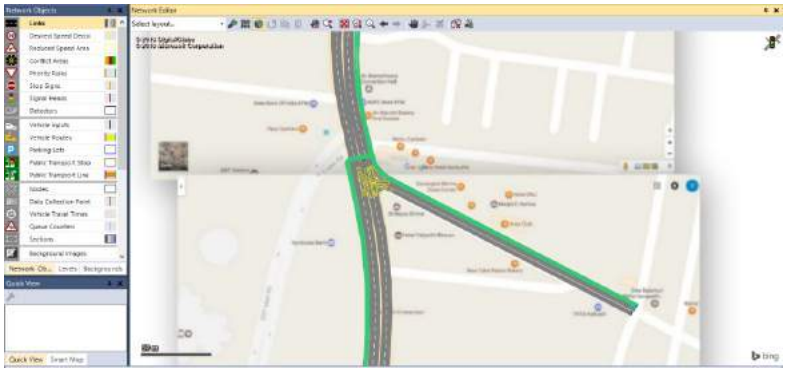
Validation of Base Model

The prepared model was evaluated to check for the correctness by measuring the time taken to travel from one location to another and the total number of vehicles. The following results were extracted from VISSIM.

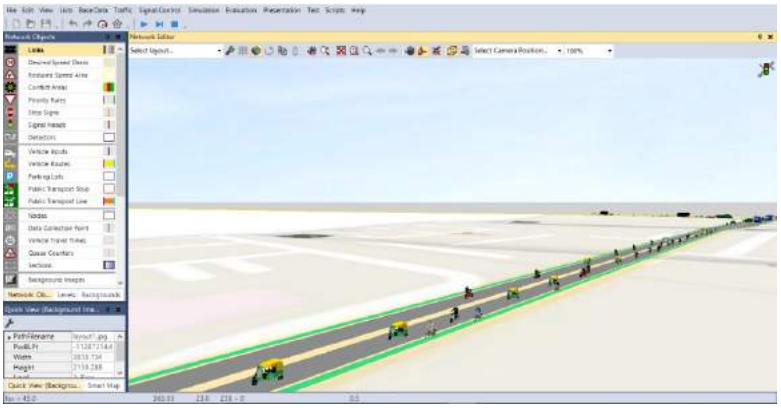
It is seen that travel time obtained from the base model showed in the table bear a resemblance to the current scenario. This indicates that the created base model is validated.

Model with Cycle Track

The below figures show the cycle track designed along the road and the track is represented in green colour.



Cycle track



Cycles in the cycle track

Project Costing and Estimation

Project cost is worked out based on estimated quantities from the detailed engineering design including road works, drainage works, pavement, culverts, bridges, road furniture, road safety appurtenances etc. The total cost provided is for 1817m stretch of the road between Call tax and Kunigal Junction.

The following factors have been considered to arrive at the unit rates for various construction items; the unit rate has been worked out based on PWP & IWTD Schedule of Rates, Bangalore Circle, for the year 2011-2012. Based on PWP & IWTD, lead costs and area weight age have been added to the basic rates. Any Item not available in the PWP & IWTD Schedule of Rates, separate rate analysis given based on available market price. Adopted rate for estimate given in the rate analysis table.

Quantification

The quantification of various items of work is based upon the proposals recommended in the previous chapters. The quantities have been worked out separately for different items of work. The approach adopted for assessment of quantities of major items of construction items is described below

Site Clearance

The quantity has been worked out for clearing and grubbing, dismantling of existing structures, RCC Hume pipe, and dismantling of existing pavement. Clearing and grubbing has been worked out based on the Proposed Typical cross sections.

Earthwork, Sub Base, Base Courses And Concrete Cycle Tracks

The total earthwork in fill/cut has been computed with average height of embankment inspected and measured at site giving due consideration to the proposed Typical cross sections. The quantification of pavement is based on the typical cross sections showing the thickness and width of various pavement layers. The quantity calculation for GSB, WMM, Prime coat, Tack coat and bituminous layers and concrete layers has been worked out based on detailed LB&D dimension as per drawings.

Drainage And Protection Works

The provision for drains on both sides along with sidewalks is considered for costing as per the detailed drawings and measurements.

Traffic Signs, Markings And Other Appurtenances

Road Signs

Traffic signs are important features of traffic control devices and transmit visually vital information to drivers and ensure increased safety and efficiency in free flow of traffic. All these signs shall be of informatory nature. All signs shall be retro reflectorized type.

Road Markings would be done with thermoplastic paints with reflective bands. It will consist of lane line and edge line. The width of center line in tangents and curves will be 100mm while that of edge line will be 150mm. The centre line will be broken line 9m long with 6m gap but the edge line will be continuous in tangents and curves more than 1000m radius while it will be a uninterrupted line in lesser radii curves.

Utility Relocation Cost

The implementation of proposed improvement of Project Road requires relocation of certain utilities like telephone poles, electric. Hence provision has been made for this in the total project cost.

Total Project Cost

The total project cost includes construction cost, Utility relocation cost plus Design and Supervision (PMC) and Contingency. The summary of the project cost is given in Table below. The estimated cost for cycle track and footpath is Rs 2,75,00,000/- is for 2105 m stretch of the road between Call Tex to Sri Siddhartha Junction on Call Tex Kunigal road

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EXPERIMENTAL ANALYSIS OF WHITE TOPPING

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ABSTRACT

India stands on the second number for a major road network worldwide after the USA, but still is termed among the developing country. Major reason is the inappropriate condition of the roads. Majority of the roads in our country if of bituminous types, which have short life because of failures such as fatigue cracking, rutting and also sooner signs of distress. These distresses occur more in regions which are hot in climate such as India as bitumen is very much sensitive to temperature for which white topping is the solution. Concrete isrelatively stiffer than bitumen and is less sensitive to high temperatures which gives better performance against rutting, cracking and in terms of rehabilitation and repair. White topping that is PCC overlay over the bituminous pavement, provides better durability, strength, and additional life up to 20 to 30 years. The aim of the project is to experimentally investigate the strength properties of concrete mix with varying percentages of fly ash and silica fume as per Indian Road Congress (IRC) guidelines.

The roads here get damaged because of the improper construction technique. White topping method is very useful in these situations as the construction of another bituminous layer would be costly along with a short life span.Hence, this method is being adapted in India at a faster rate. It has many benefits and one of them is low cost of maintenance as compared to the bituminous roads. The type of white topping includes conventional, thin, and ultrathin white topping depending upon the thickness of the road which varies from four to ten inches. As this concrete layer must be laid upon the distressed bituminous layer this can be considered as bounded and unbounded. It has been found that this overlay is beneficial for low to high volume of traffic.

Keywords: *concrete, fly ash, hot mix asphalt, rehabilitation, silica fume .*

Introduction

Whitetopping is the structural covering or overlay of an existing asphalt pavement by laying a layer of Portland cement concrete (PCC) as per suitable thickness.

There are basically three types of white topping depending upon the thickness of the concrete layer and the bond between PCC overlay and existing layer. Un-bonded whitetopping or commonly known as conventional whitetopping, has concrete thickness of 20cm (8 inches) or more that is not bonded to the asphalt. Whitetopping which is bonded has thickness of 5 to 15cm (2 to 6 inches) and is further divided into two types, thin white topping and ultrathin white topping. The bond is made by texturing the asphalt. Thin whitetopping uses a bonded layer of concrete which is 10 to 15cm (4 to 6 inches) thick while an ultrathin layer is 5 to 10 cm (2 to 4 inches) thick. Ultrathin whitetopping is good for roads with low traffic volume such as parking lots and small airports.

Whitetopping is proven good for flexible pavements which have little deterioration, although the repairs can be done directly upon the asphalt too. If the pavement is damaged beyond limit, it should be completely removed and a new concrete pavement should be installed. Deterioration chances increases on asphalt bases because these have high viscosity. However, to lay whitetopping, it is required that the asphalt layer should be at least 7.5cm (3 inches) thick.

Types of White Topping(WT): The following are the three types of white topping they are explained below :

Conventional White topping (CWT) – it is composed of concrete overlay of thickness 200

mm or more, which is generally designed & constructed without considering any bond between the existing layer& underlying bituminous layer.

Thin White topping (TWT) – in this, the PCC overlay ranges between 100 to 200 mm and is designed either by considering the bond between overlay & underlying bituminous layer or without considering the bond. High strength concrete (M40 or more) is usually adapted considering the flexure requirement. The joints are constructed at short spacing that is of 0.6m to 1.25 m.

Ultra-Thin White topping (UTWT) – in this, the concrete overlay is of thickness not more than 100 mm. Bonding amidst the overlay & underlying bituminous layer is compulsory for which the existing layer of bitumen is either milled (up to a depth of 25 mm) or surface scrapped (with a non-impact scrapper) or gently chiseled. Construction joints here, are provided at spacing of 0.6m to 1.25 m.

Benefits of white topping

• It provides long life, low maintenance cost, improved safety along with environmental benefits.

• Deformations like rutting and cracking which are quite predominant in case of flexible pavements is commonly absent in concrete surfaces of White topping. This is particularly true in a region having hot climate like India.

• Conventional White topping can improve the structural capacity of existing flexible pavement, if it is built on a strong base course, and it impedes structural distress too.

•Maintenance requirement is low in white topping and involves much less frequent lane closures in comparison to bituminous surfaces.

•It is cost-effective when looked at for annual budget and high traffic volume which are relevant conditions for India.

•It is more effective to fill in the ruts of wheel path of bituminous pavements as concrete is stiffer and much more consistent in high temperatures rather than bituminous mixes.

• Comparing concrete and bitumen, concrete is light in colour so its surface absorbs less heat, is more reflective to light and hence reduces the urban heat island effect.

• Consumption of fuel is found to be less on concrete roads than bitumen roads.

Objective

- ✓ To increase or restore the load carrying capacity and ride-capacity or both of the existing pavement.
- ✓ To achieve better workability and durability of plastic and hardened concrete, respectively, by using fly ash.
- ✓ To improve compressive strength, abrasion resistance and glare effect by using silica fume
- ✓

Raw Materials

Cement:OPC-53 grade cement of ultra tech brand is used as a binding material. Physical properties of the cement used are tested as per IS:12269 which are as follows :.

Table-1 : Physical properties of cement

Sl. No	Properties	Cement	Standards
1	Compressive Strength(MPa) 28Days 7 Days 3 Days	Minimum45.0 Minimum35.0 Minimum25.0	IS 4031:1989 (Pt 6)
2	Setting Time(min) Initial Final	90-120 Maximum 200	IS 4031:1989 (Pt 5)
3	Fineness	Minimum	IS

		2850	4031:1989 (Pt 2)
4	Soundness Le-Chatelier's expansion (mm) Autoclave expansion(%)	Maximum 2.0 Maximum 0.10	IS 4031:1989 (Pt 3)

MSand: MSand of size 600 micron which comes under zone III isused as in place of river sand as it is of higher quality than the naturally occurring river sand.

Coarse Aggregate: Coarse aggregate of size 20 mm are used which are angular in shape.The physical properties of coarse aggregates are tested as per IS: 2386 which are as follows :

Table-2 : Physical Properties of Coarse Aggregates

Tests	**20 mm size**	**Standard value**
Specific gravity	2.79	2.6 to 2.8
Water adsorption	2%	Less than 3.0
Impact value	15.3	Less than 45%
Flakiness index	14.96%	Less than 40-45%
Elongation index	31.25%	Less than 40-45%

Fly ash: Fly ash is used in different variation of 10%, 20% and 30% as replacement of portions of cement. Fly ash reduces the cost of cement along with other beneficial properties such increase of workability and compressive strength of concrete, reduction of heat of hydration andpozzolonic properties similar to cement. Here grade – 1 fly ash of class-f is used.

Silica fume: Varying percentage of silica fume is added to the mix as 2%, 4% and 6% by weight of cement as a replacement. Silica fume improves the abrasion resistance, lowers segregation, fill in the voids as it is very fine material and due to its dark texture, it can reduce the glare effect caused by white topping during the daytime. 94% densified and very fine silica fume is used.

Water: The water used in preparation of sample moulds is clean tap water and has pH greater than 6. W/C ratio used is 0.4

METHODOLOGY

Following Methodology was adopted to meet above objectives.

- Tests are performed to acknowledge the physical properties of cement, sand, and coarse aggregates.
- M30 grade concrete mix design is done by selecting suitable ingredients of concrete and determining their proportion.
- The samples are casted for different mix proportions with varying percentage of fly ash and silica fume in replacement of cement.
- Cubemoulds of size 150mm x 150mm x 150mm and cylindrical moulds of size 300mm x 150mm are casted for M30 grade concrete mix and curing is done for 28days.
- Overall, 12 cubes and 12 cylinders were casted, 3 for each of 4 different concrete mixes.

- Mechanical properties of the concrete is tested with partial replacement of cement by fly ash and silica fume. Concrete samples will be determined by experimental investigations such as workability, compressive strength and split tensile strength.

Weighing

The process of measuring material ingredients to prepare concrete mix is called as batching of concrete. Batching can be done by two methods, volume batching and weigh batching, batching should be done properly to get quality concrete mix.

Volume batching :- In this method, the materials are measured according to the volume. It is less precise method.

Weighbatching :- In this method, materials are measured according to their weight. It is an accurate method.

Mixing

Mixing process was done by hand mixing. Coarse aggregate, fine aggregate, cement, water and rice husk ash were added in a hand mixer and dry mixed and then 60% of water were added and again mixed, then polypropylene fiber was added with remaining 40 % water. Duration of mixing was 2.3 to 3 min after adding all materials. After mixing concrete mix was removed from the mixer and workability of fresh concrete was checked by slump test. For slump test, concrete wasfilled in three layers in slump cone and each layer was tamped 25 times with the help of tamping road to compact the concrete and slump was measured in mm. All moulds were greased, and concrete was poured in mould and compaction was done using a table vibrator. Specimens were demoulded after 24 hours and kept in water for desired curing days.

Casting

12 cube moulds of dimension 150 mm x 150 mm x 150 mm for each mix proportion were casted for compressive strength and 12 cylindrical moulds of dimension 150 mm diameter and 300 mm length were casted for split tensile strength.

Curing

Curing is done for a period of 28 days so that the samples could attain full strengths.

Standard Procedure

Repair:When a HMA pavement is distressed, a repair process is required in order to proceed with application of white topping.

Milling: In this process, the surface of HMA layer is levelled from undulations and ruts are removed because it will further help in the increase of bonding among existing HMA layer and new PCC overlay.

Cleaning:When the milling process is done, the top surface needs to be cleaned so as to improve the bonding between two layers.

Mixing and Laying: The materials are mixed based upon the grade of the concrete, size of the aggregates, type of the admixture and water cement ratio by IRC code recommendation. After mixing, the prepared mix should be laid immediately to avoid segregation and the mix should be uniformly spread.

Cutting: After concrete is laid, groove cutting is required to prevent the floor from cracking by expansion. Groove cutting panel size should range from 1.1 to 1.5m. Depth of groove cutting should not be more than 1/3rd of the panel thickness.Curing is then done to get the desired strength and properties of the cement concrete, by maintaining required moisture and temperature within a concrete mass as it sets and hardens further

Results And Discussions

Compressive StrengthThecompressive strength results after 28 days of curing for different replacement levels such as 0%, 10%, 20% and 30% of cement with fly ash and also 2%, 4% and 6% of cement with silica fume ash are expressed in Table 3. From the test

results, it is observed that the maximum compressive strength is obtained for mix with 10% Fly ash and 2% Silica at the water-cement ratio of 0.40.

Table-3 : Compressive Strength Results

Sample No.	**Grade**	**% of Fly ash**	**% of Silica fume**	**Compressive strength**
1.	M30	0	0	33 N/sq mm
2.	M30	10%	2%	46 N/sq mm
3.	M30	20%	4%	34 N/sq mm
4.	M30	30%	6%	31 N/sq mm

Split tensile strength

The split tensile strength results of mixes after 28 days of curing for different replacement levels of cement such as 10%, 20% and 30% with Fly ash and 2%, 4% and 6% with Silica fume are presented in Tables 4. From the test results, it is observed that the maximum split tensile strength is obtained for concrete mix containing 10% Fly ash and 2% Silica fume.

Table-4: Split Tensile Strength Results

Sample No.	Grade	% of Fly ash	% of Silica fume	Split Tensile Strength
1.	M30	0	0	5.3 N/sq mm
2.	M30	10%	2%	6.5 N/sq mm
3.	M30	20%	4%	4.5 N/sq mm
4.	M30	30%	6%	5.0 N/sq mm

CONCLUSION

Based on the experimental investigations carried out on the strength characteristics of

mixes, we arrived at the following conclusions :

- After 28 days, the compressive strength of mixes containing fly ash and silica fume has more strength than that of mixes without fly ash and silica fume. This indicates that addition of fly ash as partial replacement to cement causes an increase in strength. Thus, Fly ash acts as pozzolonic material, hence the compressive strength of concrete increased with fly ash.

- At the age of 28 days the compressive strength of mix 10% Fly ash shows the highest strength when compared to other replacement levels of Fly ash with Cement. This indicates that the optimum percentage of replacement of Fly ash with cement is 10%.

- In the replacement levels of Fly ash with cement, the most suitable replacement of Fly ash with cement for M30 grade of concrete was found to be 10% for achieving maximum split tensile strength at the age of 28 days.

- Silica fume helps in improving the homogeneity of concrete by reducing segregation and filling up voids. It also reduces plastic shrinkage, settlement and water permeability of the mix.

- Silica fumes helps in enhancing the strength of concrete and improves abrasion resistance.

- Addition of Silica fume for a long-lifeimproves the concrete strength and darkens the texture of concrete so as to reduce the glare effect.

- Both fly ash and silica fume is cost effective along with their various efficient properties

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FEASIBILITY STUDY ON CAPACITY OF SPECIFIC LANE ON SELECTED STRETCH-NH 48 (NELAMANGALA-YESWANTHPUR)

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ABSTRACT

This paper presents the issues of congestion on a highway due to merging of city traffic. It is quite difficult to determine the traffic volume and capacity of road facilities under the heterogeneous traffic conditions. So, a standard vehicular unit, called the Passenger Car Unit (PCU) has been developed to correlate the congestion caused by different vehicular types with respect to a car. Developed countries formulated several methods for calculating PCU's. These PCU esteems as evolved by created nations are not reasonable for Indians blended traffic conditions since traffic is more different in nature. Highway capacity Manual (HCM) of USA utilizes PCU factors to estimate the effect of heavy vehicles on road stream under mixed traffic conditions. Since the initiation of idea various strategies for the assessment of PCU an incentive for various vehicle classifications have been proposed. Various examinations have been completed to break down the impact of traffic condition on PCU. Anyway, these examinations focus on streets in plain landscape just and exceptionally restricted exploration has been done work date on the assessment of PCU on selected stretch.

Keywords: *Highway Capacity Manual, Passenger Car Unit, Traffic Volume.*

Introduction

Indian road network is the second biggest and busiest road network on the planet, giving vehicle to 8.3 billion travelers all over Indian communities and more than 990 million tons of Cargo yearly, starting at 2017. According to the National Highway Authority, about 67% of merchandise and 82% traveler traffic is conveyed by the streets. The National Highways convey 40% of all out-street traffic, and just about 2% of the street network is covered by these streets. The normal development of number of vehicles has been around 12% per annum throughout the long term. In 2019, Bangalore was on first spot on the list among other cities across the world and keeping in mind that Mumbai, Pune and New Delhi came fourth, fifth and eighth, individually. The Static and Dynamic Characteristics of the vehicles is ordinarily considered by changing over all vehicles as far as a typical unit known as Passenger Car Unit. Explicit path is the path assigned for development of specific class of vehicles which are messing up smooth stream traffic. Passenger Car Unit is a measurement utilized in Transportation Engineering, to evaluate traffic-stream rate on an expressway. Basically, the Passenger Car Unit method is effective when transport has traffic factors contrasted with a solitary car. The planning, arranging and support of street requires the limit as primary factor. The units utilized for this is vehicles each hour per path or street. In any case, the PCU esteems got from the thickness technique depend on basic homogeneous traffic ideas, for example, exacting path discipline, vehicle following and a vehicle that doesn't differ incredibly in width. Then again, interstates in India, convey heterogeneous traffic, where street space is divided between many traffic modes with various actual measurements.

Objectives

1. To determine hourly volume in terms of PCU by using traffic data at 6 lane NH-48 road with 1 km Stretch at 2 points.
2. To find vehicle composition, Spot speed, Speed and Delay and to know the variation of each category of vehicle and their average speed on 6 lane road.
3. To find the relationship between flow parameters like Density, Volume and Speed.

4. To find-out the feasible factors to enhance the capacity of Specific Lane at Selected Stretch.

Study Area

Figure: 1.1 Study Location Map

Methodology

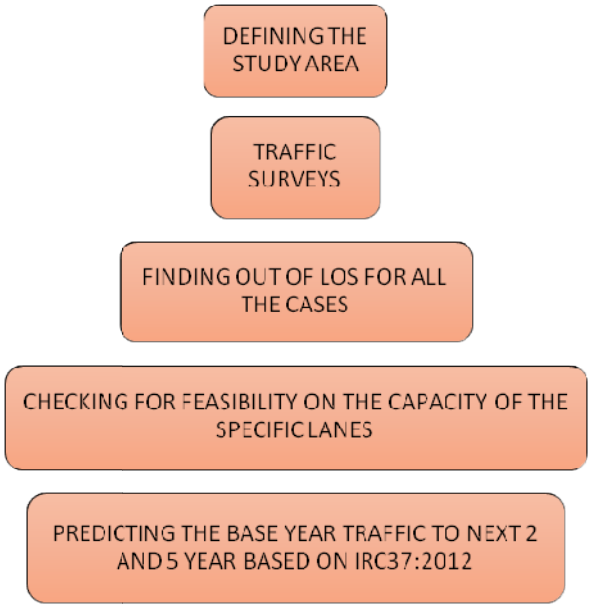

Figure 1.2 Steps Involved

With respect to the objectives of the study the required data were collected in five stages as follows

- Study stretch selection.
- Surveying to obtain required sections
- Classified traffic volume count
- Observation and collection of speed of traffic stream
- Dimension of different class of vehicles

The following types of surveys have been carried out to obtain all the data

1. Road Inventory
2. Speed and Delay
3. Spot Speed Study
4. Traffic Volume Count
5. Lane Capacity and LOS

Outcomes of the study are as follows:

1. The study helps us to find out the feasibility of that particular stretch.
2. The study helps us to find out the relation in between flow parameters like Density, volume and speed.
3. The study helps us to compare the road capacity with the existing traffic.

Capacity:

Capacity depends on factors such as road width, shoulder width, surface conditions, traffic volume, environment condition etc. The importance of capacity while designing road or highway it plays a vital role while selecting number of lanes, weaving section, width of lane. Capacity can be classified into types those are

• Basic capacity: The traffic condition where maximum rate of passenger cars that passes

given stretch on lane during one hour is known as Basic Capacity.

• Possible capacity: Passenger cars or the vehicles that crosses given stretch on roadway during one hour under suitable condition. Possible capacity is much lesser than the basic capacity.

• Practical capacity: The vehicles that passes given roadway during unit time at highest rate, during this there is no delay due to congestion, less density and less hazard to drivers' freedom to man under traffic conditions..

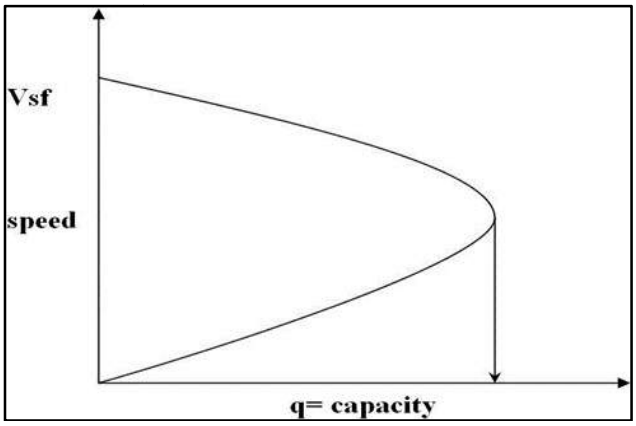

Figure 1.3 Speed Flow Relation

Total Volume Count

Data collected at the Study Area was computerized for analysis. The various vehicle types having different size and characteristics were converted into passenger car equivalents.

Passenger car unit values (PCU) suggested IRC-64-1990, 'Guidelines for Capacity of Roads in Rural Areas' has been adopted.

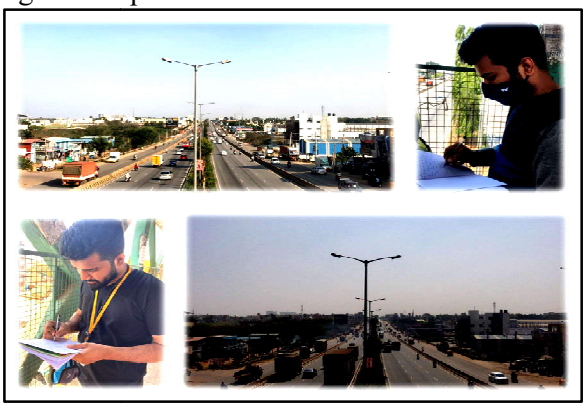

Figure 1.4 Pictures from Study Location

Passenger Car Unit

The different vehicles have different dimensions and acceleration, to make the analysis easy all vehicle characteristics are converted. The PCU values changes for every parameter of road characteristics such as road width, shoulder width, roundabouts, directionalsplitetc.PCU value can be found by ratio of speed to space occupancy of vehicle. The expression is shown below:

PCU of ith vehicle = (Cv/iv) / (Ca/ia)

Where, Cv = Car's speed (kmph)

iv = ith vehicles speed(kmph)

Ca = Car's static area(m2)

ia = ith vehicle's static area (m2)

Summary

Table 1.1 Summary of Classified Traffic Volume Count Data

Towards Yeswantpur				
Day	Date	Location	Volume	PCU

Saturday	20-02-21	Loc1	16537	23340
	20-02-21	Loc2	17883	23355
	Merging Traffic:		1346	
Sunday	21-02-21	Loc1	15901	22949
	21-02-21	Loc2	17322	22882
	Merging Traffic:		1421	
Tuesday	23-02-21	Loc1	13934	18464
	23-02-21	Loc2	14919	20186
	Merging Traffic:		985	
Wednesday	24-02-21	Loc1	13005	18559
	24-02-21	Loc2	13885	19275
	MergingTraffic:		880	

Towards Nelamangala				
Day	Date	Location	Volume	PCU
Saturday	20-02-21	Loc1	17801	21308
	20-02-21	Loc2	19067	22330
	Merging Traffic:		1266	
Sunday	21-02-21	Loc1	17006	22424
	21-02-21	Loc2	18712	21924
	Merging Traffic:		1706	
Tuesday	23-02-21	Loc1	16587	20004
	23-02-21	Loc2	17812	21419
	Merging Traffic:		1225	
Wednesday	24-02-21	Loc1	14549	17560
	24-02-21	Loc2	15155	18907
	Merging Traffic:		606	

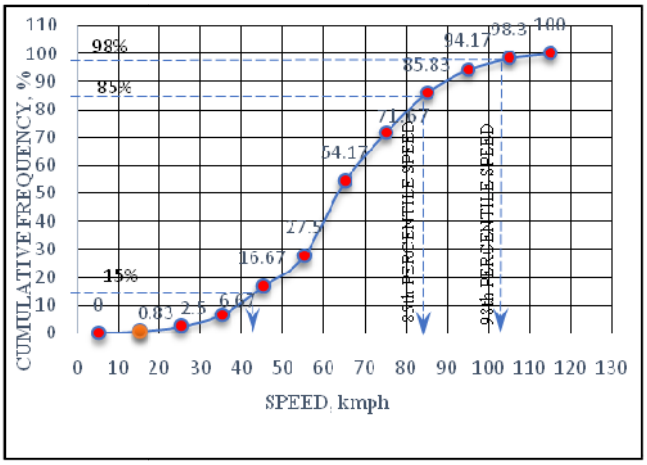

Figure 1.5 Commulative Frequency Distribution Diagram of Spot Speeds

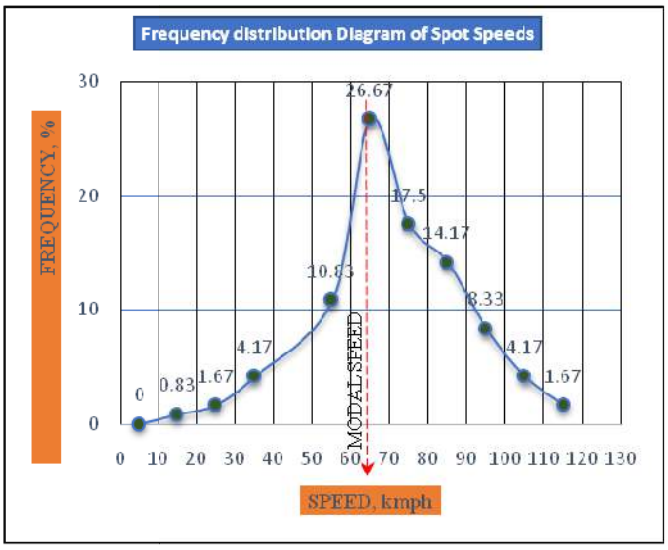

Figure 1.6: Frequency Distribution Diagram of Spot Speeds

Results

Desired Spot speed values:

a) Upper speed limit for regulation
=85th percentile speed
=84kmph

b) Lower speed limit for regulation
=15th percentile speed
=44kmph

c) Speed to check geometric design elements
=98th percentile speed
=105kmph

d) Average Speed of traffic flow
=50th percentile speed
=65kmph

Lane Capacity:

S=0.278*65*0.7+5 = 17.65m

Qc=1000*65/17.65 = 3683vehicles/hour/lane

Q (peak traffic volume average of 3-lane) = 7785

Q/Qc = 7785/ 3936 = 2.1

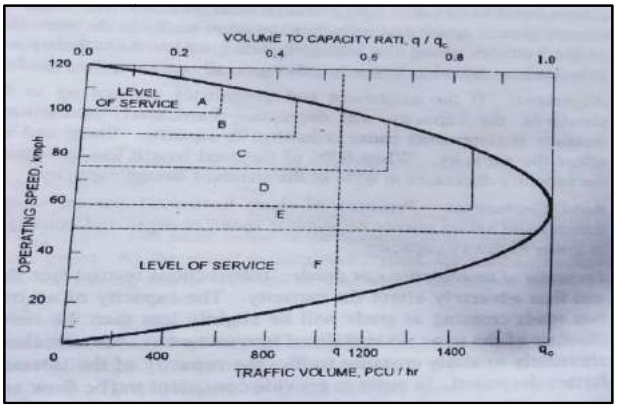

Figure 1.7 LOS: Level of Service

Speed and Delay

a. Mean journey speed in Peenya to Nagasandra MetroStation	**35.86kmph**
b. Mean journey speed in Nagasandrato Peenya Metro Station	**29.40 kmph**
c. Mean running time in Peenya to Nagasandra MetroStation	**8.30 min**
d.Running Speed in Peenya to Nagasandra Metro Station	**53.5kmph**
e.Mean running time in Nagasandrato Peenya Metro Station	**10 mins**
f.RunningSpeed in Nagasandrato PeenyaMetro Station	**44.4kmph**

Conclusion

By overall study the objectives of the study are achieved and following are the conclusions of the study:

1. Congestion at Bus Bays: Near Jalahalli Cross bus stop, the buses are halted on the road creating problem for other road users passing the intersection.
2. Solution: While going from Yeswantpur to Nelamangala at Jalahalli Cross the buses halt on the road due to lack of space so a bus bay can be providing after the signal.
3. UnevenpavementatGargantuanly:Thedamagedroadsnear GorguntepalyaandDasarahalli are causing volunteer slowdownof vehicles and inconvenience. Solution: High quality materials should beused assuring more lifetime should be laid.
4. Spots of Congestion: Nagasandra to Madavara the place preoccupied by metro has not been finished, despite of the fact that the traffic is permitted, the road work is not finished due to this unevenness the vehicles are not in a situation to utilize the total space accessible.
5. Intersection of traffic stream: Near Rockline Mall and Outer Ring Roadenormous volume of traffic is using U turn or right turn and in the process majority of road is impeded on either side. Solution: It is prescribed to provide a signal and a free left so that the traffic stream in opposite direction is not deterred.

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EFFECT OF GEOPOLYMER ON STRENGTH CHARACTERISTICS OF SOFT SOIL

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ABSTRACT

Chemical and mechanical stabilisation processes are used to improve soil behaviour in nature and engineering qualities. The soft soil (peat soil) was stabilised in this study by adding two distinct Geopolymers at varying percentages, and the engineering features and characteristics of peat soil were observed at different % concentrations of each. Geopolymer percentages of 0, 2, 4, and 6 Geopolymer consists of an amorphous polymorph of silicon dioxide, Silica fume, and Rice Husk Ash. Silica fume at 2,4 and 6 percent and Rice Husk Ash at 0, 2, 4 and 6 percent were mixed in a percentage mixture. Unconfined compressive strength (UCS) and Compaction test are used to evaluate the performance of these additives (SPT). With a mixture of 4% RHS and 4% Silica fume, dry density of soil were enhanced from 1.27 g/cc to 1.62 g/cc, and UCS consistency of soil was increased from very soft to stiff. i.e., by going from 5.8110-3 kg/cm2 to 1.62 kg/cm2

Keywords: *Peat Soil, Geo-Polymer, RHA, UCS and SPT*

Introduction

The floor is what all of essential needs, like food, clothing, and a house, meet. You can't imagine living on our planet without land. A loose rock, compound created by the decomposition of rocks, is designated as soil in basic building. Both air and water can be found in the empty space between particles. Organic matter can also be found in solid particles. Mechanical methods, such as anxiety and aquatic, can be used to separate soil particles. There are an endless number of sediments in nature which can be combined to alter soil qualities in an infinite number of ways. So, in the case of soft soil, there are a number of construction obstacles.

Soil stabilisation includes a number of tactics for changing the soil.

The following characteristics of the soil can be improved by stabilisation: compressibility, permeability, and shear strength, making the soil acceptable for construction usage. Physical, chemical, and polymer approaches of soil stabilisation are some of the ways used in practice. Among the chemical ways of stabilisation, polymer approaches are one of the most cost-effective. Two polymers were utilised to stabilise the soft soil in this investigation (Peat soil).

A. Soil

Materials and Methodology

Soft soils (peat soil) are considered in this study and stabilised with a geopolymer (Rice Husk Ash) and an amorphous polymorph of silicon dioxide (Silica Fume).

Rice Husk Ash and Silica Fume at various percentage concentrations were made and analysed. A brief explanation of the experiments and technique used throughout the study is offered.

Figure 1 Location of Site

Soft soil (peat soil) was collected from a site near Avalahalli Forest in Karnataka, India, for the studies. All soil testing are carried out in accordance with IS requirements.

B. Rice Husk Ash

Figure 2 Rice Husk Ash

Rice husk ash (RHA) is a widespread and renewable farming product produced during rice milling in rice-producing countries. Among all plant wastes, it possesses a large amount of silica. Rice husk can be utilized as an alternative energy source, for example, as a biofuel in a rice-milling kiln's furnace to produce energy, where the husk's heating value ranges from12.6 MJ/kg to 13.34–16.20 MJ/kg to 15.7 MJ/kg, with 18.8% carbon, 62.8 percent volatile compounds, and 9.3% moisture content.

Properties of RHA:

- RHA has a bulk density of 0.781 grammes per cubic centimetre.
- RHA has a specific density of around 2.14.

C. Silica Fume

Figure 3 Silica Fume

Amorphous (non-crystalline) silicon dioxide is the main component of silica fume (SiO2). Individual particles are incredibly minute, measuring around 1/100th of the size of a typical cement particle. When used in concrete, silica fume is an extremely reactive pozzolan due to its small particles, huge surface area, and high SiO2 content.

Properties of Silica Fume:

- Silica Fume has spherical particles with a diameter of less than 1mm, and its bulk density ranges from 0.13 g/cc to 0.6 g/cc depending on the degree of densification.
- Silica Fume has a specific gravity ranging from 2.2 to 2.3.

Methodology

Materials such as soft soil (peat soil), silica fume, and rice husk ash were procured. Basic experiments on soil samples with increasing percentages of stabilisers are carried out. Changes in soil properties before and after treatment with stabilisers are investigated.

A. Compaction Test

Figure 4 Standard Proctor test Apparatus

Compaction tests for soft soil with stabilisers were carried out according to IS regulations to determine the optimal moisture content (IS 2720: Part VIII) and maximum dry density (IS 2720: Part VIII). The soft soil (peat soil) is stabilised in this work by adding geo-polymer and an amorphous polymorph of silicon dioxide, namely Rice Husk Ash and Silica Fume, respectively, the effect on the engineering features and characteristics of the soft soil (peat soil) at different percentage concentrations combinations as 0 percent, 2 percent, 4 percent, and 6 percent was observed using twelve (12) distinct percentage combinations. Rice Husk Ash, a geopolymer, was prepared at percentages of 0%, 2%, 4%, and 6%, while Silica Fume, an amorphous polymorph of silicon dioxide, was prepared at percentages of 2%, 4%, and 6%, respectively. as shown in table below.

Table 1 Details of Geo-Polymer Mixed Soil

Sl No.	Name of the Mix	Particulars of Mix
1	RHA (0%) + SF(2%)	Soil + 0% Rice Husk Ash by weight of total solids + 2% Silica Fume by weight of total solids
2	RHA (0%) + SF(4%)	Soil + 0% Rice Husk Ash by weight of total solids + 4% Silica Fume by weight of total solids
3	RHA (0%) + SF(6%)	Soil + 0% Rice Husk Ash by weight of total solids + 6% Silica Fume by weight of total solids
4	RHA (2%) + SF(2%)	Soil + 2% Rice Husk Ash by weight of total solids + 2% Silica Fume by weight of total solids
5	RHA (2%) + SF(4%)	Soil + 2% Rice Husk Ash by weight of total solids + 4% Silica Fume by weight of total solids
6	RHA (2%) + SF(6%)	Soil + 2% Rice Husk Ash by weight of total solids + 6% Silica Fume by weight of total solids
7	RHA (4%) + SF(2%)	Soil + 4% Rice Husk Ash by weight of total solids + 2% Silica Fume by weight of total solids
8	RHA (4%)+ SF(4%)	Soil + 4% Rice Husk Ash by weight of total solids + 4% Silica Fume by weight of total solids
9	RHA (4%) + SF (6%)	Soil + 4% Rice Husk Ash by weight of total solids + 6% Silica Fume by weight of total solids
10	RHA (6%) + SF (2%)	Soil + 6% Rice Husk Ash by weight of total solids + 2% Silica Fume by weight of total solids
11	RHA (6%) + SF (4%)	Soil + 6% Rice Husk Ash by weight of total solids + 4% Silica Fume by weight of total solids
12	RHA (6%) + SF (6%)	Soil + 6% Rice Husk Ash by weight of total solids + 6% Silica Fume by weight of total solids

B. Unconfined Compressive Strength Test

Figure 5 UCS Apparatus

On soft soil and soil treated with stabilisers, tests were undertaken to determine the unconfined compressive strength values according to IS code (IS 2720: Part X). Different quantities of soil and additives are blended at a water content that corresponds to pretreatment OMC values, and samples are produced for testing. For each proportion in the constant volume mould, perform an unconfined compressive strength test. These samples are in an undrained state. Following the production of the mould, these samples are evaluated for unconfined compressive strength with curing times of 0 days, 3 days, and 7 days.

Result and discussion

Test on Untreated Soil

The soil used in this investigation was taken from a location near Avalahalli forest in Karnataka, India. The table below lists the specifics of the soil tests that were performed.

Table 2 Geo-Technical Properties of Soft Soil (Untreated Soil)

Sl. No	Properties	Values
1	Maximum Dry Density (MDD)	1.27 g/cc
2	Optimum Moisture Content (OMC)	7.1 %
3	Liquid Limit	42 %
4	Plastic Limit	24.96 %
5	Shrinkage Limit	12.45 %
6	Specific Gravity (G)	1.97
7	Unconfined Compressive Strength (UCS)	5.81×10^{-3} kg/cm²

A. Compaction Test

B. According to IS 2720: Part 8, a standard proctor compaction test was performed, yielding a Maximum Dry Density (MDD) of 1.27 g/cc and an Optimum Moisture Content (OMC) of 7.1 percent.

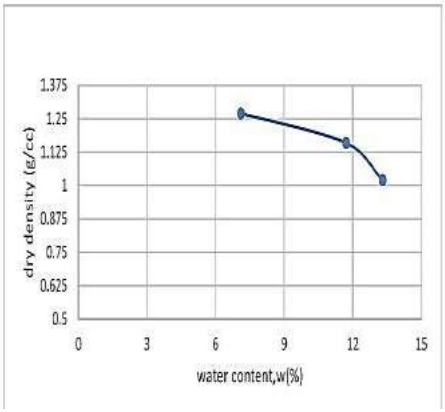

Figure 6 Compaction Curve of Untreated Soil

A. Liquid Limit

The liquid limit test was performed in accordance with IS 2720: Part-5, with a result of 42 percent and a flow index of 14.

B. Plastic Limit

Plastic limit was tested according to IS 2720: Part-5, with a result of 24.96 percent, Plasticity index of 17.03 percent, Liquidity index of -1.16 percent, Consistency index of 1%, and Toughness index of 0.62 percent.

C. Shrinkage Limit

Shrinkage limit was tested according to IS 2720: Part-5, with a result of 12.45%, Shrinkage index of 12.45%, Shrinkage ratio of 1.975, Volumetric Shrinkage of 66.55 percent (0.66), Linear Shrinkage of 15.63 percent, and Specific gravity of 1.97.

D. Unconfined Compressive Strength

According to the IS, the following table-3 shows the relationship between soil consistency attribute and unconfined compressive strength of soil.

Table 3 Relationship between consistency of soil and qu [1 KN/m² = 0.01 kg/cm²]

q_u, KN/m² or KPa	Consistency
< 25	Very soft
25 – 50	Soft
50 – 100	Medium
100 -200	Stiff
200 – 400	Very stiff
> 400	Hard

The UCS test was performed in accordance with IS 2720: Part 10 and the UCS value obtained was 5.812^{-3} kg/cm2 or 0.56 KPa.

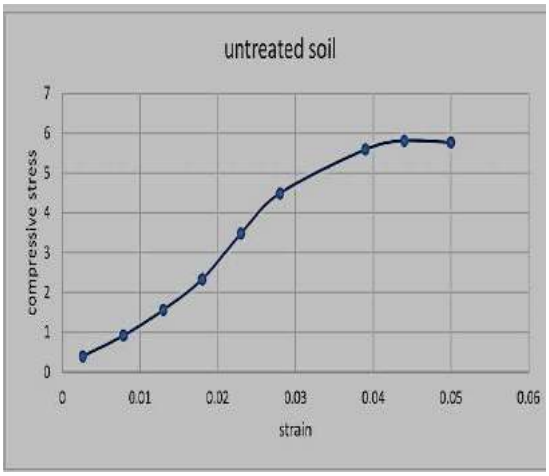

Figure 7 Stress-Strain Curve for Untreated Soil

Test on Treated Soil

A. Compaction Test

The graph below compares OMC and MDD of untreated soft soil with soft soil treated with increasing percentages of Rice Husk Ash (0, 2 percent, 4 percent, and 6 percent) with Silica Fume (2 percent , 4 percent and 6 percent). The table below shows the overall results of OMC and MDD of treated soft soil with various percentage combinations.

MDD increases with the addition of Rice Husk Ash and Silica Fume, as can be seen, as OMC varies. The best concentration of rice husk ash with silica fume is obtained when 4 percent rice husk ash is combined with 4 percent silica fume in a percentage combination of 4 percent rice husk ash and 4 percent silica fume with a maximum dry density (MDD) of 1.608 g/cc and a maximum moisture content (OMC) of 10%.

Table 4 OMC and MDD of Treated Soil

Sl No.	Sample Name	OMC (%)	MDD (g/cc)
1	RHA (0%) + SF (2%)	13.3	1.260
2	RHA (0%) + SF (4%)	13.3	1.270
3	RHA (0%) + SF (6%)	14.2	1.313
4	RHA (2%) + SF (2%)	16.6	1.410
5	RHA (2%) + SF (4%)	7.6	1.356
6	RHA (2%) + SF (6%)	10	1.436
7	RHA (4%) + SF (2%)	20	1.425
8	RHA (4%) + SF (4%)	10	1.608
9	RHA (4%) + SF (6%)	15.3	1.366
10	RHA (6%) + SF (2%)	15.7	1.390
11	RHA (6%) + SF (4%)	18.7	1.320
12	RHA (6%) + SF (6%)	9.0	1.440

Table 5 MDD and OMC of Soft Soil with best Combination of RHA with SF

Sample Name	OMC (%)	MDD (g/cc)
Soil + 4% RHA + 4% SF	10	1.608

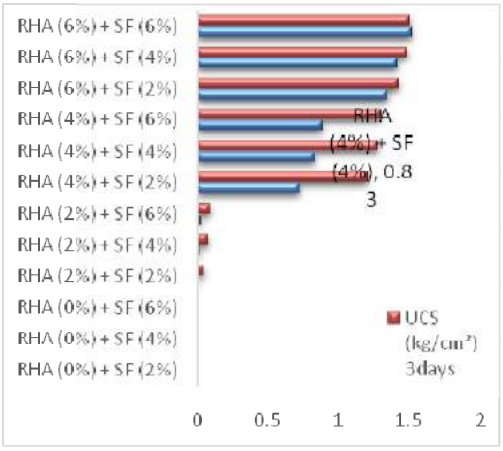

Figure 8 Compaction Results

B. Unconfined Compressive Strength

The UCS of soil with variable amounts of stabilisers and different curing durations is shown in the graph below. The table shows the findings of UCS of treated soil with various % stabilisers and cure durations.

The greatest compressive strength of treated soil was 1.62 kg/cm2 [158.86 KPa] after 7 days of curing.

Table 6 UCS of soft soil with Rice Husk Ash (0%, 2%, 4%, 6%) and Silica Fume(2%, 4%, 6%) with curing (0 days, 3 days and 7 days)

Sample Name	UCS (kg/cm²) 0 days	UCS (kg/cm²) 3 days	UCS (kg/cm²) 7 days
0% RHA + 2% SF	2.85×10^{-3}	3.4×10^{-3}	5.6×10^{-3}
0% RHA + 4% SF	4.5×10^{-3}	4.2×10^{-3}	5.61×10^{-3}
0% RHA + 6% SF	2.7×10^{-3}	2.9×10^{-3}	4.67×10^{-3}
2% RHA + 2% SF	0.010	0.041	0.35
2% RHA + 4% SF	0.016	0.069	0.57
2% RHA + 6% SF	0.022	0.089	0.71
4% RHA + 2% SF	0.72	1.197	1.23
4% RHA + 4% SF	0.83	1.27	1.36
4% RHA + 6% SF	0.88	1.29	1.42

6% RHA + 2% SF	1.34	1.42	1.43
6% RHA + 4% SF	1.41	1.48	1.58
6% RHA + 6% SF	1.51	1.50	1.62

Table 7 Maximum UCS Value with geo-Polymer Percentage and with Curing Period

Sample Name	UCS Value with 7days of Curing
6% RHA + 6% SF	1.62 kg/cm² [158.86 KPa]

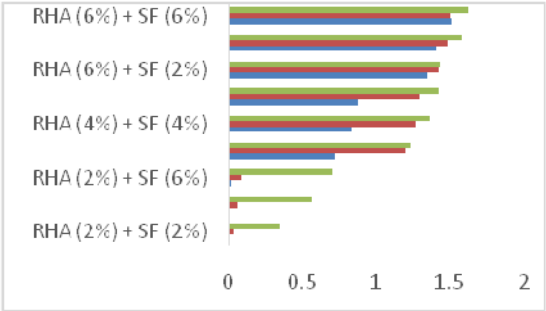

Figure 9 UCS Results

Conclusion

The stabilization of soft soil was done to avert devastating consequences for constructions and buildings, among other things. A novel idea for stabilizing soft soil (peat soil) with Geo-polymer was discussed in this paper.

The following conclusions can be formed based on the obtained data and discussion: The maximum optimal moisture (OMC) content was for soft soil with 4 percent Rice Husk Ash and 2 percent Silica Fume. The soil with 4 percent Rice Husk Ash and 4 percent Silica Fume had the highest Maximum Dry Density (MDD).It was discovered that when geo-polymer is added to soft soil, MDD increases while OMC changes erratically. The maximum density for the soil was attained using a geo-polymer percentage of 4 percent Rice Husk Ash with 4 percent Silica Fume, according to the results. As a result, we may conclude that this proportion combination is optimal for soil stabilisation. Geo-polymer stabilisers were shown to improve the UCS value of soil, with the highest value attained with 6 percent Rice Husk Ash + 6 percent Silica Fume and a 7-day curing period. With the addition of geo-polymer percentage, it was discovered that the UCS of soil increases as the curing period of the soil grows. In other words, the soil consistency changed from very soft to stiff.

The results of this investigation suggest that geo-polymer can be employed as a soft soil stabilising agent.

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GIS INTEGRATED RAIN WATER HARVESTING

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ABSTRACT

This paper attempts the application of Geographic Information System (GIS) in Rain Water harvesting and runoff from a study area. The study area is REVA Campus, which is located in Bengaluru. The typical areas like area of rooftop of all the buildings inside the campus, roads, lawns and open areas are measured which is considered to be catchment area. The rainfall data of the rain gauge near to study area is collected from government agency. The runoff for the study area is computed by using the method of Soil Conservation Service Curve Number (SCS-CN). The potential of rain water harvesting by roof top and ground surface water runoff from the camp is reported. An attempt is made to integrate GIS for roof top potential for rain water harvesting and runoff generation of the REVA campus.

Keywords: *Rain Water harvesting, Geographic Information System, Soil Conservation Service Curve Number, Runoff*

Introduction

Rainwater harvesting involves the process of collecting, storing and use of rainwater in a scientific manner for future use. The rainwater harvesting involves catching the rain from the individual catchment surfaces such as the roof of the buildings or ground surfaces. The rainwater that falls on the catchment can be diverted into dug out pond or underground tanks for storage and subsequent utilization thus reducing the dependency of the municipal water supply.

In the work carried out, the Google image of the REVA campus is transported to GIS environment using GIS software. Based on survey data and ground truth data, land use has been classified into different groups as per SCS-CN classification. Appropriate CN was assigned to each soil group. Using the software, the area of the land under each soil group was calculated. Assuming AMC-II condition & by SCS-CN approach the roof top rain water potential and surface runoff of REVA campus, Bengaluru are obtained.

Background

The water scarcity problem of campus can be overcome by Rain Water Harvesting [1,5,8,9]. Also, by storing runoff of the campus by percolation pits, maintenance of the ground water level at higher levels and can be effectively used in summer season [2,3,4,5]. The advanced technology of GIS & Remote sensing assists in achieving sustainability of water resources in the campus [6,7].

GIS Integrated SCS-CN Runoff Model

In hydrology, Runoff is one of the important variables and this. reliable prediction is important.in watershed development and management. Estimation of runoff require considerable hydrological and meteorological data. Geographical Information Systems (GIS) acts as a tools for data input into data base, retrieval, manipulation, analysis and processing of data.

Flow diagram shows the methodology involved in estimation of the runoff from different types of areas in the basin. The flow chart for estimating the runoff is as in Figure. 1

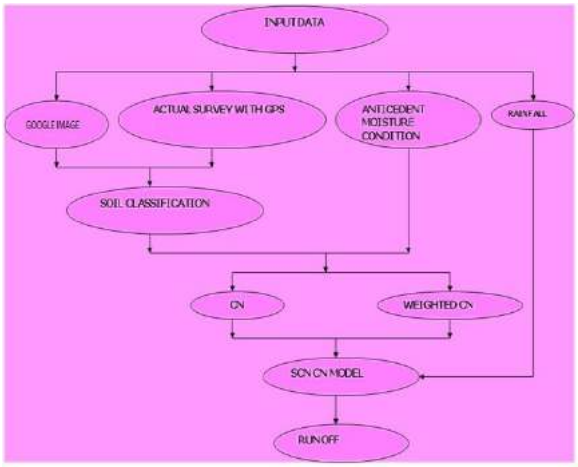

Figure 1: Curve Number Model by Soil Conservation Service (SCS)

Runoff Calculation

The runoff can be calculated by using the equation.

$$Q = (P- 0.2S)^2/(P+0.8S) \quad \text{……..(1)}$$

Here

Q=Runoff in 'mm'.

P=Precipitation in 'mm'.

S=Potential max. Infiltration in 'mm'.

Runoff curve number is defined to relate the spatially distributed unknown variable 'S' as :

$$CN = 25400/(S+254)$$

Where CN is the Curve Number

$$S = (25400/CN)-254$$

Where S = Potential maximum infiltration in 'mm'

Thus the Eq. (1) has only one unknown which relates rainfall & runoff in terms of CN. The value of CN varies from 0 to 100 and gives the measure of retention of water by a given soil vegetation complex.

Determination of Curve Number (CN)

The Table .1 shows the curve number (AMC-II) taken from the available literature for the present study.

Table 1 Land Use and Curve Number Values

Sl. No.	Land Use	Hydrologic Soil Group			
		A	B	C	D
1	Buildings	98	98	98	98
2	Paved roads	98	98	98	98
3	Parks/Lawns	39	61	74	80
4	Open areas	49	69	79	84

Hydrological Soil Group Classification

Soils are classified into A, B, C, and D according to their infiltration rate, which is obtained for bare soil after prolonged wetting.

Antecedent Moisture Condition (AMC)

The water content present in soil before a rainfall event is termed as Antecedent Moisture Condition refers to the water content present in the soil at a given time.

The soil of dry condition will be AMC I, Average wet condition as AMC II and wet soil is assigned AMCIII condition.

In the study for calculation of runoff from the four soil conditions are assumed as AMCII condition.

GIS based Rainfall-Runoff Modeling

From the google earth/AutoCAD drawing/actual survey and ground truth, the study area boundary map and land use map are

generated. Then, the land use and hydrologic soil group maps are overlaid using GIS software to identify each unique land use-soil group polygons and their respective areas required for rooftop rain water harvesting and surface rain water harvesting respectively. Following methodology of SCN CN technique the respective CN are assigned to these land use-soil group polygons, and weighted value of CN for the watershed was determined from the following equation:

$$CNavg = \left(\sum_{i=1}^{N} CNi * Ai\right) / \left(\sum Ai\right)$$

Where

CNi =curve number for each type of land use-soil areas

Ai = area of respective combination, and

∑Ai = the total area of watershed.

The weighted CN represents the AMC(II) or CN (II) condition. Later, this CN (II) values for AMC(II) are converted into CN values for AMC(III) or CN (III) and AMCI or CN (I) by using the equations as follows.

CN I = 4.2 CN (II)/ (10-0.058CN (II))

CN III = 23 CN (II)/ (10+0.13CN (II))

Study Area and Data Used

REVA campus is developed in sprawl of 45 acrees of land and is located at 13.1138°N and longitude in 77.6347°E in Bangalore North District of Karnataka. The Google image of the campus is as in Figure. 2. The campus accommodates in addition to academic and administration blocks, six hostels- 4 boys hostel, 2 girls hostel and residential staff quarters

Figure 2 REVA Campus

Analysis of Rainfall Records

The Google map of REVA campus is prepared. The rainfall data for the period of past 11years (2001to 2011) for the nearby rain gauge station of study area is collected. The statistical analysis of the monthly rainfall are computed as in Table 2

Table 2 Monthly Rainfall Mean & Standard Deviation

Sl. No.	Month	Mean (mm)	Standard Deviation(mm)
1	January	0	0
2	February	2.36	4.05
3	March	4.32	11.54
4	April	47.5	188.90
5	May	123.00	71.44
6	June	63.30	33.00
7	July	105.63	61.57
8	August	119.99	68.03
9	September	169.68	83.00
10	October	161.40	108.00
11	November	72.64	67.15
12	December	3.61	1.26

The analysis shows that mean of monthly maximum rainfall (169.68 mm) has occurred in the month of September. The average annual rainfall for 11 years is 887.41 mm.

Determination of Curve Number (CN)

The CN value is determined from hydrological soil group and land use description of the study area. By standard table and overlying the land use/cover map and soil map, the following Curve Numbers are assumed:

For Pavement Area CN=98

Rooftop Area CN=98

Parks with good grass cover (Soil group 'B') CN=61

Open Spaces (Soil group 'C') CN=79

Roof Top Rain Water Harvesting

The roof top rain water potential of key buildings of REVA campus is as shown in Table.3

Table 3 Roof Top Potential Volume of Rainwater

Sl. No	Building Name	Area (m^2)	Volume (m^3)
1	Vivekanand Block	3287.70	2695
2	C V Raman Block	4434.79	3636
3	VisvesvarayaBlock	3628.60	2974
4	Admin Block	1171.23	960
5	REVA Library	1099.20	901
6	P U Block	1862.26	1526
7	Staff Quarters 1	907.39	743
8	Staff Quarters 2	352.22	288
9	G 2 Hostel	1125.73	922
10	G 1 Hostel	2491.29	2039
11	Guest House	745.54	611
12	C Block	3997.86	2909
13	D Block	2051.89	1682
14	Boy's Hostel 1	2121.38	1739
15	Boy's Hostel 2	2211.02	1812

Surface Rainwater Harvesting

By using GIS software the area of each soil group is calculated. The weighted CN is obtained knowing the antecedent average moisture condition as in table 4.

Table 4 Surface Runoff by Using SCS –CN Mode

Land Use	Soil	Campus Area (m^2)	CN	%	Product= (%Area)* (CN)	Weighted

	Type			Area		CN
Building	**-**	**31488.10**	**98**	**35.79**	**3507**	
Roads	**-**	**12563.15**	**98**	**14.28**	**1400**	
Parks/Lawns	**B**	**16080.37**	**61**	**18.27**	**1115**	
Open Spaces	**C**	**27856.31**	**79**	**31.66**	**2501**	**85.32**
TOTAL		**87987.93**			**8523**	

Using Weighted CN and mean monthly rainfall record, surface runoff for each month is computed and tabulated in Table 5.

Table 5 Surface Runoff Computation by Using SCS –CN

Surface Runoff Q = $(P-0.2S)^2/(P+0.8S)$ S=57.64 mm ; where S=Potential Infiltration			
Months	**Av. Rainfall (mm)**	**Runoff (mm)**	**Runoff (m^3)**
JAN	0	0	0
FEB	2.36	1.73	152.219
MARCH	4.32	1.03	90.627
APRIL	47.5	13.82	1215.99
MAY	122.95	73.48	6465.35
JUNE	63.27	24.49	2154.82
JULY	105.6	58.36	5134.97
AUG	119.99	70.82	6231.31
SEPT	169.68	115.91	10198.68
OCT	161.4	108.24	9537.89
NOV	72.64	31.45	2767.22
DEC	3.61	1.260	110.865
TOTAL	**873.44**	**500.59**	**44059.941**

Mean Monthly runoff for REVA campus
Mean Monthly Runoff potential of REVA campus in each of the year is represented in Figure. 3

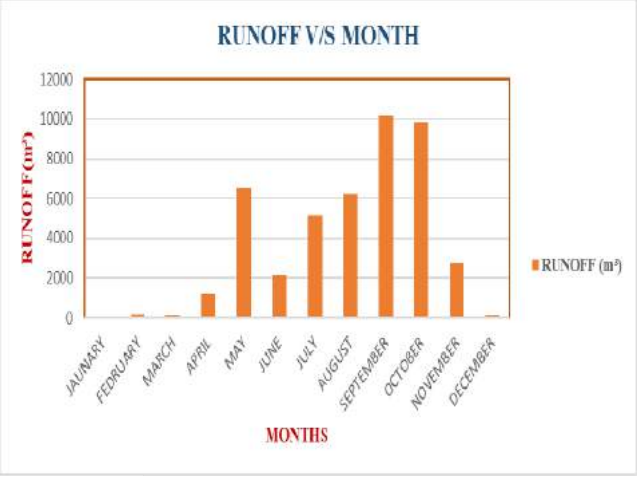

Figure 3 Monthly Runoff Potential of REVA Campus

Analysis Using GIS

The application of GIS for the analyzed data of REVA campus is as follows,

Preparation of the REVA Campus Plan:

- REVA campus plan is prepared by google pro image.

- Using GIS software the campus is image is imported into the GIS environment, using universal translator Digitizing
- When digitizing a projected map, use the projection button in digitizer setup which is used to specify the projection of map.

The thematic map prepared based on the Rain Water Harvesting (RWH) potential is as shown in Figure.4.

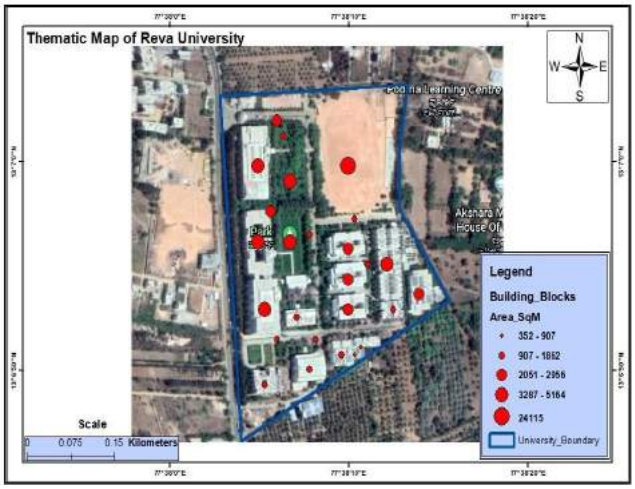

Figure 4: Thematic Map of RWH Potential of REVA Campus

The thematic map shows higher roof water harvesting potential for Raman Block.

Results

The total roof top harvesting for the study area is estimated to be 25,834 m3 and surface water runoff works out to be 44,059 m3.

The relevant rainfall data for the 10-years, required for the computation of runoff is collected and statistical parameters are computed.

- The weighted CN for the study area is CN=85.32.
- The Av. annual rainfall for 11 years is 887.41 mm.
- The total roof top rainwater potential of the campus by considering key buildings is 25,437 cubic meters with a maximum potential of 3636 cubic meters in C V Raman block.
- The total runoff potential of the campus is calculated as 44,059 cubic meters with maximum runoff of 10,198 cubic meters during the month of September.

Using the values of average rainfall 'P' for each month and potential infiltration 'S', the runoff for each month is computed. Then using the values of total area of the campus and runoff, the volume of runoff for each month is computed and tabulated in Table5. A graph of volume of runoff v/s months is drawn as in Fig.3. The total volume of runoff potential of REVA campus is 44,059 m3.

Conclusion

The runoff estimation and rain water potential is important for self-sustenance of campus. From the study the conclusions drawn are,

- Rainwater harvesting is a very useful process during the rainy season and meets the scarcity of water and will lead to sustainable water use.
- For rain water harvesting, the runoff is one of the most important hydrological variables.
- By using GIS software, thematic layer of the campus has been created and areas of each of the polygon area and respective percentage area are determined. Using the SCS-CN method, weighted CN of the campus area was calculated.

The total rooftop rainwater harvesting potential and surface runoff potential are calculated. The roof top water can be utilized for consumption for various purposes by storing in

tanks or sumps. The runoff potential of campus gives the insight of utilization of this water for recharging the aquifer by percolation pits or storing this water in small check dams and use it for the campus requirements.

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AN EARLY TERMINATION CUCKOO SEARCH ALGORITHM TO SOLVE RANDOM TSP

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ABSTRACT

Travelling salesman problem (TSP) is an NP-hard problem. It is very easy to understand. At the same time, it is very difficult to solve. It can't be solved in given polynomial time. Various nature inspired algorithms are proposed to solve TSP. Mostly all algorithms have used static TSP instances available in literature for checking their effectiveness. So, in general all these approaches solve a static TSP. But, in actual, all problems which can be converted into TSP are real time problems. They change their nature in real time. It is necessary to have algorithms which can provide best solutions to those real time TSP problems. Nature inspired algorithms such as genetic algorithms, ant colony optimization, particle swarm optimization, firefly algorithm, bat algorithm, whale optimization algorithm, grey wolf optimizer, artificial immune algorithm, Cuckoo Search and many others have been applied to solve Static TSP. In this paper, an Enhanced version of Cuckoo Search algorithm is proposed to solve random TSP. Random TSP uses randomly generated TSP instances and makes itself more real then Static TSP. A TSP instance generator is used to create the instances of random TSP. We have developed a new stopping mechanism to improve the searching practice of the CS algorithm. in this stopping mechanism the algorithm stops and exits the search process when the optimal solution is found. The proposed algorithm is evaluated compared with the other algorithms. The proposed algorithm takes significantly less time for all instances (0.20 seconds to 5.12 seconds), this algorithm also produces short tour lengths (231.83 to 834.65) for most of the instances. Number of iterations (115 to 380) suggests that this algorithm does not falls in local optima.

Keywords: *nature inspired algorithms, cuckoo search algorithm, random traveling salesman problem, optimization..*

1. Introduction

In 1930, Karl menger defined and studied travelling salesman problem (TSP). M.M. food made it very popular by using it as a base problem for solving bus routing problem [1]. In 1972, tsp proved to be a NP-hard problem [2]. TSP can't be solved in a polynomial time with its increase in size. TSP is very easy to understand but difficult to solve. Due to this characteristic of TSP, it has become a benchmark problem for the researchers for evaluating their research. Since then it remains a favourite problem for the researchers. Researchers have continued to improve the optimal result of TSP using their research work.

Travelling salesman problem (TSP) can be represented as a hamilton cycle where each node is traversed only once [3]. We try to achieve a very short hamilton cycle considering the fact that each arc between the nodes represents a path. The weight of the each arc represents the cost or distance required to traverse between the nodes to which the arc is associated. So, we try to find a short hamilton cycle in terms of distance, cost and time.

Nature inspired meta-heuristics have played a very significant role in solving TSP. Several nature inspired algorithms have applied to solve travelling salesman problem (TSP). some of the recently applied are, whale optimization algorithm (WOA) [4], water cycle algorithm (WCA) [5], fruit fly algorithm (FFA) [6][7], particle swarm optimization algorithm (PSO)[8], cuttlefish optimization algorithm (COA)[9], artificial bee colony algorithm (ABC)[10], bat algorithm (BAT) [11], bacterial memetic evolutionary algorithm (BMEA) [12], immune algorithm (IA) [13], lion swarm optimization algorithm (LSA) [14], firefly algorithm (FA) [15], and ant colony optimization (ACO) [16]. All of them have produced results based on their criteria and limitations.

We can model various real time applications into a TSP. Real time application works based on the current situations. It means that, they change their nature during their working. So, the TSP also will change its nature during

runtime. For this, we need to convert our problem in real instead of static. We use randomly generated TSP instances instead of the available instances in the literature. That is why, we call our TSP problem as a random travelling salesman problem (RTSP). In this research, an early termination cuckoo search algorithm (ETCS) is proposed to solve the random travelling salesman problem (RTSP).

This paper is organized as follows. In section 2, a brief literature review is given. We describe the Random Traveling Salesman Problem (RTSP) in section 3. Basic cuckoo search algorithm is discussed in section 4. Section 5 introduces the proposed ETCS model for RTSP. Section 6 analyzes the results obtained with proposed model. Conclusions and references follow this.

2. Literature Review

The researchers have developed numbers of nature inspired algorithms for solving TSP. cuckoo search algorithm is comparatively new and rapidly attractive algorithm on the continuous and discrete optimization problems. A brief review on the solutions for TSP and RTSP using CS is given in this section. There have been numerous attempts to modify and apply the CS algorithm to the discrete TSP. The CS algorithm is modified by [17] in two ways, one is adjusting the parameters and other is hybridization. Three different search strategies to explore the search space are proposed by [18]. Random long-distance, stochastic moderate-distance and stochastic short-distance search strategy are proposed in this algorithm. Saelim et al. proposed a new crossover and random replacement mechanism for producing new solutions in place of Lévy flight. The proposed algorithm is tested on seven different TSP problems. The results outperformed the basic CS [19]. Ouaarab et al. [20] presented a random-key approach to switch between the continuous and combinatorial search space to achieve a good balance between exploration and exploitation. Ouaarab et al. [21] modified the CS by rebuilding three types of cuckoos for performing more efficiently with less number of iterations. [22] gave a hybrid CS-GA approach to overcome the local minima problems. [23] proposed a hybrid IWD-CS approach for solving the CVRP.

Very few algorithms are presented to solve a random traveling salesman problem (RTSP). [24] proposed an ACO approach to solve RTSP. A memetic algorithm to solve RTSP is introduced by [25]. Also, [26] proposed a genetic algorithm to solve RTSP. Firefly algorithm is also used by [27] to solve random traveling salesman (RTSP). Firefly approach has produced best results among all of them.

3. Random Travelling Salesman Problem

In a Random Travelling Salesman Problem, city problems are generated randomly. This is done to explore more search space to address the problem of local optima. A random problem instance generator is used to generate the city problems randomly.

Other than random TSP, there are many types of travelling salesman problem (TSP) described in the literature. To list a few; Symmetric TSP, Asymmetric TSP, Dynamic TSP, Spherical TSP etc. Symmetric TSP is a tsp where distance between the cities is same from the either side. Asymmetric TSP is a TSP where distance between the cities from the either side is not same. Dynamic TSP is a TSP where the problem changes itself at run time. In a spherical TSP all cities lie on a sphere. This paper presents an enhanced cuckoo search algorithm to solve Random Travelling Salesman Problem. All TSP instances are generated in the range of 10 to 100.

4. Basic Cuckoo Search Algorithm

The cuckoo search algorithm (CS) is one of the recently proposed algorithms. CS was proposed by yang [28][29]. The reproduction behaviour of cuckoos is the inspiration for the development of this algorithm.

Cuckoos don't build their own nests. They have a tendency to lay their eggs in other birds' nests. Cuckoos fly randomly for finding a suitable nest for laying their eggs. They check all the nests to find a nest which has very high chances of getting hatched its eggs. Cuckoos some time change the shape and colour of their eggs to fool the host bird. Sometimes, the host bird finds the cuckoos' eggs in its nest. In this case, host bird either throw out the eggs or

abandon the nest. The simplest approach of using new metaheuristic CS algorithm can be done through three idealized assumptions, which are:

1. Every cuckoo chooses a nest to lay an egg randomly.
2. The better nest with best quality eggs will go to next iteration.
3. In case of the discovery of a foreign egg in the nest, the host bird either abandons the egg or makes a new nest at other place. The discovery of egg has a probability $p \in [0, 1]$.

Rule number 3 can be estimated with the replacement of a small part p of host nests with some newly created nests randomly. The quality of the solutions directly based on the value of the fitness function. Considering the implementation part, every egg in a nest is a solution and each cuckoo lays only one egg in a nest. Our aim is to find a best egg to replace a worst egg in a nest.

Lévy flight is a random walk with random direction. The step length is derived from a Lévy distribution. Equation 1 is used to generate a new solution $Sol_i^{(t+1)}$ by a cuckoo via Lévy flight.

$$Sol_i^{(t+1)} = Sol_i^{(t)} + \alpha \oplus Lévy\ (S, \lambda) \quad (1)$$

In which,

- α - represents step size which follows a Lévy distribution given in equation 2.
- $\oplus$ - represents entry wise multiplications

In most of the cases the value of step size (α) is kept one. The step length follows a Lévy distribution,

$$Lévy\ (S, \lambda) \sim s^{\lambda},\ (1 < \lambda \leq 3) \quad (2)$$

Where, S - represents the step size drawn from the Lévy distribution. The Lévy flight is a very special kind of random walk where length of step is not constant. A probability distribution is used to select the step length. Due to this a large step length is also possible.

4.1.Flow of Cuckoo Search Algorithm

The flow of the Cuckoo Search Algorithm is given in figure 1.

1. Initialize the parameters
2. Initialize a random population of *n* nests of cuckoos
3. Gets a cuckoo *i* randomly using random walk
4. Evaluate the Fitness of it
5. Select a nest *j* among *n* randomly
6. If the fitness of *i* is less than fitness of *j* replace *j* by the new solution else let *j* as the new solution
7. Abandon the fraction of worst nests and build new ones at new locations randomly
8. keep the current best nest
9. If the termination criteria met display current best as the best solution else go to step 3

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Figure 1 Flow of Cuckoo Search Algorithm

5. Proposed Cuckoo Search Algorithm

5.1. Early Termination Mechanism

We propose a new early termination (ET) mechanism to improve resources exploitation while execution. Our algorithm terminates as soon as it founds the optimal solution. The algorithm stops exploring search space based on following mechanism. Description of the new mechanism is given below.

1. Store the best solution achieved at each iteration in an array.

2. Observe the solution values ($V= v_1,v_2,v_3,....,v_n$) of last few iterations ($I= i_1,i_2,i_3,....,i_n$).
3. Calculate the difference between solution values as below for the defined iterations,

- $D_1 = v_{n+1} - v_n$
- $D_2 = v_{n+2} - v_{n-1}$
- $D_3 = v_{n+3} - v_{n-2}$

4. If ($D_1=D_2=D_3$) up to defined iterations, terminate the algorithm and display results else continue execution.

We can represent above mechanism mathematically as below.

$$ET = \begin{cases} 1, & D_1 = D_2 = D_3 = 0 \\ 0, & Otherwise \end{cases}$$

Where,

- $D_1 = v_{n+1} - v_n$
- $D_2 = v_{n+2} - v_{n-1}$
- $D_3 = v_{n+3} - v_{n-2}$

The proposed early termination cuckoo search algorithm is given in figure 2.

Input:
Step-size
Solution range
Number of iterations
Output:
Accepted tour
Algorithm:
1. Generate initial population (p_i) of nests (solutions) (n) randomly
2. Define the objective function (fn)
3. Calculate the fitness (fi) of all solutions based on the objective function
4. while (Termination criteria not met)
   For all nests (solutions) (p_i) do
   Compute step size
   Create new nest (Solution) p_j randomly from all nests (p_i)
   If ($p_j < P_{min}$) then
   $p_j = P_{min}$
   If ($p_j > P_{max}$) then
   $p_j = P_{max}$
   Compute the fitness of new cuckoos (f_j)
   Randomly select a nest (P_k) from available nests
   If ($F_j > F_k$) then
   $p_j \leftarrow P_k$, $F_j \leftarrow F_k$
   End for
   Find the current best solution out of n nests
   Find the global best solution of the iteration
   Calculate differences of last defined pairs of best solutions: $D_1, D_2, D_3, \ldots, D_n$
   If ($D_1, D_2, D_3, \ldots, D_n = 0$) then
   Terminate the execution
   Else repeat the loop
5. Return the global minimum value of fn.

Figure 2 Pseudo code of proposed ETCS algorithm

6.2. Parameter Settings

The table 1 describes the setting of the parameters used in the proposed ETCS algorithm

Table 1 Parameter Settings of ETCS algorithm

Sr. No	Parameter	Value
1	Number of iterations	30
2	Population size (P)	40
3	Step size (α)	01
4	Levy distribution	1.5

6. Experiments and Results

The proposed early termination cuckoo search algorithm (ETCS) is coded in MATLAB R2015a and implemented using an Intel i3 CPU, 8GB RAM and Windows 10 operating system. Eleven instances of random TSP are created and tested by WOA, WCA, FFA, FA, COA and ETCS. Every algorithm is executed for 30 times on all 11 instances. The euclidian distance between two cities is considered here.

6.1. Experiment Setting

The early termination cuckoo search algorithm (ETCS) is proposed and investigated on solving a real TSP, which changes itself with every iteration. A new random instance is generated in each iteration and provided to the algorithm. We executed algorithm 30 times for each instance. The best iteration value is taken as the result of the algorithm.

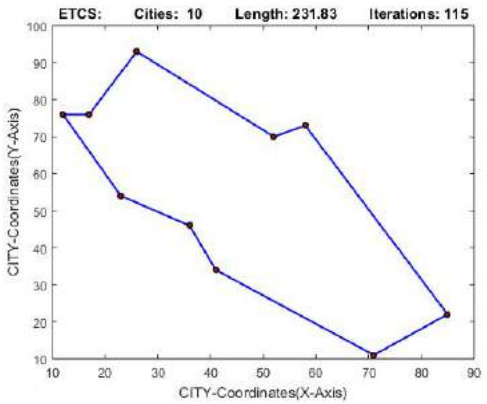

Figure 3 Results for Random-10 instance

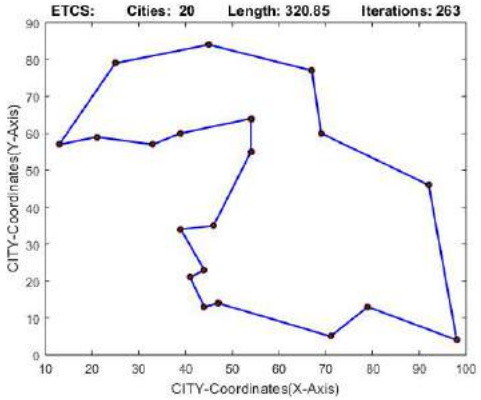

Figure 4 Results for Random-20 instance

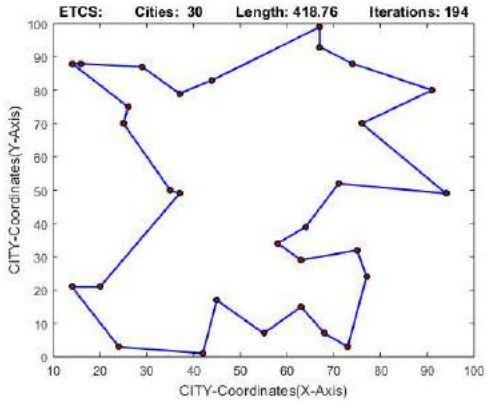

Figure 5 Results for Random-30 instance

Table 2 Comparison on Iterations required

Instance	WOA	WCA	FFA	FA	COA	BMEA	ETCS
Rand-10	103	103	102	106	106	115	115
Rand-20	103	168	108	122	109	263	263
Rand-30	152	168	163	194	194	366	194
Rand-40	203	330	369	254	280	524	250
Rand-50	174	194	245	248	268	769	244
Rand-60	159	221	242	319	318	960	310
Rand-70	202	251	242	487	502	1034	487
Rand-80	168	222	245	468	476	1425	462
Rand-90	288	288	279	335	346	1194	330

Rand-100	180	302	325	398	466	1363	437
Rand-110	293	373	334	407	424	1936	380

Table 3 Comparison on Time (seconds) Required

Instance	WOA	WCA	FFA	FA	COA	BMEA	ETCS
Rand-10	0.21	0.21	0.27	7.67	0.25	4.07	0.20
Rand-20	0.52	0.88	0.95	9.04	0.59	4.57	0.28
Rand-30	0.79	2.93	3.21	14.30	0.79	7.12	0.60
Rand-40	1.50	7.21	7.91	28.55	1.65	10.22	1.06
Rand-50	2.23	9.60	10.07	18.81	2.50	8.69	1.32
Rand-60	3.73	13.29	14.59	19.89	3.93	10.71	1.70
Rand-70	7.14	23.35	25.71	20.87	7.86	12.50	2.00
Rand-80	8.48	25.71	27.31	19.82	8.68	12.35	2.89
Rand-90	8.69	17.31	19.51	25.44	8.96	14.91	2.58
Rand-100	13.55	15.20	16.25	18.20	14.35	16.11	3.13
Rand-110	15.59	20.68	21.71	23.38	15.59	18.36	5.12

Table 4 Comparison on Length of the Tour

Instance	WOA	WCA	FFA	FA	COA	BMEA	ETCS
Rand-10	232.82	231.83	231.83	231.83	232.82	232.82	231.83
Rand-20	325.42	320.85	326.83	320.85	327.42	325.55	320.85
Rand-30	420.26	418.76	418.76	452.47	420.19	442.47	418.76
Rand-40	468.44	468.64	464.88	486.78	476.33	476.78	460.71
Rand-50	605.32	615.25	606.51	621.01	607.42	618.01	596.30
Rand-60	628.66	643.09	631.33	675.47	629.37	645.66	626.93
Rand-70	705.40	714.47	711.45	786.29	710.60	726.24	681.79
Rand-80	753.43	789.90	749.83	810.28	758.54	802.28	744.28
Rand-90	781.18	816.74	791.33	905.58	784.43	855.58	779.83
Rand-100	860.62	870.30	849.83	872.12	861.82	862.12	844.49
Rand-110	841.60	870.64	860.99	914.90	841.60	914.90	834.65

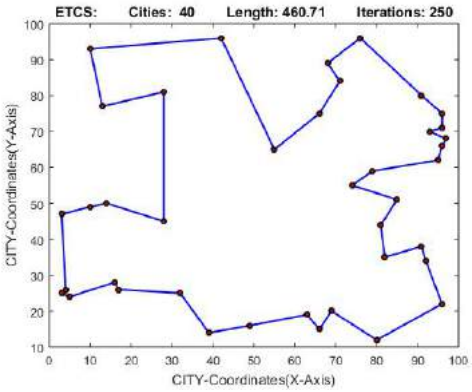

Figure 6 Results for Random-40 instance

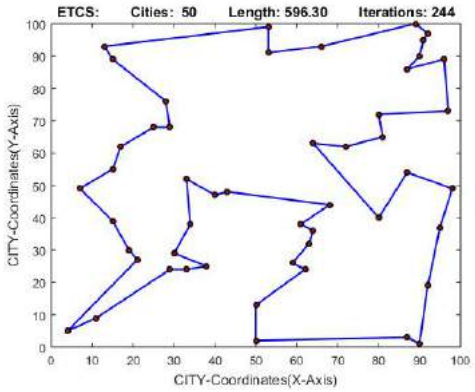

Figure 7 Results for Random-50 instance

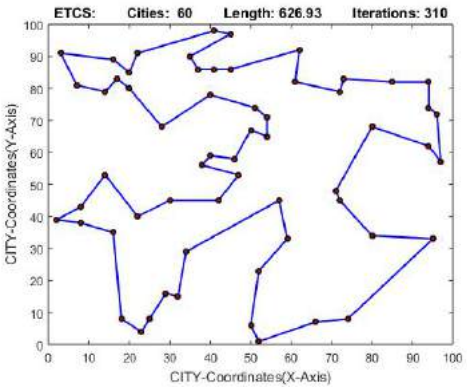

Figure 8 Results for Random-60 instance

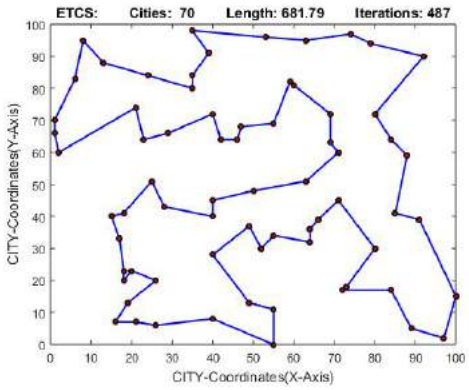

Figure 9 Results for Random-70 instance

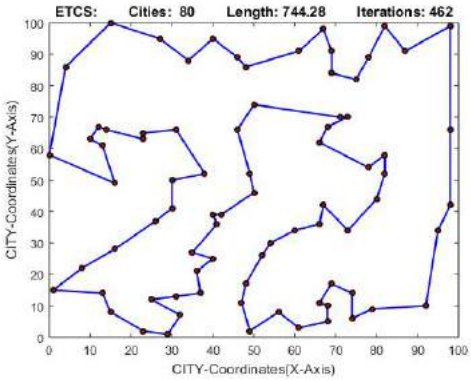

Figure 10 Results for Random-80 instance

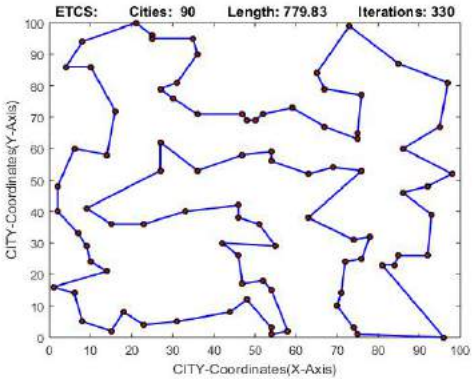

Figure 11 Results for Random-90 instance

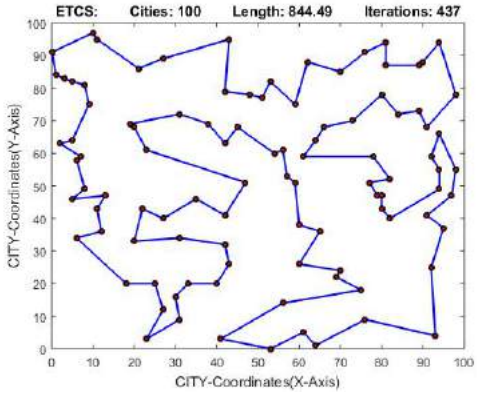

Figure 12 Results for Random-100 instance

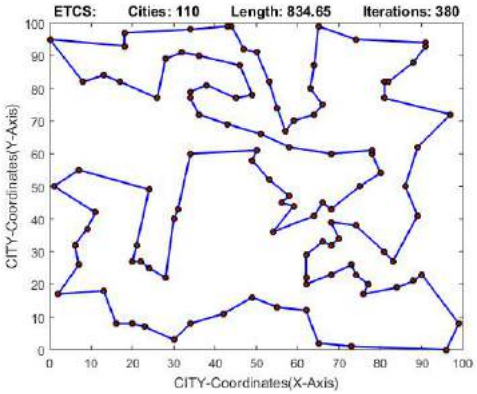

Figure 13 Results for Random-110 instance

7. Conclusions

The proposed ETCS algorithm shows very good results for the random travelling salesman problem (RTSP). This algorithm generates the best quality output faster than the other algorithms like WOA, WCA, FFA, FA and COA**.** The introduction of early termination mechanism improves the effectiveness of basic CS in terms of time, cost and distance. As this algorithm proves itself a time efficient, it can be used for different types of real and natural applications.

- **Conflicts of Interest**

There is no conflict of interest in this research.

- **Author Contributions**

Conceptualization, NMS and BVC; methodology, NMS; software, NMS and BVC; validation, ARV and BVC; formal analysis, BVC; investigation, NMS; resources, ARV; data collection, NMS and BVC; writing—original draft preparation, NMS, BVC, ARV;

writing—review and editing, NMS, BVC and ARV; visualization, NMS; supervision, NMS.

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COMPARITIVE STUDY ON DECOMPOSITION OF KITCHEN AND AGRICULTURE WASTE

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ABSTRACT

This paper is attempts to discuss on the production of manure from food waste recycling through Bookish method in laboratory scale. From this study, perhaps it could help to reduce food waste by converting it into fertilizer that proven to be commercially used by society. Bokashi is the result of a composting method based on the addition of a liquid solution of effective microorganisms, which are anaerobic bacteria and lactic acid yeasts. It is produced by fermenting organic waste materials known as "effective microorganisms". Unlike aerobic composting piles that require several months of attention and turning, Bokashi systems can degrade wastes into plant available nutrients in less than four weeks with decreased need for turning piles manually. In this studies along with food waste, the other waste like shells of groundnut rich in nitrogen, tamarind rich in potassium, magnesium, phosphorous and pongamiapinnata rich in calcium, iron, potassium which are required for the plant growth is used in the samples for decomposition and to convert into manure. These are tested in laboratory for the analysis of compost minerals like Nitrogen, Phosphorus ,Potassium, Moisture Content, Carbon , C/N Ratio, pH. The main objective of the study is the Selection of method for reducing the amount of waste by anaerobic techniques. To advise for use the obtained product as manure to control pollution problem by solid waste. The result of this study the results achieved suitably for using as a manure for growing of crops

Keywords: *Anaerobic, Bokashi, Manure, Nitrogen, Potassium..*

Introduction

The presence of food waste in large quantities has attracted many attentions and create worries. Excessive food waste can cause energy losses than losses occurring earlier in the chain and have many negative, economic and environmental impacts. Hence, reducing the amount of food waste sent to landfills is likely to be the best way to overcome the problems. The world has recognized food waste as an additional material in the production of manure, which give benefits to the environment, economy and social vitality complies. Food waste (FW) comes from the subsequent of food supply chain of human usage which is also known as leftover food and the food that discarded or uneaten by humans around the world. According to the term food waste commonly meant by food that was purchased but not consumed and ends up in the garbage.

The other meaning, 'food waste' refers to the food which is of good quality and fit for human consumption but that does not get consumed because it is discarded. Compost is organic matter that has been decomposed in a process called composting. This process recycles various organic materials otherwise regarded as waste products and produces a soil conditioner. Compost is rich in nutrients. It is used, for example, in gardens, landscaping, horticulture, urban agriculture and organic farming. The compost itself is beneficial for the land in many ways, including as a soil conditioner, a fertilizer, addition of vital humus or humic acids, and as a natural pesticide for soil. In ecosystems, compost is useful for erosion control, land and stream reclamation, wetland construction, and as landfill cover. At the simplest level, the process of composting requires making a heap of wet organic matter, such as leaves, grass, and food scraps, and waiting for the materials to break down into humus after a period of months. However, composting can also take place as a multi-step, closely monitored process with measured inputs of water, air, carbon and nitrogen rich materials.

Materials and Methodology

The materials used in the present study to carry out different analysis of project, Bokashi powder (fermented powder), Air tight container, Fruit and vegetable waste, Agriculture waste like groundnut, tamarind and pongamiapinnata shells, Mesh wire. Bokashi Powder powder is already a fermented powder and this is used for rapid composting in this study. This is used in Bokashi method of composting.

Airtight container is used for doing the anaerobic process. This Airtight container is used for doing Bokashi composting method for not letting the air inside the container.

Food Waste: Food waste used in this project is the waste obtained from home. Here the food waste used was fruit and vegetable and agriculture waste.

Mesh wire: The mesh wire is placed at the bottom of food waste to drain out the bokashi liquid from the compost.

Methodology

Food waste we used in this project was obtained from our homes and agriculture waste. Bokashi powder in the amount of 10grams was sprinkled in the bottom of the bin. Food waste was cut into pieces and put in the bin about 3-4 cm.

Bokashi powder in the amount of 60grams was sprinkled again over the food waste. The air was removed from the bin by pressing down the food waste. The lid was ensured to be closed-tight and let it sit for 10 to 14 days. The Bokashi liquid was drained 3 times a week to avoid the mixture too moist.

Bokashi method

Bokashi is a process that converts food waste and similar organic matter into a soil amendment which adds nutrients and improves soil texture. It differs from traditional composting methods in several respects. The most important are the input matter is fermented by specialist bacteria, not decomposed. The fermented matter is fed directly to field or garden soil, without requiring further time to mature.Wehavedonetestsinthelabforourobtainedsamplestofindoutthefollowing:Nitrogen, Phosphorus, Potassium, Moisture Content, Carbon, C/NRatio and pH

Nitrogen (N) is important for plant growth and development, and of the macronutrients, is often the one that is most limiting. Soil nitrate (NO3) and ammonium (NH4) are both forms of inorganic nitrogen that are readily available for use by plants. They are formed from the mineralization (by microorganisms) of organic forms of N such as soil organic matter, crop residue, and manures.

Phosphorus plays an important role in plant health and growth; it encourages root development, increases the ratio of grain to straw, and increases resistance to disease, among other things. Some soil phosphorus is in a form available to plants, but much of it is tied up in the organic matter pool, or bound tightly to mineral particles. The soil pH has a large influence on phosphorus availability and solubility

Potassium (K) enhances disease resistance in plants by strengthening stalks and stems, contributes to a thicker cuticle (leaf surface layer) which guards against disease and water loss, controls the turgor pressure within plants to prevent wilting, and enhances fruit size, flavour, texture and development. Soil potassium is found in three forms; trapped between clay layers (relatively unavailable), adsorbed on the surface of soil colloids (exchangeable), and in the soil solution (available). Available potassium supply for maximum crop production depends on the type of clay mineral in the soil parent material (some minerals have more potassium than others) and its resistance to weathering actions.

Water content or moisture content is the quantity of water contained in a material, such as soil (called soil moisture), rock, ceramics, crops, or wood. Water content is used in a wide range

of scientific and technical areas, and is expressed as a ratio, which can range from 0 (completely dry) to the value of the materials' porosity at saturation. It can be given on a volumetric or mass (gravimetric) basis.

Calculate the % moisture for each of the materials you plan to compost.

a) Weigh a small container.

b) Weigh 10 g of the material into the container.

c) Dry the sample for 24 hours in a 105-110 degree C oven.

d) Reweigh the sample, subtract the weight of the container,

and determine the moisture content using the following equation:

Mn = ((Ww-Wd)/Ww) x 100

in which:

Mn = moisture content (%) of the Sample

WW = wet weight of the sample, and

Wd = weight of the sample after drying.

The soil reaction, or pH, is a measure of the acidity or alkalinity of the soil. A pH of 7.0 is neutral. Soil pH values below 7.0 are acid, while those above 7.0 are basic or alkaline. Each whole unit (e.g., 1.0) change in pH represents a tenfold difference in acidity or alkalinity. For example, a pH of 5.2 is 10 times more acidic than a pH of 6.2. For most Vegetable and row crops, a pH of 5.8 to

6.5 is optimal. A pH range of 5.5 to 5.8 is desirable for roses, turf grasses, fruits and nuts. Certain shrubs and blueberries thrive in soils with a pH below 5.5.

Discussion

The main purpose of this study is to compare the decomposition of kitchen and agriculture waste. Analysis of pH for Different Proportions with respect to Days. Here in table no 1 shows the variation in the pH that are observed with respect to days while doing project for various compositions of Bokashi and Berkeley. By noticing pH we can assess whether the project had become Acidic or Alkaline while processing to Manure.

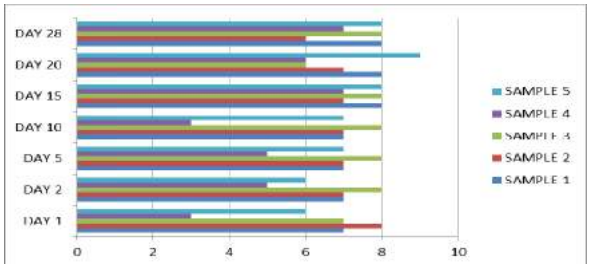
Results

Table 1- Shows the Details of pH

Bokash Powder with other waste	pH Values in Different Days						
	1	2	5	10	15	20	28
Food waste	7	7	7	7	8	8	8
Groundnut shells	8	7	7	7	7	7	6
Pongamia pinnata shells	7	8	8	8	8	6	8
Tamarind shells	3	5	5	3	7	6	7
Kitchen waste+ Agriculture waste	6	6	7	7	8	9	8

Fig no-1. The figure shows the variation of pH values

Temperature



1. The main aim of our project is to decompose the food waste as a natural fertilizer in the home itself by usingAnaerobic process that too should be done in room temperature.

2. So the temperature we have maintained in our project is Room temperature.

Test Values for Compost Materials of the Sample:

This shows the percentage of different compost materials that are essential for a manure from the give sample. Which can be used to know the C/N Ratio.

Table 2- Shows the Details of Parameters in Percentage

Bokash Powder with other waste	N	P	K	C	Moisture content	C/n ratio
Food waste	2.1	2.6	2.9	43	73	20.4
Groundnut shells	1.9	2.7	2.4	32	82	16.8
Pongamia pinnata shells	2.9	2.8	3	4.9	86	1.6
Tamarind shells	1.8	2.9	2.5	33	83	18.3
Kitchen waste, Agriculture waste	2.3	2.7	2.8	45	87	19.5

Note: N-Nitrogen, P-Phosphorus, K-Potassium C-Carbon

Conclusion

From this study the following conclusions can be drawn based on laboratory investigations carried out in this study.

- Through this study, by the use of bokashi method for composting reduces the amount of solid waste generated in our day to day life.
- The results achieved in the project is suitable for using as a manure and can be applied for growing of crops.
- The compost from this method can also be achieved within a month and the manure obtained can be used for garden and also for agricultural fields.
- As we can see from the results obtained that the Sample 1(kitchen waste) and Sample 5(kitchen and agriculture waste) are showing better results than other three samples. Hence instead of using shells alone in the composting, When it is combined with kitchen waste it decomposes faster and will give nutrient rich compost.
- Compost is rich in required nutrients. Therefore it can be used for various purposes like gardening, organic farming, horticulture, urban agriculture and landscaping.
- Note: The temperature maintained while doing this project is Room temperature i.e 25°C.
- The compost is essential for the land in many ways, including as a soil conditioner, a fertilizer, addition of vital humus or humic acids, and as a natural pesticide for soil.
- By reducing the solid waste the landfill pollution may decrease and waste can be reused.
- Through the obtained fertilizer by reducing solid waste using Anaerobic techniques can be used as fertilizer in home if it was done small scale and if was done large scale it can be used as fertilizer in Agriculture.

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QUANTITY ESTIMATION OF B+G+3 COMMERCIAL COMPLEX BY COSTX SOFTWARE AND FORECASTING MANPOWER PLANNING FOR PROJECT USING MICROSOFT PROJECT (MSP)

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ABSTRACT

The price which is required for the project can be determined theoretically by using the Drawings, Plans, and Current market rates of the construction materials. We can also calculate by using the thumb rule which will be not as much as accurate. Therefore to get the better accuracy of the project we use CostX software for calculating the more accurate estimation of the project.

In construction industries estimation and forecasting plays an important role, efficiency of estimation and manpower planning depend upon the modern solutions which will help us ensure the quality of a project. To overcome those aspects Microsoft Project (MSP) software is used, it aims to assist particular works for several specified internal and external laborers. Manpower planning is systematically enhanced, to boost the quality of planning, scheduling, manpower utilization etc. To overcome from external effects we should focus on supply and demand. To establish whether manpower planning methods and practices are serving effectively, and to find out disputes in a project. The Estimation includes the calculation of various quantities of materials and cost control.

Keywords: *Man-Power, Estimation, CostX, Scheduling, Microsoft Project (MSP).*

1. Introduction

Estimating is the strategy for registering various amounts and consequently the normal use to be caused on a particular chosen work. The off chance that simply for the situation where the accessibility of assets are not exactly the estimated cost, The work is done mostly or by diminishing it or particulars are adjusted, the estimation provides detailed specifications about regarding amount of materials. To estimate the quantity here we use CostX software. Here the estimation provides a better knowledge to understand the cost which will be required for the construction of a B+G+3 commercial complex and the concept of Manpower planning makes society to overcome from the disciplinary planning, scheduling, estimating, etc. The objective of Man-power is to ensure the particular work of a laborer or construction activity.

Manpower planning is defined as the process assessing organizational manpower needs in changing condition making plans to ensure stable work force is retained and employed. Analysis of man-power demand and supply has enormous history and played as crucial tool in the field of human resources planning. This project subject to deal with meaning, importance, need, and steps involved in Manpower planning.

1.1 CostX

CostX was coded and released in July 2004 by company Exactal, To integrate the measurement process with CAD drawings and PDF drawing files. There were already a few programs in the field at that time, but their approach was different from the way they directly tied the standards to the elements of CAD drawings. This method allows them to move different bi-directional links between the scale and parts of the diagram represented. In June 2020, the product was renamed and renamed iTWOcostX® to fit perfectly with the range of RIB software. ITWO costX® is now widely used and used to build, test quantities, develop, make small contracts and scale large and small firms, worldwide. After its first release, iTWOcostX® sales have grown exponentially and are now on sale and supported by more than 90 countries.

1.1.1 What CostX Can Do

- It helps to estimate, 3D BIM models and CAD drawings, correspondingly PDF formates.

- Capacity to coordinate with drawings and to spot variation in drawing.
- Measures the lengths, counts and regions with one tick.
- Live-linked, workbooks.
- Capacity to hide or to show layers which are drawn in CAD.
- Capability to form infinite price libraries.
- Subcontractor examination/tender tool for recording statements and evaluation.

1.1.2 Advantages of CostX

- CostX software permits non-CAD users to measure from CAD or PDF files while not running CAD software.
- Depending on our versions, we may issue detailed documents such as rates, cost plans, bills or tenders.
- It provides a powerful and versatile report which permits skilled quality output.
- The measurements are taken easily and quickly by 2D or 3D drawings.
- We can switch back and forth between models at any time.

1.2 Microsoft Project [MSP]

Microsoft Project is a software, the executives programming created by team of Microsoft. It's future to help a venture administrator for fostering a timetable, disseminating material goods to coursework, pursuit progress, dealing with the economic plan, and investigate the workloads. Within a years after its dispatch, it turned out to be more predominant PC-based project management software.

1.2.1 Terminology in MSP

- Calendar**:** A graph or arrangement of pages showing the months weeks, and days of a specific year, or giving specific occasional data is called calendar. In MSP, calendar is used to for assigning, and planning specific non-working days. MSP comprises of three kinds of calendars:
  - 24 hrs – usually for machineries
  - Night shift – software department,
  - Standard – 8 hrs
- Work breakdown structure: WBS is a key project that breaks down the extent of work into sensible segments. The primary objects of WBS are to make plan more efficient, to finish a plan on fixed time and with fixed expense, to complete the arranged work with quality and fulfill the necessities of partner, to make arranging steady, to give viable task execution.
- Baseline: A baseline in a project is a clearly defined as starting point of project plan. It's a predetermined reference highlight look at and measures tasks progression. This permit getting to the production of task over the long haul.
- Critical path: The critical path is a series of connected tasks that in a straight line affects the planned finish date. If any task on a critical path is delayed the whole project is delayed.
- Float: Float or slack is the measure of schedule, that an assignment of task in a project network can be postponed without causing a late to the following tasks and project end date. Float helps to examine project schedules and work out how much time separate tasks can slip influencing the general course of events or conveyance date.

1.2.2 Advantages of Microsoft Project

- Microsoft Project helps to make project planning easy since it is user friendly.
- It helps to assign Schedule, Resource and Rates.
- It helps to track project.
- It helps to provide Baseline cost of Project.
- Provides result in format of Document and PDF's.
- Helps to show over allocation.

2. Objectives

- To carry out the complete quantity estimation of materials of commercial complex B+G+3 including Excavation, Backfilling, Concrete, Steel, Bricks and Plastering by using CostX software.
- To design the forecasting of manpower by using Microsoft Project, Fallowing the Scheduling, Resources and Rates.
- To know the impact of manpower forecasting.

3. Methodology

To achieve the study on estimation and manpower forecasting of commercial complex B+G+3 we need to have fallowing requirements.

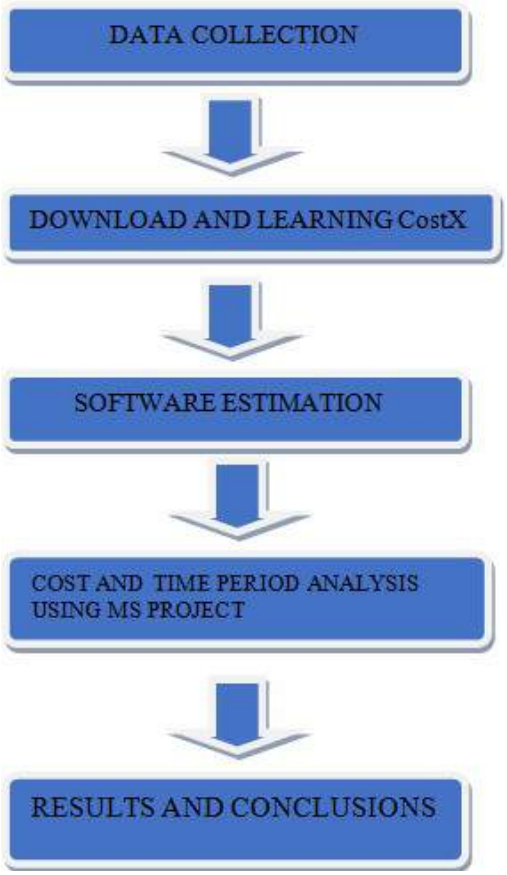

Figure 1: Work Methodology Flow Chart.

3.1 Project Details

The building is approved for a construction of Base floor, Ground floor, First floor, Second floor and Third floor.

The details regarding the building are:

- Commercial building B+G+3
- Location: Kengeri, Banalore.
- Approximate Budget: 1 Crore
- Site area is of 1200Sqft
- Expected Construction Time:10 months
- Project Start Date:November 17-2020
- Expected Completion of Project date: September 2021

Table 1: Quantity Estimation of a Building

Sl. No.	Work Description	Quantity	Unit
1	Earth Work Excavation	807	m^3
2	P.C.C Foundation Works	10	m^3
3	Footing Concrete	27	m^3
4	R.C.C 1:2:4 for Column	29	m^3
5	Bricks	145	m^3
6	Steel	44	MT
7	Lift walls	21	m^3
8	R.C.C 1:2:4 for Staircase	13	m^3
9	R.C.C 1:2:4 for Slab	185	m^3
10	R.C.C 1:2:4 for Beam	63	m^3
11	Plastering with CM 1:5	3628	m^2

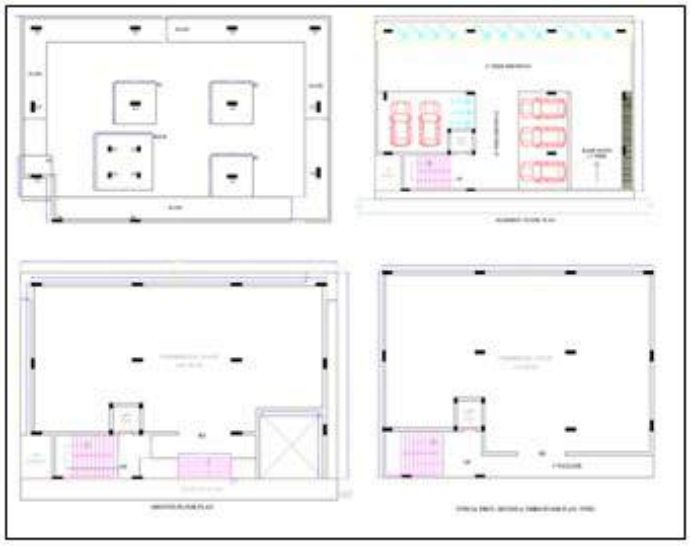

Figure 2: Building Plan.

3.2 Methodology of CostX Software

Estimation includes a list of quantity of all materials used to complete a project. It helps us to give complete information about the materials and to maintain the budget according to the client's expectation.

- Open the software.
- Add required drawings.
- Calibrate the drawings.
- Measure the drawings by making groups(Beams, Columns, Slabs, etc..).
- Note the quantities and multiply with cost per units.

B17 Cell = Total = 6,695,045

	A:Code	B:Description	C:Quantity	D:Unit	E:Rate	F:Subtotal	G:Factor	H:Total
1	1	Excavation (807 cum)	4		40,000.00	160,000		160,000
2	2	Footing	27	cum	4,500.00	123,705		123,705
3	3	PCC	10	cum	4,500.00	45,495		45,495
4	4	Pedestal	5	cum	4,500.00	21,870		21,870
5	5	Beams	63	cum	4,500.00	283,320		283,320
6	6	columns	29	cum	4,500.00	131,940		131,940
7	7	Lift walls	21	cum	4,500.00	95,220		95,220
8	8	Slabs	185	cum	4,500.00	830,295		830,295
9	9	Walls	185	cum	6,000.00	1,111,740		1,111,740
10	10	Plaster	3,628	sq m	250.00	907,060		907,060
11	11	Steel	44	MT	65,000.00	2,889,900		2,889,900
12	12	stairs	21	cum	4,500.00	94,500		94,500

Figure 3: Output from the Software CostX.

3.3 Methodology in MSP

- Create a new file.
- Create a new calendar on basis of work hours.
- Entering activity names.
- Enter required resources and its rates.
- Provide predecessors, successors and constraints for activity.
- Assign resources for activities.
- Create baseline cost to know the cost of each activity and overall project.

4. Results

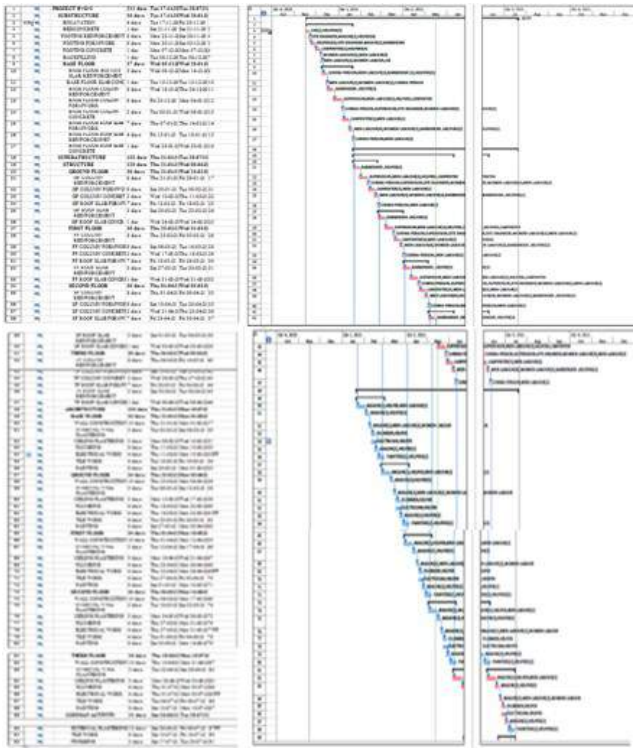

Figure 4: GANTT Chart.

Results obtained are:

- Cost estimated is Rs 66,70,805 by CostX software.
- Cost of manpower planning Rs 21,29,180 by MSP.
- Total cost obtained is Rs 87,99,985.
- Total duration of the project 211 days.
- Miscellaneous cost will be around Rs 50,00,000.
- Total cost of Project is about 1.5 crores.

4.1 Project Duration

Duration taken to complete the projectfrom start to finish of all the tasks.

Table 2: Total Duration for Completion of Project

Sl. No.	Description	Duration
1	Sub Structure - (Site cleaning, Earthwork, Foundation, Basement Floor)	56 Days
2	Super Structure - (Wall construction, Column, Beams, Roof slabs)	155 Days
3	Total Time Taken	211 Days

4.2 Cost

Table 3: Total Cost for Project

Sl. No.	Description	Duration
1	Sub Structure - (Site cleaning, Earthwork, Foundation, Basement Floor)	21,12,185
2	Super Structure - (Wall construction, Column, Beams, Roof slabs)	66,99,500
3	Total Time Taken	88,11,685

4.3 Network Diagram

Network diagram is the schematic representation of the activities in a continuous form and way to view tasks dependencies and critical path of the project.

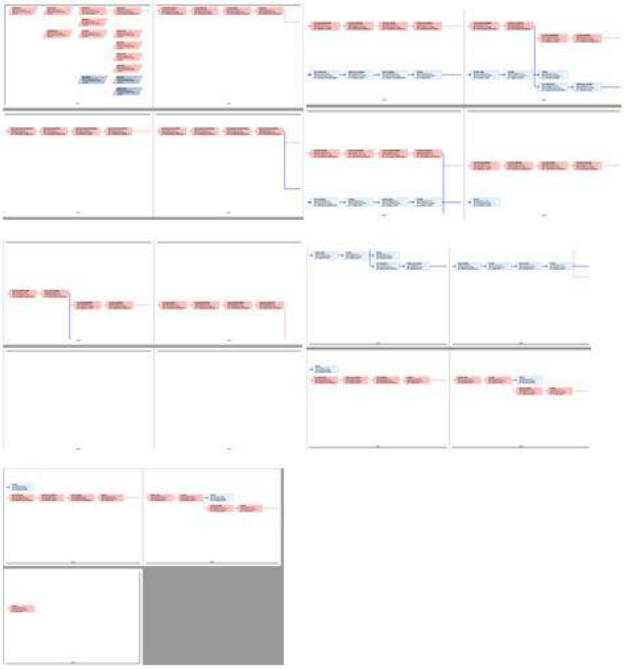

Figure 5: Network Diagram.

With the help of these diagrams we can easily point out the sequence of activities and duration of each activities.

Conclusion

The study is to examine the estimation and forecasting of manpower to B+G+3 commercial complex. The purpose is to forecast the organizational needs and to balance the internal and external supply of laborers according to the activities or task. This study reveals that perfect scheduling and planning of a project can be done in a specified duration incase of delays due to exceptional conditions may leads to lagging of the project. In some conditions the cost of project varies due to sudden fluctuation of cost of materials, equipments and labors.

- The total cost and duration is thoroughly calculated for B+G+3 Commercial complex is Rs 1.5 crores and 211 days correspondingly.
- The CostX involves estimation of quantities and the MSP involves scheduling, planning and assigning of resources. Unnecessary expenditures can be controlled and requirement of manpower for project can be easily predicted for numerous tasks. By proper implementation of manpower planning by MSP the possible interruptions and over allocations can be determined and prevented successfully.

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A STUDY ON UTILISATION OF COAL ASH IN MANUFACTURING OF MUD BRICKS AND INFLUENCE ON ITS PHYSICAL AND STRENGTH PROPERTIES

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ABSTRACT

In the modern society construction has taken a huge leap. Buildings are constructed using different materials, technique, and modes of operation. Waste has been an major issue affecting the society as the country grows and evolves. new materials and modern equipment are used which leads to generation of waste. Waste has been a huge impact on the society at this point. Through this project we aim to maximize the the utilization of waste at the place of generation and to minimize the waste gathering. We decided to considered bricks as our material due to its history and its common utilization by everyone and in every construction project. Hence an attempt is made to utilize the waste material (COAL ASH) that is generated during the manufacturing process of bricks to utilize it as a composite mix to the regular Mud bricks and to check for compressive strength, water absorption, shape, size, colour, impact strength, efflorescence, soundness test and to determine whether these composite bricks are able to meet the required parameters like physical and strength properties by considering different percentage of waste to the clay bricks and to find an alternative solution in case the desired parameters is not obtained to satisfy the required criteria.

This project mainly deals with integrating of coal ash as an mixture with clay during the manufacturing process at a varying percentages of 10,20,30,40,50,60 % with the rest being clay. By the end of this experiment the strength and other parameters are determined and to check at what percentage of mixing the external agent (coal ash) to the clay to form bricks and these bricksloose its strength. At the end of 60% utilization of coal ash we try to use 10% cement to increase the strength and study the comparison of this bricks

Keywords: *Cement, Clay, Coal Ash, Mud bricks ,physical properties, strength properties*

1. Introduction

Waste is one of the most talked and the most faced problems in the modern growing society which is in turn creating a huge impact in the lifestyle of people. Even though the waste management is improving everyday but the waste minimization is not possible due to the modern culture and practices. Modern method of waste Management usually deals with disposal and collection of waste thus leading to utilization of waste for reuse at a few percentages at the place of generation itself. To bring an ecological balance and to provide a sustainable living we need to maximize the utilization of waste at the place of generation and minimize waste gathering.

By this project we want to be able to bring a change in the society and tackle its problems to make a great future and a sustainable living. So, to tackle the problem of waste we tried to face it with a civil as a background by using a building material into consideration. So as to utilize the waste into new materials we have chosen “BRICKS” as the material as it is one of the oldest and has an historical importance and as this can be used by anyone of any class and used in every construction project as a main material

To maximize the waste utilization, we must make sure to use the waste that is generated in the place where it is generated to cut down the external expenses. This is why we are using “COAL ASH” as the waste material that is generated in the brick manufacturing plant due to the burning process of bricks which is done to achieve the strength and hardness . the bricks are burned in huge kiln with the help of coal after the burning the ash which is

formed is the coal ash which is generally piled up. We are using this coal ash as our composite mix waste for the manufacturing bricks which also gives a representation of green building material criteria. So, to make this project work we decided to add the coal ash with the mud/clay which is generally used in the brick at a varying percentage of coal ash at 10,20,30,40,50,60% and rest being clay. This is done to see at what percentage of adding an external material coal ash will have an impact on the bricks leading to failure in the strength parameters required by the bricks. After knowing the percentage at which the brick starts to fail in the strength which is at 60%. We use 60% so as to utilize coal ash to maximum. After we know that the brick fails to an extreme content at 60%, we try to bring up the strength by using a binding agent which is "CEMENT" to increase its binding capacity to get the strength back up. We use the composition of 60:30:10 (coal ash:clay:cement) to test and make bricks to increase its strength. thena comparative study of the physical and strength properties of all the bricks was attempted.

Table 3.1 - Properties of Coal Ash

S. No	Property	Value
1.	Normal consistency	33mm
2.	Fineness of cement	4%
3.	Initial setting time.	48min.
4.	Final setting time.	11hrs.
5.	Specific Gravity	1.440 g/cm3

3. Material

3 Materials were utilized during this process of brick manufacturing

3.1 Coal Ash

Coal Ash is an major component in this project and manufacturing as it the waste material that is generated during the burning process of brick manufacturing to achieve the hardness of the bricks. This coal ash are very fine particles which lies between 0.5 µm to 300 µm. This particles are usually in gray/white colour and are easily move when wind occurs. Reusing coal ash can create many environmental, economic, and product benefits:- Environmental benefits, Economic benefits, Product benefits

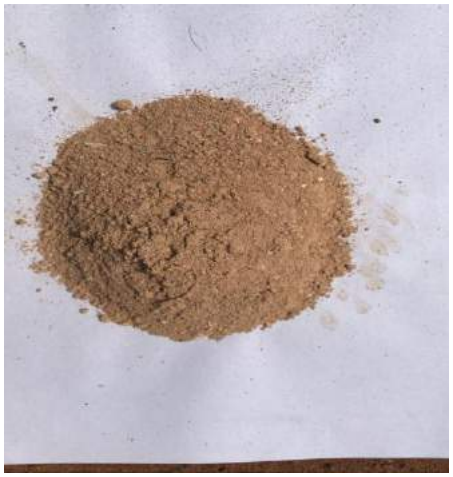


Fig 3.1 - Coal Ash Sample

3.2 Clay

Clay is an important material used in brick manufacturing as it is the major material which is used in mud bricks manufacturing. Natural clay minerals, including kaolin and shale, make up the main body of brick. Small amounts of manganese, barium, and other additives are blended with the clay to produce different shades, and barium carbonate is used to improve brick's chemical resistance to the elements.

Clay used in brick manufacturing contains the following ingredients:

1.Silica (sand) – 50% to 60% by weight
2.Alumina (clay) – 20% to 30% by weight
3.Lime – 2 to 5% by weight
4.Iron oxide – ≤ 7% by weight
Magnesia – less than 1% by weigh

Table 3.2 - Properties of Clay

S.No.	Property	Value
1.	Specific Gravity	1.702 g/cm3
2.	Particle size	0.002 to 0.05 mm

Fig 3.2 - Clay Sample

3.3 Cement

Ordinary Portland cement of 53 grades from a single batch was used for the entire work and care has been taken that it has to been stored in airtight containers to prevent it from being affected by the atmospheric and monsoon moisture and humidity. The cement procured was tested for physical requirements in accordance with IS: 12269-1987 and for chemical requirements in accordance with IS: 4032-1977.

Table 3.3 - Properties of Cement

S.No.	Property	Value
1.	Specific Gravity	1.059 g/cm3
2.	Fineness Modulus	250 m2/kg
3.	Particle size	0.5 µm to 300 µm

Fig 3.3 - Cement Sample

4. Method and Methodology

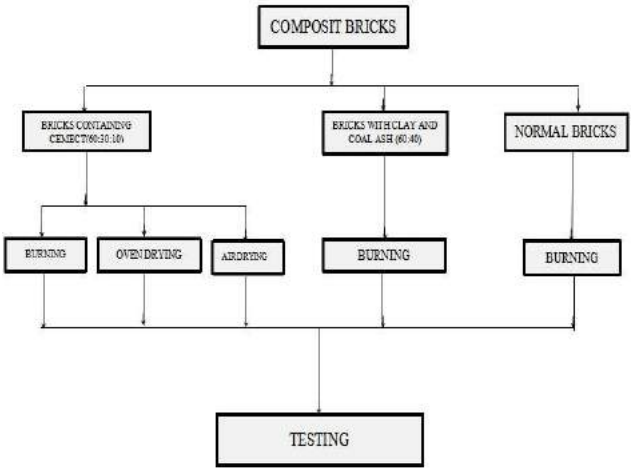


Fig 4 - Flow chart representing methodology

4.1 Calculation of required quantity of materials

Before starting the work we need to determine the quantity of each material required for making bricks according to their percentage requirements. The size of the mould should be considered and the volume should be determined so that the materials can be calculated accordingly to get the perfect quantity required according to the percentage variation. For calculation the specific gravity of each material is required. And the quantity obtained is multiplied with the number of bricks required to get the required amount of bricks.

4.2 Collection of materials

Once the required quantity of material if found we need to go to the place of where the materials are found to get the calculated amounts. For our experiment we used the clay and coal ash which was present the the brick manufacturing plant and cement was brought from the shop according to the amount of required as calculated

4.3 Batching of materials

Weigh batching is used to collect materials and added according to the required quantity which should be made ready for mixing process.

Fig 4.3 - Weighing the material

4.4 Mixing of materials

All the materials are mixed thoroughly by adding adequate amount of water to achieve the consistency mix that is to be used to make the brick cake using the mould

Fig 4.4 - Mixing

4.5 Making of brick cakes using mould

After the mixing process id done the good consistency mix is taken and dropped into the mould and to bottom layer is swiped to get a good finish and then it is slowly lifted to remove the mould and to obtain the mould cake without and warping or damage. Then this brick cakes are kept for air drying For 1-2 Weeks to achieve the minimum hardness/drying before keeping it for burning to achieve max hardness

Fig 4.5 - brick Cake

4.6 Hardening process of bricks by burning,airdrying,oven heating

After the bricks are sufficiently dry this bricks are kept for burning in kiln to achieve the maximum hardness so that this bricks can be used. To achieve to hardness the process is differently done for these 2 types of bricks of different composition

(i) For coal ash : clay :-

For the bricks made of this composition we use the regular burning process in kiln to achieve the maximum hardness

(ii) For coal ash : clay : cement (60:30:10) :-

For the bricks made of this composition we use 3 methods to achieve the hardness they are :-

4.6.1.Burning :- This process if followed by burning the bricks in the kiln as the traditional bricks are done to achieve the hardness this was done after 14 days of air drying followed by 12 days of burning

Fig 4.6.1 - Burning

4.6.2.Air drying :- This process is done to check if the extra added cement content is enough to get the bricks to achieve the hardness required to be used in the construction practices which was done for a duration of 28 days.

Fig 4.6.2 - Air Drying

4.6.3.Oven heating :- This process is done by following the manufacturing the process of ACC blocks manufacturing where the blocks contain the same composition of materials are steam oven curing to achieve the hardness so the same is done to achieve the hardness.3.this was left for air drying for 14 days and 7 days in oven at a temperature of 300℃

Fig 4.6.3 - Oven Drying

After the burning is don't the bricks are left for few days to cool down before using it for testing as well as construction

5. Sample

5.1 Samples bricks with composition of Coal Ash and Clay with varying percentage of Coal Ash

Fig 5.1.1 - 10% Coal Ash

Fig 5.1.2 - 20% Coal Ash

Fig 5.1.3 - 30% Coal Ash

Fig 5.1.4 - 40% Coal Ash

Fig 5.1.5 - 50% Coal Ash

Fig 5.1.6 - 60% Coal Ash

5.2 Samples bricks with composition of Coal Ash, Clay and cement with different hardening process of Air Drying, Oven Drying and Burning

Fig 5.2.1 - Air drying **Fig 5.2.2 - Oven Drying**

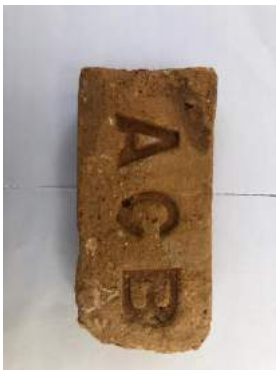


Fig 5.2.3 - Burning

6. Result and discussion

It is necessary to test the ingredient materials before used to make stabilized adobe to suits the requirements of various IS codes specifications. The various materials required are coal ash, clay and cement

6.1 Impact Test

Impact Test of the brick are conducted to test the quality of the brick. The brick is drop from one-meter height. A good quality brick should not break if the bricks are broken that it has low impact value and it should be rejected.

Fig 6.1 - Impact Test

Result

1) We can observe the as the percentage of coal ash increases in the brick it starts to break when dropped from 1m height
2) At 60% the strength falls too much that it cannot be used so we use this percentage to use as an composition to mix cement to achieve the strength
3) When we add cement we can see that the bricks which left for air drying and oven heating has achieved the good hardness to avoid braking and form few chippings at edges than the burnt bricks of this composition which break.

6.2 Shape And Size

In this test, a brick is closely observed. It should be of standard size and the shape should be truly rectangular with sharp edges and corners. For this purpose, 10 bricks of standard size (190mm x 90mm x 90mm) are selected at random and they are stacked lengthwise, along with the width and along with the height. For good bricks, the results should be within the permissible limit.

Result

1) We can observe the as the percentage of coal ash increases in the brick the shape starts to deform and break at the ends
2) At 60% the strength falls too much that it cannot be used so we use this percentage to use as an composition to mix cement to achieve the strength
3) When we add cement we can see that the bricks which left for air drying and oven

heating has good shape than the burnt bricks of this composition which is warped and deformed

4) Size of the bricks resemble the shape of the mould and as the percentage increases it gets deformed

Fig 6.2 - Shape and Size Test

6.3 Colour test

A Good brick should have a uniform deep red,cherry or copper colour

Result

1) We can observe the as the percentage of coal ash increases in the brick colour starts to fade from brownish red to light coffee brown
2) At 60% the colour stays intact at some regions of the bricks
3) When we add cement we can see that the bricks which left for air drying and oven heating are gray/ash colour than the burnt bricks of this composition which is a bit burnt and reddish colour at few places

Fig 6.3 - Colour Test

6.4 Soundness Test

Soundness test of bricks shows the nature of bricks against sudden impact. In this test, 2 bricks are chosen and struck with one another. Then sound produced should be clear bell ringing sound and brick should not break. Then it is said to be good brick

Result

1) We can observe the as the percentage of coal ash increases in the brick the metallic sound decreases
2) At 60% the soundness of the bricks are faint metallic sound
3) When we add cement we can see that the bricks which left for air drying and oven heating and the burning are not having any metallic sound and they have a hollow sound.

6.5 Efflorescence Test

Efflorescence is a whitish crystalline deposit on surface of bricks. Usually magnesium sulphate, calcium sulphate and carbonate of sodium and potassium are found in efflorescence.

Fig 6.5 - Efflorescence Test

Result

1) No efflorescence is observed in any brick

Water Absorption test on bricks are conducted to determine durability of bricks such as degree of burning, quality and behavior of bricks in weathering.

6.6 Water Absorption

Fig 6.6 - Water absorption

6.6.1 Test values on Traditional Bricks

Table 6.6.1 - Water Absorption Test values on Traditional Bricks

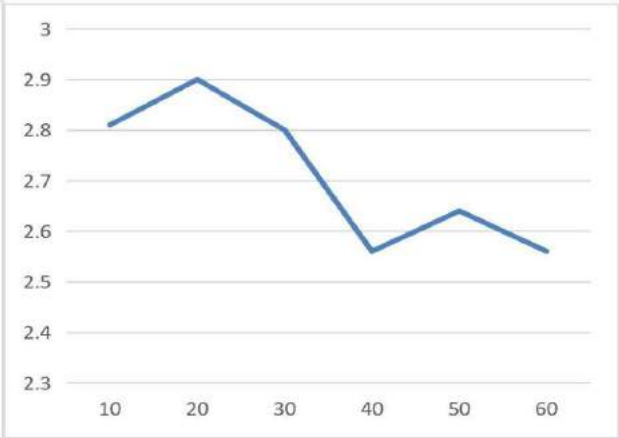
SL No.	Particulars	Traditional bricks
		Clay Bricks
		(100% Clay, 0% Coal ash)
1	Wet Weight (Kg)	3.26
2	Dry Weight (Kg)	3.01
3	% of Water Absorption	8.3

6.6.2 Test values on Bricks made of Clay : Coal Ash

Table 6.6.2 - Water Absorption Test values on Bricks made of Clay : Coal Ash

Particulars	Wet weight (Kg)	Dry weight (Kg)	% of Water Absorption
(90% Clay,10% Coal Ash)	3.1	2.81	10.3

(80% Clay,20% Coal Ash)	3.2	2.9	10.34
(70% Clay,30% Coal Ash)	3.17	2.8	13.2
(60% Clay,40% Coal Ash)	2.99	2.56	16.79
(50% Clay,50% Coal Ash)	3.02	2.64	15.35
(40% Clay,60% Coal Ash)	3.01	2.56	17.57

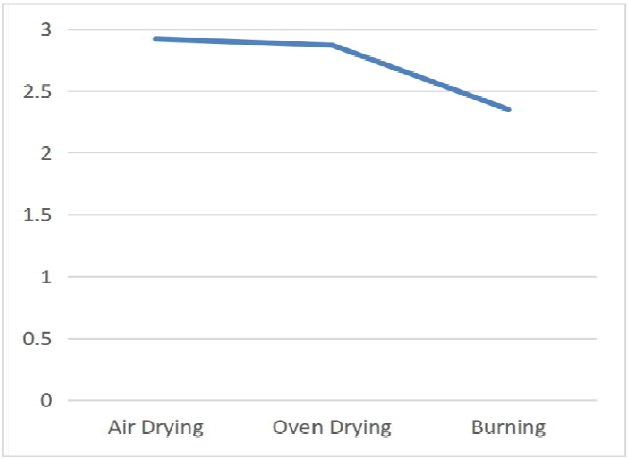


Graph 6.6.2 - Weight in Kg vs % of Coal Ash

6.6.3 Test values on Bricks made of Coal Ash : Clay : Cement (60:30:10)

Table 6.6.3 - Water Absorption Test values on Bricks made of Coal Ash : clay : Cement (60:30:10)

Particulars	Wet weight (Kg)	Dry weight (Kg)	% of Water Absorption
Air drying	3.16	2.92	8.21
Oven Drying	3.1	2.87	8.01
Burning	2.98	2.35	26.8



Graph 6.6.3 - Weight in Kg vs Different Hardening Process

Result

1) We can observe the as the percentage of coal ash increases in the bricks % of water absorption increases
2) At 60% the % of water absorption rises too much that it cannot be used so we use this percentage to use as an composition to mix cement to achieve a good water absorption properties
3) When we add cement we can see that the bricks which left for air drying and oven heating has achieved good water absorption than the burnt bricks of this composition.

6.7 Compressive Strength

compressive strength of bricks is the capacity of bricks to resist or withstand under compression when tested on compressive testing machine [CTM].

Fig 6.7 - Compressive strength Test

6.7.1 Test values on Traditional Bricks

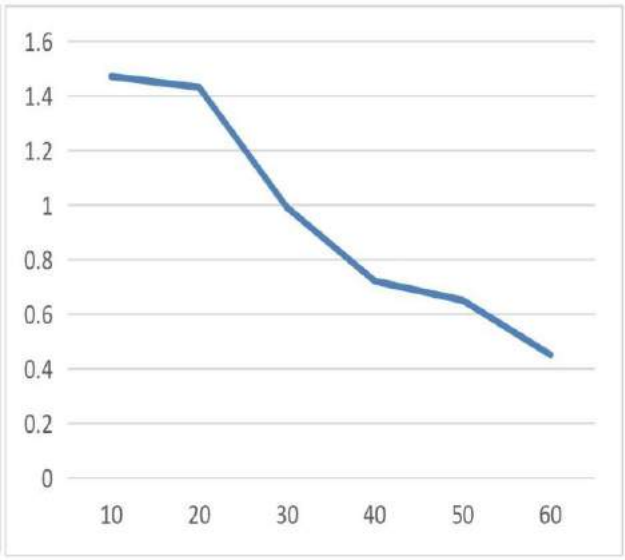
Table 6.7.1 -Compression Test values on Traditional Bricks

SL No.	Particulars	Traditional bricks
		Clay Bricks
		(100% Clay, 0% Coal ash)
1	Peak load (KN)	36.3
2	Peak Stress (Mpa)	1.65

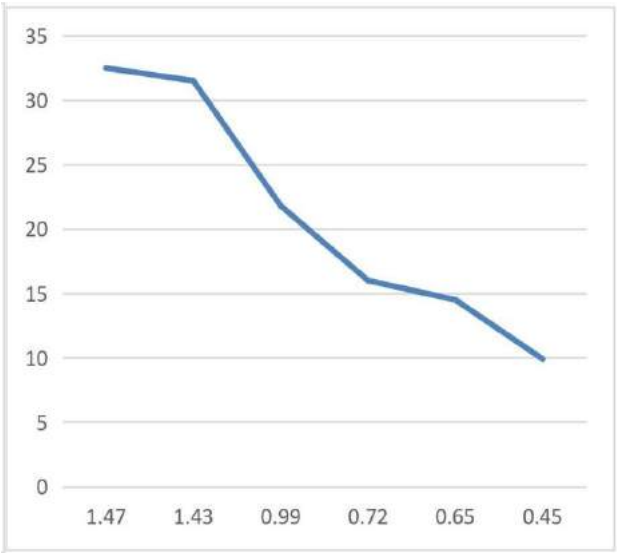
6.7.2 Test values on Bricks made of Clay : Coal Ash

Table 6.7.2 - Compression Test values on Bricks made of Clay: Coal Ash

Particulars	Peak load(KN)	Peak Stress (Mpa)
(90% Clay,10% Coal Ash)	32.5	1.47
(80% Clay,20% Coal Ash)	31.3	1.43
(70% Clay,30% Coal Ash)	21.8	0.99
(60% Clay,40% Coal Ash)	16	0.72
(50% Clay,50% Coal Ash)	14.5	0.65
(40% Clay,60% Coal Ash)	9.9	0.45



Graph 6.7.2.1 Stress in MPA vs % coal ash

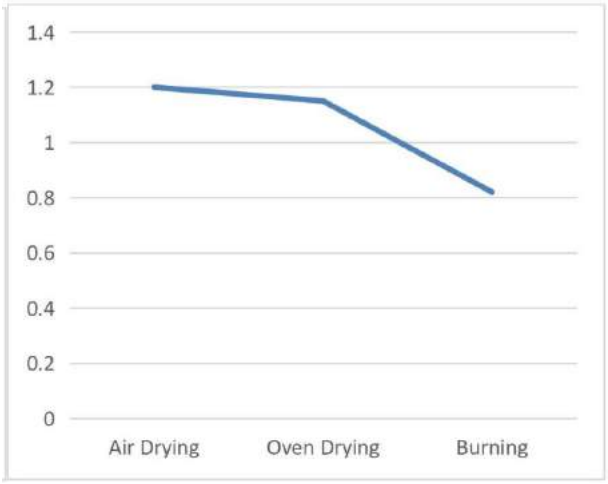


Graph 6.7.2.2 Stress in MPA vs Load in KN

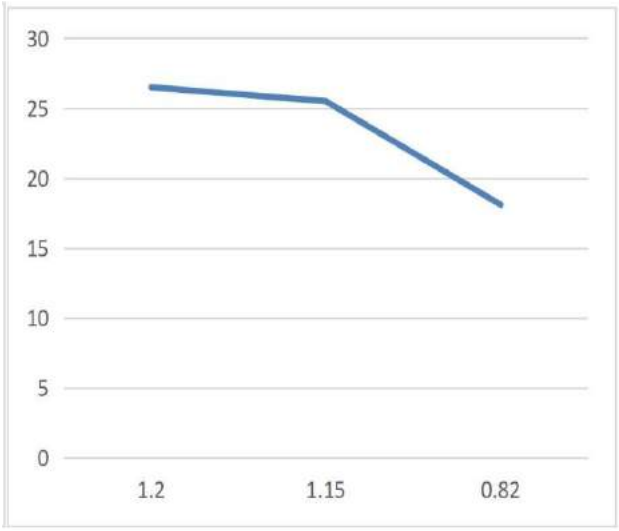
6.7.3 Test values on Bricks made of Coal Ash : Clay : Cement (60:30:10)

Table 6.7.3 - Compression Test values on Bricks made of Coal Ash : Clay : Cement (60:30:10)

Particulars	Peak load(KN)	Peak Stress (Mpa)
Air drying	26.5	1.2
Oven Drying	25.5	1.15
Burning	18.1	0.82



Graph 6.7.3.1 Stress in MPA vs Different Hardening Process



Graph 6.7.3.2 Stress in MPA vs Load in KN

Result

1) We can observe the as the percentage of coal ash increases in the brick it starts to loose its strength
2) At 60% the strength falls too much that it cannot be used so we use this percentage to use as an composition to mix cement to achieve the strength
3) When we add cement we can see that the bricks which left for air drying and oven heating has achieved the maximum hardness required than the burnt bricks of this composition.

7. Conclusion

The main aim of this study is to utilize the waste that is generated in manufacturing of traditional bricks during the burning process i.e., ash. To increase strength and to lower the cost alternative solution is making of composite bricks by adding natural clay, ash and cement. But adding ash to clay will decrease strength. To increase the strength of clay and ash composite if we mix some percentage of cement the strength will increase.

The strength and water absorption are an important factor that influence the durability of mud bricks. A block with low water absorption will result greater strength, durability and resistance to natural environment.

The rise in requirement of building materials has leads us to search for newer materials or composite materials that are cheap and locally available especially countries like India. Even now mud blocks are used in rural areas in India.

In order to improve the quality of these mud/clay blocks we tried in this study.

As expected, we observed that the compressive strength increases with increasing cement content percentage in manufacturing of blocks.

We also observed that when clay, ash and cement added to blocks significant change in water absorption and strength.

When percentage of coal ash increase from 10%, 20%, 30%, 40%, 50%, 60% the strength and all other parameters decrease.

We observed that adding 10% cement to the 60% clay, 30% coal ash the strength of the block's increases.

We also observed that air dried or oven dried bricks have more strength than burnt bricks. When bricks are burnt, they lose their strength and other characteristics.

Finally, the optimum proportion to get maximum strength and lesser water absorption is 60% clay: 30% Coal Ash: 10% Cement in Bricks manufacturing is strongly recommended. So that the waste coming out of bricks industry during burning process can be used effectively.

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NOISE POLLUTION ANALYSIS IN SELECTED STUDY JUNCTION POINT OF BENGALURU CITY - A CASE STUDY

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ABSTRACT

The noise pollution is one disturbing the environment at present days, many noise creating activities are responsible for causing the pollution in atmosphere today, in that vehicular activity is one of the major thing to disturb the atmospheric condition and change the status of surrounding area. In this study traffic junctions were selected for conducting the analysis to find the level of Noise pollution. The Bengaluru city is fastest growing city due to silicon activities, the population of vehicles are also increasing and causing the pollution problem, in study area the noise pollution is crossing the limits in the selected areas.

Keywords: *Noise level, Vehicles, parameters, Bengaluru.*

Introduction

The Environmental pollution is big problem to society, Today the increase of human population in city areas may increase the population of vehicles also to create the noise pollution. The Bengalurucity isthe capital of Karnataka state, which is located at height of 900 meters above the sea level, The city is called now silicon city due to many more IT companies are actively functioning in different parts of the city, The city population is crossed the one crore and the vehicle population has crossed the more than 85 lakhs. The Bengaluru city is hub for getting employment to the outsiders and also is fastest growing city in Asia. The mean annual rainfall is about 900 mm in June to September and October to November, with opposite wind regimes corresponding to Southwest and Northeast monsoons respectively. The average monthly relative humidity ranges from 85% between Jan to Oct to 44 % in dries in March. The high wind speed averages 17 km/h throughout the westerly winds in the month of July and a lowest of 8 to 9 km/h during the months of April and October (Air quality trends-2006, cpcb). The type of vehicles are different plying in the Bengaluru city, most of the vehicles are two wheelers and auto rickshaws. Many of the vehicles are old enough, It has observe that two wheelers are more in number than light and other category of vehicles plying in the cities. It is alarming to note that 32 percent of all vehicles are plying in metropolitan cities alone. The urban expansion, industrialization, lack of services, energy and transport demands are leading to a various cycle of air pollution. The Bengaluru city is facing the problem of various pollutions in atmosphere due to increase in the vehicles, industrial activities and various constructional activities. This problem would be more severe in coming years considering the development rate of city. Hence serious studies are required to analyses and assess the pollution in city in order to better it.

Materials and Methods

The study was carried out during Feb 2019 to April 2019 with selected traffic junction points and instruments like electronic noise level measuring device for assessment of noise pollution, the noise level analyzer is a portabal instrument used to collect noise levels, which works on laser scattering principles. Using laser scattering principle: Fig. 1 shows that noise levels measuring with electronic devise. In Bengaluru city most of the main traffic junctions are busy with heavy vehicles, especially in peak hours is more in volume and pollution levels were also shows crossing the permissible limits, keeping in that the important selected junction was identified for study, the selected junctions was Gorguntepalya junction. Gorguntepalya is a main junction point to connect Tumkur and also continuation to the major district headquarters of Karnataka state, the National high way connects to this, also this junction connects the Hebbal circle which close to IT park of Manyatha park area which has got so many IT

industries and small scale industries are located. Also many educational institutes are located in surrounding area of this junction. Due to this effect, the population of both human and vehicles were showing is high. Gorguntepaly junction is connecting with major outer ring road of linking between Hebbal and Mysore road area and also it connects the Yeshwanthpur road, so that the junction is most of the time is busy with the vehicular population

Fig 1: Noise level Measuring Electronic Devise

Results and Discussion

The study were carried out at selected junction points of Gorguntepalya, those points were shows the pollution rate of Noise level was crossing the permissible limits, it was due to high volume movement of vehicles and other activities like generator sets nearby shops due to power failure. It will be more in the morning and then gradually decreases towards afternoon and then increase towards the evening. Table 1, Shows that the average values of noise levels in week days and weekend days respectively. As observed that traffic is only the major cause to pollution level variation. When the traffic is more it make noise due to traffic jams on the road to raise, with this the pollution rate will become high. The fig No 2 shows that average percentage of vehicles plying at Gorguntepalya junction, here in peak hours the movement of vehicles were high volume due to more number of employ working nearby industrial area of Penya which is located nearby Gorguntepalya, and also due to the main National Highway is passing through this junction.

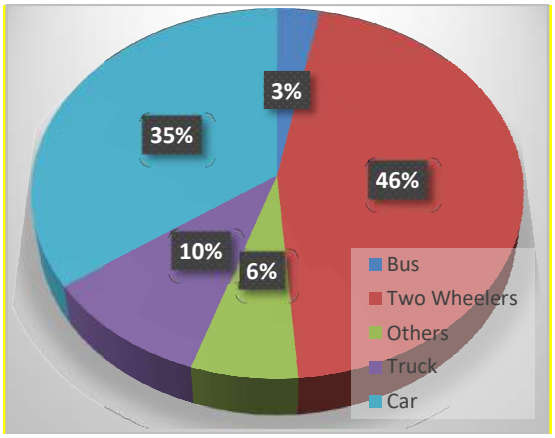

Fig No: 2. Average Percentage of Vehicles in Week Days near Gorguntepalya Junction

Table: 1 Average Values of Noise levels inGorguntepalya Junction in Week Days and Weekend Days

Sl No	Time in Hours	Noise Levels Week Days	Noise Levels Weekend Days
1	07-08 am	61.46	54.00
2	08-09 am	83.67	61.20
3	09-10am	83.33	64.30
4	10-11 am	87.71	66.00
5	11-12 pm	92.35	69.80
6	12-01pm	80.25	65.00
7	01-02 pm	75.23	71.20
8	02-03 pm	72.24	69.40
9	03-04 pm	86.42	73.50
10	04-05 pm	84.97	74.00
11	05-06 pm	80.23	78.00

Fig no. 2 shows the traffic analysis and data obtained from traffic survey, which was carried out at the selected study area. Fig. 3: shows that variation of Noise Levels in weekdays. It can be seen that the values vary in same trend in both cases but pollution levels quit high in the weekdays as compare to weekend
.

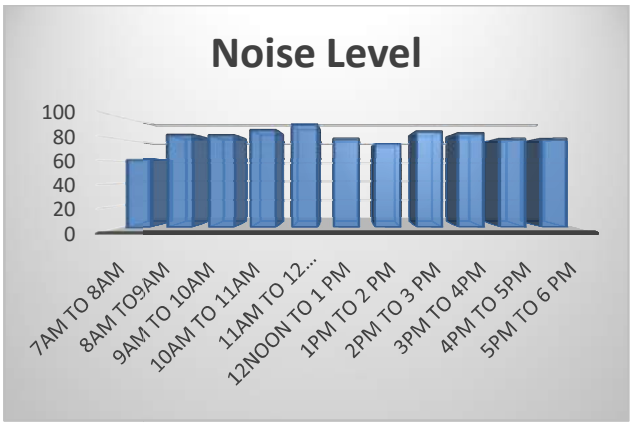

Fig 3: Variation of Noise Levels in Weekday

The table no 1 shows that the average values of Noise levels in the junction of Gorguntepalya, The values are obtained fromdifferent days, the values are shown here for wee days and also for weekend days, most of the values are varying and showing the high level than permissible value, it is due to the high density of traffic volume, improper function of Engine and most of the vehicles are old,and these are plying in the city
.

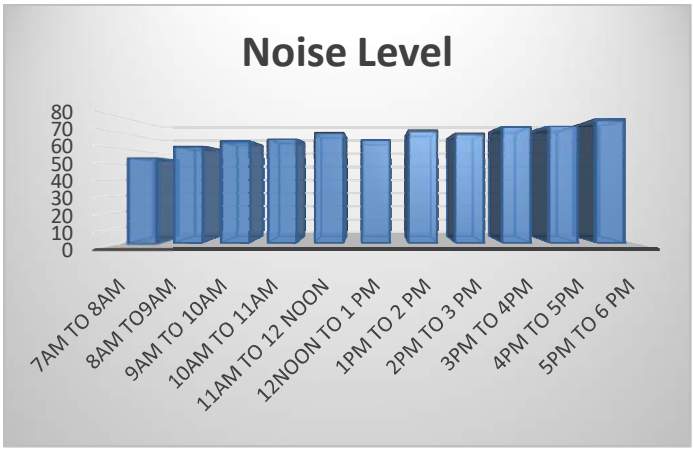

Fig 4: Variation of Noise Levels in Weekend Days

The fig 4 shows that variation of noise levels in Goruguntepalya from morning 7AM to 6 PM on weekend days. During peak hours of morning the noise level is very high due to moment of vehicles from the city areas to outside their work places. During evening hours the vehicle moments are also high, those vehicles were returning back from their work.

Conclusions

Most of the vehicles were play a major role to pollute thenoise in the surrounding area. The trucks or four wheelers were predominate in this study area and also other vehicles also affect the pollution problem, the classification of vehicles like auto-rickshaws; heavy vehicles were also may cause pollution level more in that study junction points.. The value of pollutants show more than the permissible values during peak hours and other period of time.

Acknowledgement

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"PRIMARY EPIDEMIOLOGICAL INDICATORS TO ASSESS THE LEVEL OF COMMUNITYTRANSMISSION FOR COVID-19 IN JORDAN "

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ABSTRACT

The study aimed to identify the basic indicators to assess the level of community transmission of Coronavirus infection in Jordan, and to work on assessing the epidemiological situation in order to determine the degree of community spread and to define the basic criteria for that.

This research was conducted through the descriptive approach and the quantitative research method, where data collected through daily casualty reports of the Jordanian Ministry of Health in 2020 and the data were analyzed to extract the results.

The results showed that there are four epidemiological criteria that determine the degree of societal prevalence, namely: the rate of hospitalization per hundred thousand of the population per week(12.8),Death rate per hundred thousand of the population per week(3), rate of infection occurrence per hundred thousand of the population per week(249), and rate of positive BCR for samples examined by visitors of the monitoring centers for influenza and acute respiratory diseases(16.2 %).also The results showed that the state of community spread of infection is divided into four stages or degrees, which are the first degree, the second degree, the third degree and the fourth degree. The level of the epidemiological situation of countries in the world is classified into five levels, starting from zero and ending with the fourth level.Where 64% of the deaths occurred among males and 36% of them among females in 2020 in Jordan

The study also recommended conducting several future studies that include an assessment of the epidemiological situation for each period of time.

Keywords *– Covid- 19, Safety Rules, Epidemiological indicators,Community transition*

الملخص

"المؤشرات الوبائية الأساسية لتقييم مستوى الانتقال المجتمعي لعدوى فيروس كورونا في الأردن"

هدفت الدراسة الى التعرف على المؤشرات الاساسية لتقييم مستوى الانتقال المجتمعي للعدوى لفيروس كورونا في الاردن , والعمل على تقييم الوضع الوبائي لكي يتم تحديد درجة الانتشار المجتمعي وتحديد المعايير الاساسية لذلك .

تم اجراء هذا البحث من خلال المنهج الوصفي والمنهج البحثي الكمي حيث تم جمع البيانات من خلال تقارير الاصابات اليومية لوزارة الصحة الاردنية في عام2020 وتم تحليل البيانات لاستخراج النتائج .

حيث أظهرت النتائج أن هناك أربعة معايير وبائية تحدد درجة الانتشار المجتمعيفي الاردنوهي: معدل الاستشفاء لكل مائة ألف من السكان أسبوعياً 12.8 ، معدل الوفيات لكل مائة ألف من السكان أسبوعياً 3 ، معدل حدوث الإصابة لكل مائة ألف من السكان في الأسبوع 249 ، ومعدل فحصوصات ال بي سي ار الإيجابي للعينات التي يتم فحصها من قبل زوار مراكز مراقبة الإنفلونزا وأمراض الجهاز التنفسي الحادة 16.2٪.كما أظهرت النتائج أن حالة انتشار العدوى في المجتمع تنقسم إلى أربع مراحل أو درجات وهي الدرجة الأولى ، الدرجة الثانية ، الدرجة الثالثة ، الدرجة الرابعة. يصنف مستوى الوضع الوبائي لدول العالم إلى خمسة مستويات تبدأ من الصفر وتنتهي بالمستوى الرابع. حيث حدثت 64٪ من الوفيات بين الذكور و 36٪ بين الإناث عام 2020 في الأردن

كما واوصت الدراسة باجراء العديد من الدراسات المستقبلية التي تتضمن عمل تقييم للوضع الوبائي لكل فترة زمينة .

1.INTRODUCTION

A new virus called Severe Acute Respiratory Syndrome Coronavirus 2 (SARS Cove 2) was discovered as a cause of an outbreak of a disease that began in China in 2019. The resulting disease is called Coronavirus Disease 2019 (Covid 19).(WHO,2020)

In March 2020, the World Health Organization (WHO) announced that it had classified COVID-19 as a pandemic. Public health groups monitor the pandemic and post updates online, including the US Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). These groups also issued recommendations on preventing the spread of the virus.(WHO,2020)

Where data showed that it is the virus that causes Covid 19, which spreads from person to person through close contact (within 6 feet, or 2 meters). The virus is spread by respiratory droplets released when a person infected with the virus coughs, sneezes, breathes, sings or talks. This spray can be inhaled or got into the mouth, nose, or eyes of a close person. Sometimes the Covid 19 virus can spread when a person is exposed to small droplets that remain stuck in the air for several minutes or hours, and this is called

airborne transmission. It is not yet known how common the virus is to spread in this way. It can also be transmitted if a person touches a surface with the virus on it and then touches their mouth, nose, or eyes, although this is not the main method of transmission.(Pellino G, Spinelli A,2020)

2.Coronavirus pandemic in Jordan

The Coronavirus pandemic in Jordan 2020 is part of the global pandemic of Coronavirus disease 2019 (Covid-19), which first appeared at the end of the year 2019 in China and subsequently spread to most countries of the world. Associated with severe acute respiratory syndrome »(SARS-CoV-2), and to prevent the epidemic from reaching its territory, the Jordanian government has taken several proactive measures since announcing its spread outside China and recording cases and deaths in different countries of the world, and approximately four months after the onset of the disease, it was recorded. The first confirmed case of HIV infection inside the country on March 2, 2020. The Jordanian Minister of Health, Saad Jaber, announced at a press conference that the injured young man in his thirties had symptoms of the disease 14 days after his return to Jordan from Italy, and a quarantine was imposed on him and his family members to conduct laboratory tests and found that he had the disease.(Ministry of Health, the Hashemite Kingdom of Jordan,2020)

3.Government preventive measures in Jordan

The first preventive government measures began on February 23,2020 when the Jordanian government announced its intention to examine all travelers coming from the Palestinian territories after cases of infection were recorded there, and the competent authorities in Jordan tightened control and preventive measures at all border crossings and crossings and installed thermal scanners, on the day Next, Jordan has temporarily banned entry to travelers from China, South Korea and Iran in light of the increasing number of cases in these countries and to keep pace with what many countries apply as precautionary measures to prevent the spread of the disease.(corona.moh.gov.jo)

Mandatory chest, throat and temperature checks were conducted for all arrivals through the Jordanian border crossings and airports, and instructions were issued for a 14-day quarantine for suspected cases, in tourist hotels that the government had previously rented for this purpose in Amman, Aqaba and the Dead Sea.(Abu-Farha RK, 2020)

The government also decided to prevent the export of medical masks or their sale to foreign parties for a period of two months, starting from February 20, in order to maintain a safe strategic stock in Jordan. (Alzoubi KH,2020)

The Cabinet also decided to exempt masks and hand sanitizers from the 16% sales tax. With the aim of reducing its prices to be accessible to everyone. The government also increased the production of protective masks by speeding up the licensing of additional manufacturers, and equipping a field hospital in coordination with the Royal Medical Services. And work to intensify awareness-raising campaigns to prevent and avoid the disease. (Abu-Farha RK, 2020)

The Jordanian government also issued a decision to suspend all national events, and advise citizens not to gather in social events (weddings and funerals). With an emphasis on citizens' commitment to stay in their homes as much as possible, and not leave unless necessary. A fatwa was issued by the House of Ifta and the Council of Churches in Jordan prohibiting prayer in all mosques and churches of the Kingdom as a preventive measure, and tourist sites were closed in order to carry out cleansing campaigns in these sites, singing and cultural activities were canceled, cinemas, swimming facilities, sports clubs, youth centers, cafes and restaurants were closed. Visits to hospitals and prisons have been stopped. And sporting events in the Kingdom have also been canceled, including the boxing championships that qualify for the Olympic Games, which were to be held in Wuhan, China, but were transferred to Jordan and canceled due to the pandemic. (Center for Security and Crisis Management – Jordan,2020)

4.Importance of studying

The epidemic began to spread rapidly in Jordan and entered the stage of community spread of the infection gradually escalating and the death rate at the beginning of the pandemic was low, as it constituted 1 % of the total number of infections, while it increased greatly to reach 21.7 % during November of 2020

It is noteworthy that there has been a change in the hospitalization policy and the start of the application of the home isolation policy for mild and asymptomatic injuries as of September 25, 2020, and hospital admission has been restricted to moderate, severe and critical cases only, with admission rates ranging 10% of the total confirmed cases, and this explains the high fatality rates among the initially admitted cases. From October compared with the previous months of the epidemic before October, when all laboratory-confirmed cases were admitted to hospitals for purposes of isolation, treatment, or both, regardless of the presence of disease symptoms or the severity of these symptoms if they were present.

The total fatality rate among all hospitalized cases that were isolated at home at the end of January was 1.3%, while this percentage among the cases admitted to hospitals at the end of January was 15.3%,This required the existence and identification of indicators to assess the level of community transmission of infection in Jordan.

5.Aim of study

This study aims to analyze the data of Coronavirus infections in Jordan during the year 2020 and work to define epidemiological criteria and indicators to divide the level of community transmission of infection

6.Questions of Study

1- What are the levels of community transmission of infection in Jordan?
2- What is the level of the epidemiological situation in Jordan?
3- What are the epidemiological indicators indicating the level of community transmission?

7.Methodology

This research was conducted through the descriptive approach and the quantitative research method, where data were collected through daily casualty reports of the Jordanian Ministry of Health in 2020 and the data were analyzed to extract the results.The received data were classified and analyzed to determinePrimary epidemiological Indicators to Assess the level of CommunityTransmission in Jordan.

8.Results and Discussion - Epidemiological situation in Jordan

The epidemic began to spread rapidly since the beginning of the second week of August 2020, when Jordan entered the stage of societal spread of the infection. Prior to that and during the previous five months from March to July, the spread was either in the form of individual cases imported from abroad, individual local cases, or a group of local cases in the form of foci resulting from imported cases.

The total number of cases recorded during the months from March to the end of July was 1269, and deaths reached 11 deaths. For the most part, this period coincided with a period of blanket ban and closures. This period was characterized by the availability of the possibility of isolating all sick cases in hospitals, regardless of the severity of the case, as this period did not coincide with the presence of pressure on hospital beds. The capabilities also allowed suspicious cases to be quarantined in institutional quarantine places under the supervision of government agencies. (Kemp S. Digital, Jordan 2020)

Despite this, this period had some gaps related to the lack of tightening of the quarantine process, which caused the spread of infection and the formation of some limited foci in some regions of the Kingdom.

The mortality rate during this period was low and constituted less than 1% of the total injuries, and this is due to the fact that all cases that were proven positive by laboratory examination are admitted to hospitals, regardless of whether the patient suffers from symptoms of disease or not, and regardless of the severity of the disease, whether simple Moderate or severe, and about 45% of this disease is known (Sallam M,2020)

The injuries are asymptomatic and about 35% have mild symptoms, and this explains the main reason for the low death rate during this period.

The detected cases began to escalate gradually from the beginning of August, when 832 cases were recorded, followed by 9725 cases during the month of September. Then 60,782 cases during the month of October and 71,071 cases during the first half of the month of November. (Ministry of Health report ,2020)

Despite this large number of injuries, the total fatality rate among the total number of injuries ranged between 5.0 %- 3.1%, while the fatality rate among hospitalized patients witnessed a big jump during the months of October and the second, coinciding with the change in hospitalization policy and the start of the isolation policy. Household for mild and asymptomatic injuries. This percentage reached 6.12% during the month of October, then increased to reach 1.22% during the first half of November.(Center for Security and Crisis Management – Jordan,2020)

Table1: Distribution of injuries,deaths and fatality rate by months

Months	Number of cases	Deaths	Total fatality rate %	Hospital admission rate %	Mortality rate among hospital patients %
from March -July	1269	11	0.90%	100%	0.90%
August	832	4	0.50%	100%	0.50%
September	97255	46	0.50%	50%	0.90%
October	60782	768	1.30%	10%	12.60%
November	71071	943	1.30%	6%	22.10%

When studying the fatality rate of hospitalized patients during weeks from 42-46, it was found that this rate ranged between 1.12% and 7.13%, as it rose slightly and gradually during these weeks from 1.12% to 3.12% and 4.12%, then to 3.13% and 7.13% for weeks. 42, 43, 44, 45 and 46 respectively, Table No. (2.)

Table 2:Mortality rate of hospital disease according to weeks

weeks	Cases in hospitals	Deaths per week	Total fatality rate
42 - 17/10 to 23/10	1641	198	12.10%
43 - 24/10 to 30/10	2414	264	12.30%
44 - 24/10 to 30/10	2925	364	12.40%
45 (11/4-13/11)	3620	482	13.30%

It is noteworthy that the reason for the increase in this percentage is due to the widespread societal spread of infection in addition to the change that occurred in the policy of directing laboratory examinations during the last two months, so that it became directed to the groups most at risk of infection, such as contacts of injuries, people with suspected symptoms, health personnel and the like, while these examinations were in The former is running properlyRandomized and targeted populations of high and low risk. Figure 1 as below:

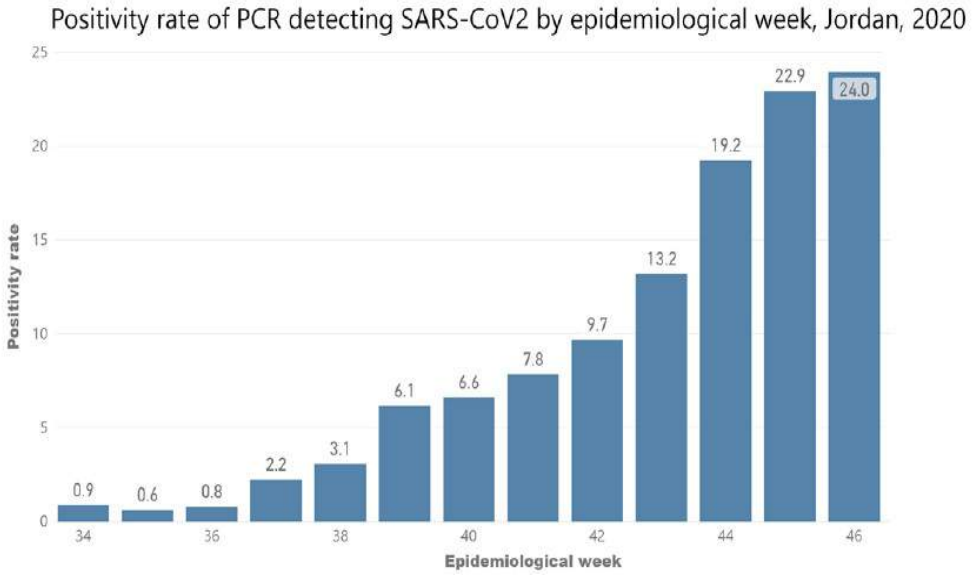

Figure 1: positive rate of CPR detecting, Jordan, 2020

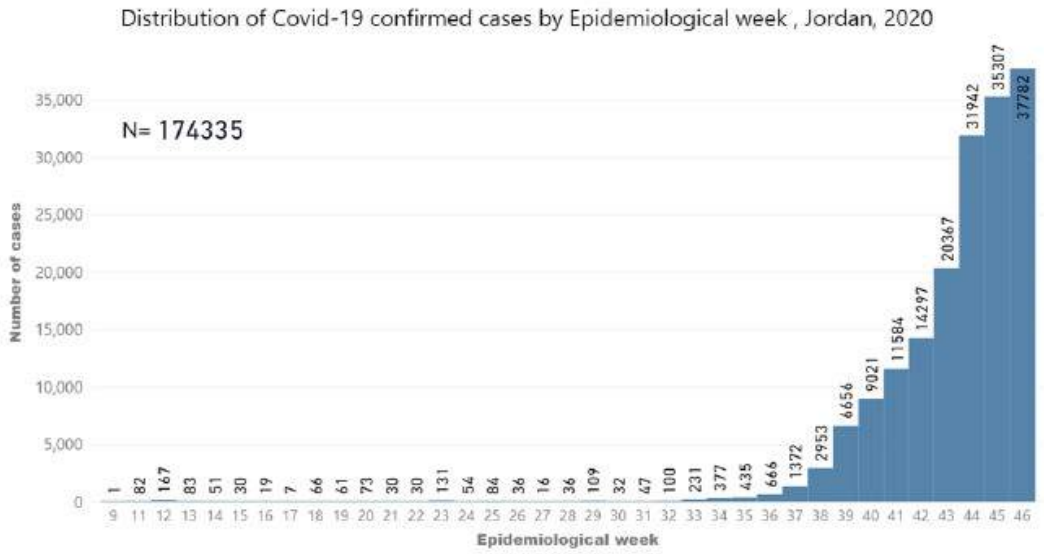

Figure 2: Distribution of Covid-19 confirm cases by epidemiological week

It is noted from Figure 2 the steady increase in the number of infections during the weeks since the beginning of the epidemic until week No. 46 ending 11/20 then It is observed that there are large jumps in the number of weekly cases between weeks 42 to 44, and then the differences returned to increase to diminish during weeks 44 to 46.

Figure 3 shows the distribution of the 105,121 cases for which gender data is available, where it is noticed that the proportion of cases among males is greater than among females. This difference can be attributed to the fact that males in general have the opportunity to move and mix more than females, which makes them more exposed to sources of infection in addition to the fact that the percentage of males in the society, as is known, is slightly higher than the percentage of females, and females may be more committed than males to the application of preventive measures.

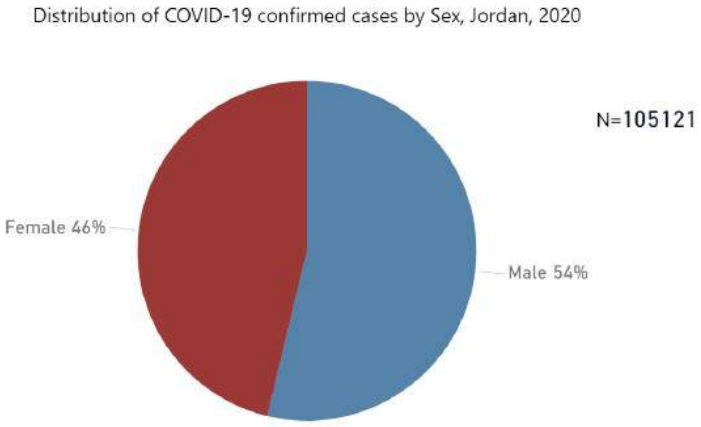

Figure 3: Distribution of Covid-19 confirmed cases by gender

Table No. (3) shows the cumulative incidence rates of injuries per hundred thousand of the population, according to the Kingdom's governorates, which are in descending order. It is highest in Amman, Aqaba and Zarqa, and lowest in the governorates of Mafraq, Irbid and Madaba.

Table 3: The cumulative incidence rate of injuries by governorate per 100,000 inhabitants

Aqaba	2596.7
Amman	2025.9
Ajloun	1999.5
Tafila	1877.9
Jerash	1688.3
Albalqa'	1581.1
alkarak	1510.9
maan	1497.6
Az Zarqa'	1448.1
Madaba	1354.7
Irbid	895.5
almafraq	595.6

Figure No. (4) shows the cumulative incidence rate of injuries per hundred thousand of the population, according to age groups. It is noticed that the rate is a little and the lowest among children under five years of age (160) and it doubles approximately two and a half times in the age group 5-14 years to become 399, then this number soon increases and doubles about three times in the age group 15-24 to become 1241 and then increases to reach 2201 In the age group 25-34 years .The rate then decreases in the groups 35-44 and 45-55 years old, while the highest incidence rates are in the age group 75 years and over, followed by the age group 55-65 years.

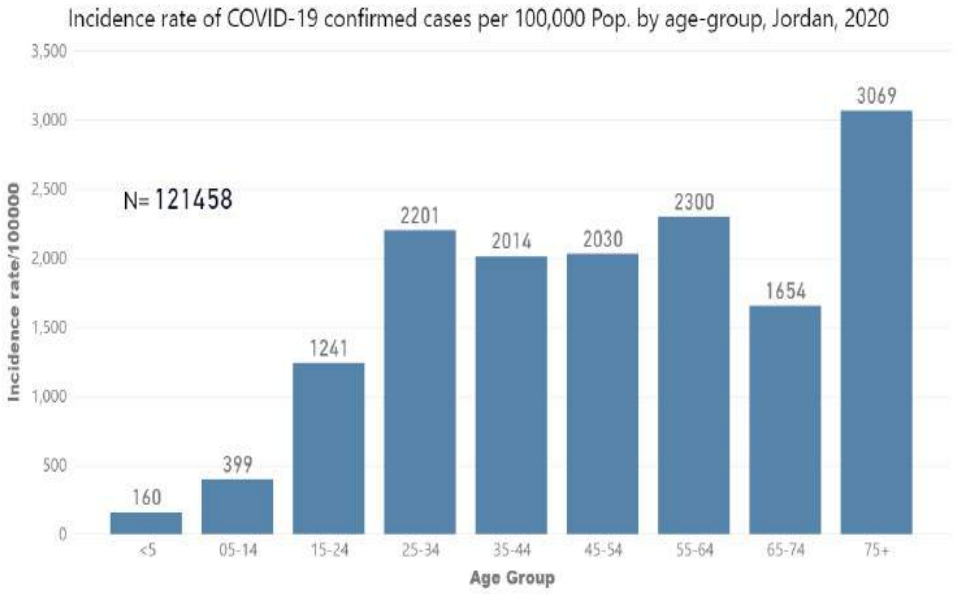

Figure 4: incident rate of Covid-19 confirmed cases per 100.000

Figure No. (5) shows the distribution of the number of deaths that occurred from the beginning of the epidemic until the end of the week No. 46 ending on 11/20/2020.

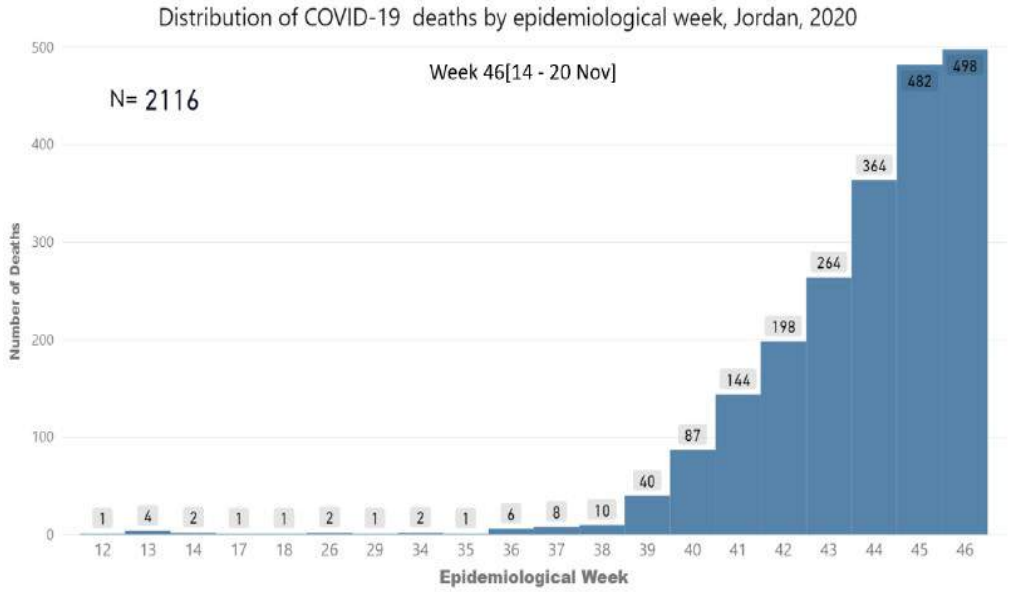

Figure 5: Distribution of Covid-19 Deaths by epidemiological week, Jordan

It is noted that there were only 30 deaths during the period before the 39th week, and then the deaths began to increase weekly after that. In Week No. 39, more deaths were recorded than during the previous twelve weeks since the beginning of the epidemic. Then this increase continued at a steady pace until the number reached 364 deaths during week No. 44, then to 482 during week No. 45, then to 498 deaths during week No.46.

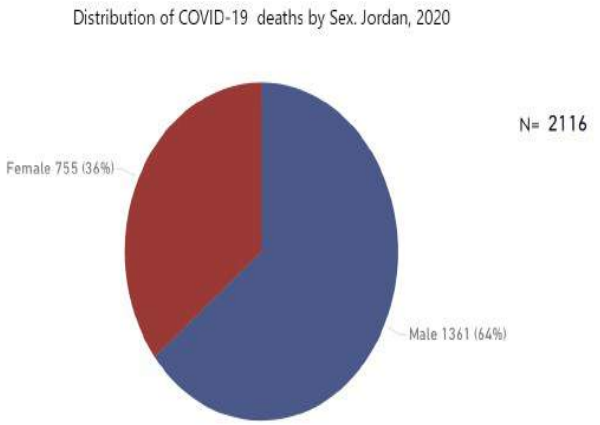

Figure 6: Distribution of Covid-19 Deaths by sex, Jordan, 2020

Figure No. (6) shows that 64% of the deaths occurred among males and 36% of them among females. This is in line to a large extent with the pattern of morbidity incidence between males and females, and also consistent with the general pattern of the distribution of crude deaths, which increases among males than among females.

9.Classifying the level of the degree of societal prevalence of infection and assessing the level of the epidemiological situation in Jordan:

Based on the latest WHO guidelines issued on 4/11/2020 (Considerations for implementing and adjusting public health and social measures in the context of COVID-19) as on table 5 Which divides the state of community prevalence of infectionto four stages or degrees, which are the first degree, the second degree, the third degree, and the fourth degree. The level of the epidemiological situation of countries is classified into five levels, starting from the zero level and ending with the fourth level.(WHO guidelines,2020)

Table 4: Situational Level assessment matrix using transmission level and response capacity indicators to guide adjustment of PHSM

	Response capacity		
Transmission level	Adequate	Moderate	Limited
No cases	0	0	1
Imported/Sporadic cases	0	1	1
Clusters of cases	1	1	2
Community - CT1	1	2	2
Community - CT2	2	2	3
Community - CT3	2	3	3
Community - CT4	3	3	4

*Considerations for implementing and adjusting public health and social measures in the context of COVID-19, 4 November 2020

* **Situational Level 0** corresponds to a situation, with no known transmission of SARS-CoV-2 in the preceding 28 days. The health system and public health authorities, are ready to respond, but there should be no restrictions on daily activities.

***Situational Level 1** is a situation where basic measures are in place, to prevent transmission; or if cases are already present, the epidemic is being controlled, through effective measures around the cases or clusters of cases, with limited and transient localized disruption to social and economic life.

***Situational Level 2** represents a situation with low community incidence or a risk, of community transmission beyond clusters. Additional measures may be required to control transmission; however, disruptions to social and economic activities can still be limited.

***Situational Level 3** is a situation of community transmission with limited additional capacity to

respond and a risk of health services becoming overwhelmed. A larger combination of measures may need to be put in place to limit transmission, manage cases, and ensure epidemic control.

***Situational Level 4** corresponds to an uncontrolled epidemic with limited or no additional health system response capacity available, thus requiring extensive measures to avoid overwhelming of health services and substantial excess morbidity and mortality

In order to determine the degree of societal prevalence, there are fourepidemiological criteria that must be calculated:

1- The rate of hospitalization per 100,000 inhabitants per week.

2- The death rate per hundred thousand of the population per week.

3. Rate of injuries per hundred thousand of the population per week.

4- Positive percentage of PCR tests for the examined samples for the visitors of the monitoring centers for influenza and acute respiratory diseases.

The organization developed a numerical scale for each standard to be guided by countries. When calculating these four criteria for Jordan, they were as shown in Table (5), noting that we used a positive percentage of the college PCR examinations per week instead of the percentage of monitoring centers referred to in Criterion No. 4 above due to the lack of data on this indicator.

Accordingly, it is evident that Jordan is currently witnessing a mixed level of community spread between the third and fourth levels, which is characterized as high and widespread. (Hajj Hussein& Chams N,2020)

In order to assess or diagnose the epidemiological situation of any country, these guidelines indicate the need to identify the level of health system capacity to respond and whether this level is sufficient, medium or limited, and after determining the level of capacity, a matrix is designed that links between the level of community prevalence and the level of health system capabilities, and then an assessment is made. The epidemiological situation of the country in any degree or level of severity, as we have shownPreviously.

Table 5: epidemiological indicators to assess the level of community transmission

Epidemiological Indicators to Assess the level of Community Transmission

Indicators	WHO guideness	Jordan	CT level
Hospitalization rate/100000/Week	CT 3=10 - <30	12.8	CT 3
Mortality rate/100000/Week	CT 3= 2-<5	3	CT 3
Case incidence/100000/Week	CT 4= 150+	249	CT4
Testing positivity %	5% - <20%	16.2	CT 3

Table No. (6) shows the level of capabilities of the Jordanian health system according to the standards adopted by the organization and mentioned in the same table. In summary of the evaluation of these five criteria, Jordan obtained two standards with a degree of sufficient capacity for the system, one standard with a medium degree, and two standards with a degree of limited capabilities.

Table 6: Epidemiological indicators to assess level of health system and public health services capacity & response

Domain	Indicator	Capacity to respond	Jordan
Clinical care capacity	Proportion of occupied hospital beds(Should count all hospitalizations, not only COVID-19	Adequate: <75% Moderate: 75-<90% Limited: 90%+	Adequate
Clinical care perforance	Case fatality rate of resolved (i.e., outcome known) hospitalized cases	Adequate: Decreasing trend Moderate: Stable trend Limited: Increasing trend	Limited
Public health response capacity	Number of persons tested /1000 population/week	Adequate:2+ Moderat: 1 - < 2 Limited: <1	Adequate
Public health response performance1	% of cases for which an investigation conducted within 24 hours of identification	Adequate: 80%+ Moderate: 60-<80% Limited: <60%	Limited
Public health response performance2	Support for/or adherence to public health&social measures	Adequate: High Moderate: Moderate Limited: Low	Moderate

After determining the degree of community spread in Jordan, which is between the third and fourth levels, as mentioned above, the level of health system capabilities can be estimated as shown in Table No. 6 as being at the average level.

We come now to develop a final matrix linking the prevalence of infection and the level of health system capabilities, as calculated through tables 4 and 5, in order to assess the level of the epidemiological situation of Jordan.

By analyzing this matrix shown in Table No. 7, it is noted that the assessment of the current epidemiological situation in Jordan with regard to the epidemic is located in the fourth level (before the last) according to the five levels shown in the matrix which are level 0 and levels 1, 2, 3 and 4

10.Epidemic situational Level assessment matrix using transmission level and healthsystem response capacity indicators

Based on the classification of the European Center for Disease Control, which classifies the levels of severity of the epidemic into low, medium and high risk, through the use of two criteria: The incidence of injuries during a two-week period per 100,000 population and the rate of positive BCR examinations from among the total weekly examinations, it appears that when these two criteria are applied to the situation in Jordan.

Transmission level	Response capacity		
	Adequate	Moderate	Limited
No cases	Zero	Zero	1
Sporadic/imported cases	Zero	1	1
Clusters of cases	1	1	2
CT1	1	2	2
CT2	2	2	3
CT3	2	3	3
CT4	3	3	4

table 7: transmission level for current epidemiological situation in Jordan

11.CONCLUSION

In light of the aforementioned epidemiological indicators, Jordan is witnessing during the study period the end of the third level and the beginning of the fourth level of community spread of infection, which is characterized by a high speed of spread, which diagnoses the current epidemiological situation as being of high risk and which results in a significant increase in the number of infections that need to enter hospitals in addition to the increase in the daily registration of deaths.

The epidemiological situation during the time period before week No. 37 of the year 2020 (before 9-12-2020) was of low risk and became during the two-week period No. 37 and38 Medium risk and after this date and until now the situation has become high risk as this stage witnesses the evolution of the widespread community spread of infection.

- 64% of the deaths occurred among males and 36% of them among females in 2020 in Jordan
- The injuries are asymptomatic and about 35% have mild symptoms, and this explains the main reason for the low death rate during this period
- The total fatality rate among the total number of injuries ranged between 5.0 %- 3.1%
- Fatality rate among hospitalized patients witnessed a big jump during the months of October and the second, coinciding with the change in hospitalization policy and the start of the isolation policy.
- current epidemiological situation in Jordan with regard to the epidemic is located in the fourth level (before the last) according to the five levels

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DISPOSABLE MASK SOLID CONCRETE BLOCKS

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ABSTRACT

In the face of COVID-19 outbreak, we are living through truly unprecedented times. One of the areas where guidance continues to evolve includes face coverings and masks. The use of PPE, in particular face masks, and to lesser extent gloves and face shields, has become widespread and a common tool used in preventing the spread of pandemic.These masks eventually land up in oceans and land-fills. These masks will take as long as 450 years to break down and negatively impact marine wildlife and Ecosystem.More than 1.5 billion disposable face masks will wind up in the world's oceans this year polluting the water with tons of plastic and endangering marine wildlife, according to a Hong Kong-based environmental group. With each mask weighing three to four grams, the situation could lead to 6,800 plus tons of plastic pollution that will take as long as 450 years to break down.In addition to the harmful effects of micro-plastic and nano-plastic particles, elastic ear loops pose a possible entanglement risk for wildlife.

If historical data is a reliable indicator, it can be expected that around 75 per cent of the used masks, as well as other pandemic-related waste, will end up in landfills, or floating in the seas. Aside from the environmental damage, the financial cost, in areas such as tourism and fisheries, is estimated by the UN Environment Programme (UNEP) at around $40 billion.The UN Environment Programme (UNEP) has warned that, if the large increase in medical waste, much of it made from environmentally harmful single-use plastics, is not managed soundly, uncontrolled dumping could result. The potential consequences, says UNEP, which has produced a series of factsheets on the subject, include public health risks from infected used masks, and the open burning or uncontrolled incineration of masks, leading to the release of toxins in the environment, and to secondary transmission of diseases to humans.Because of fears of these potential secondary impacts on health and the environment, UNEP is urging governments to treat the management of waste, including medical and hazardous waste, as an essential public service. The agency argues that the safe handling and final disposal of this waste is a vital element in an effective emergency response.

Keywords: *Bio-Medical Waste, Disposable masks, Pollution, Solid Concrete Blocks.*

INTRODUCTION

While masks and other protective items have been vital in the fight against COVID-19, they can have an incredibly detrimental impact on the environment. Single-use face masks are made from a variety of melt blown plastics and are difficult to recycle due to both composition and risk of contamination and infection.

Plastic masks can take hundreds of years to break down. The use of PPE, in particular face masks, has become a common tool used in preventing the spread of the virus, with many jurisdictions mandating the wearing of masks in public. The production of PPE has expanded in an attempt to meet skyrocketing demand, and PPE waste has also increased dramatically.

They enter oceans when they are littered, when waste management systems are inadequate or non-existent, or when these systems become overwhelmed due to increased volumes of waste.The promotion of mask wearing as a way to slow the spread of COVID-19 has led to an extraordinary increase in the production of disposable masks: the UN trade body, UNCTAD, estimates that global sales will total some $166 billion this year, up from around $800 million in 2019.Recent media reports, showing videos and photos of divers picking up masks and gloves, littering the waters around the French Riviera, were a wake-up call for many, refocusing minds on the plastic pollution issue, and a reminder that politicians, leaders and individuals need to address the problem of plastic pollution.

Bio-Medical Waste Solid Concrete Blocks:

During the pandemic large amounts of disposable masks are been disposed off either in landfill or end up in seas, these masks can be reused instead of leaving to rot in oceans causing negative impact on marine animals. In this study these masks are used to prepare solid concrete blocks by adding the disposable mask to the conventional raw materials by doing so not only reduces the pollution but also tends to reuse disposable masks. Bio-Medical Waste Solid Concrete Blocks are manufactured using Cement, mixture of M-Sand and stone chips and Disposable Masks in a proportion of 3:3:1 (which is obtained after trial and error method). These solid blocks are found to be strong and can be used in construction of both Load bearing and Non Load bearing wall constructions, irrespective of the weather conditions. The process involved in manufacturing and the test results are show below.

Objectives of the study:

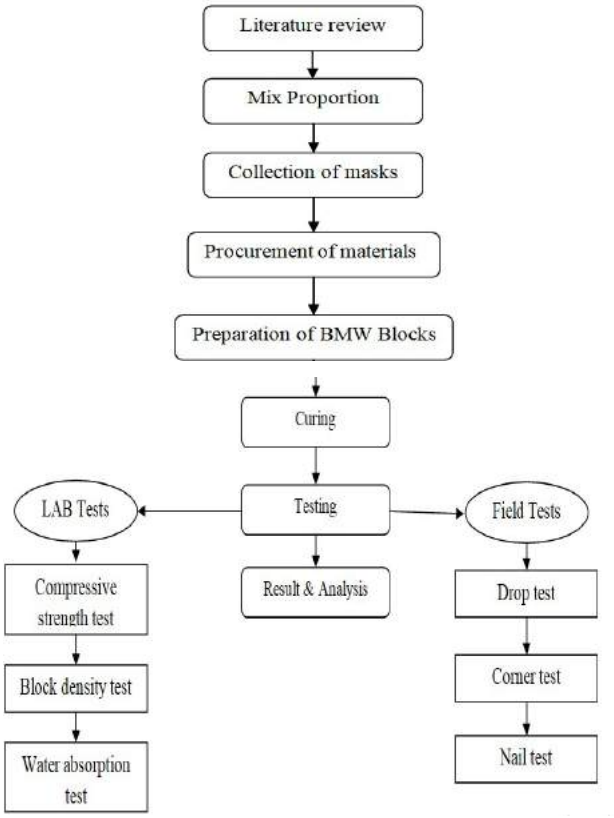
- To study the effects of used Disposable face mask on the Environment.
- To manufacture solid concrete blocks with Bio-Medical Waste (Disposable Mask).
- To find out optimum ratio by trial and error method (Through literature survey).
- To study the effect of bio-medical waste (Disposable Mask) on the compressive strength, block density and water absorption capacity according to IS 2185(Part1):2005.
- To compare the results of BMW solid blocks with Standard or Conventional solid bocks.

Significance of the study:

The onset of COVID-19 established a new set of health advisories, the need to practice social distancing, washing hands frequently, and the absolute and unarguable requirement to wear a mask. Wearing of masks is now the new normal, blurring all divides. To further emphasis the importance, it has been made a punishable offence not to wear one. More importantly, its sign of civic responsibility for all citizens, not wearing one is a mark of irresponsibility. These play an important role in present situation and once they are disposed off they cause problems to the environment in form of land and marine pollution. To overcome these problems, it is necessary to study the effects of these wastes and find a way to recycle and reuse these left over masks before it is too late to do so.

Methodology:

In this study a total of 32 specimens were made which include 16 specimens of Bio-Medical Waste Solid Blocks (BMWBlocks) and 16 specimens of Standard or Conventional Solid Blocks.The mix proportions of 3:3:1 and 2:3 were selected for BMW and Standard Solid Blocks after trial and error method.



Materials used

Cement:

Is the most common type of cement in general use around the world, because it is a basic ingredient of concrete, mortar, stucco and most non-specialty grout. It is a fine powder produced by grinding Portland cement clinker (more than 90%), a limited amount of calcium sulphate which controls the set time, and up to 55 minor constituents (as allowed by various standards).

The specific gravity of the cement was 3.15.

Disposable Masks:

One part of disposable mask is used to produce the Bio-Medical Waste Blocks, the masks were collected from various sources and were kept sealed for a period of 72 hrs. Later they were removed and hand shredded into small pieces.

Stone Chips (Size < 12mm):

Standard crushed stone chips passing 12mm Indian Standard sieve are used in the manufacturing of standard Concrete Blocks. The same were used for the production of Bio-Medical Waste Blocks as well.

M-Sand:

Manufactured Sand is generally used in the manufacturing of standard Concrete Blocks. The same were used for the production of Bio-Medical Waste Blocks as well to provide a similar mix.

Water:

Potable water used for the production of Bio-Medical Waste Blocks.

Selection of mix proportion for bio-medical waste blocks using trial and error method

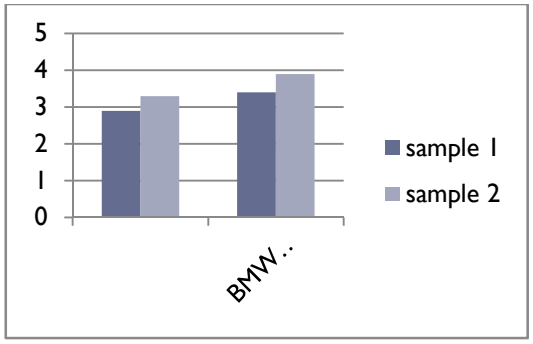
Two proportions were chosen for both standard concrete blocks and BMWblocks and compressive strength test were conducted on the samples after 7 days of curing in accordance to "is 2185 (part1) : 2005" to obtain the final mix proportion for various tests to be conducted on the blocks.

The selected mix proportions were 1:2 and 2:3 for standard concrete blocks and 1.5:2:1 and 3:3:1 for BMW blocks and the test results are shown below.

Table1. Compressive strength after 7 days

Sl. no.	Samples	Compressive strength after 7 days of curing
Standard blocks		
01.	1:2	2.9 N/mm^2
02.	2:3	3.3 N/mm^2
BMW blocks		
01.	1.5:2:1	3.2 N/mm^2
02.	3:3:1	3.9 N/mm^2

Fig.1 Compressive Strength Test Results



According to results obtained from above chart mix proportions of 2:3 and 3:3:1 are considered for Standard Concrete blocks and Bio-Medical Waste blocks respectively.

Manufacturing process of BMW Blocks:

The various steps used in preparation of BMW Blocks specimens are given below:

- The disposable masks were collected from various collection points and were sealed for 72 hours. The masks are then taken out and were left for about 3 hours in a disinfectant solution.
- The masks are shredded into small pieces and mixed with cement and water uniformly.
- Initially 3 parts of cement with 3 parts of mixture of M-Sand and stone chips and 1 part of mask are added and mixed together to obtain a uniform mix.
- The mix obtained is added into standard solid block moulds and vibro-compacted.
- The above obtained solid concrete blocks are sun dried and cured.
- After curing the samples for 7 days, 14 days and 28 days, tests are to be performed on them to determine the maximum compressive strength, block density, water absorption capacity and shape of the solid blocks according to IS 2185(Part 1):2005.
- The results are then compared with the results of standard solid concrete blocks.

Testing:

Compressive strength test

In this test the blocks are placed in the CTM and load is applied gradually without shock until the specimen fails.

Fig.2 Compressive Strength Test

Block Density Test

According to IS 2185(Part 1):2005, the block shall be weighed in kilograms (to the nearest 10g) and the density of each block shall b calculated by dividing mass by volume of the block.

Fig.3 Block Density Test

Water Absorption Test

Water absorption test is found in form of percentage after 7, 14, and 28 days of curing according to IS 2185 (Part 1) 2005.

Fig.4 **Fig.5**

Saturated WeightDry Weight

Results and Discussion:

Test Results:

Compressive strength test:

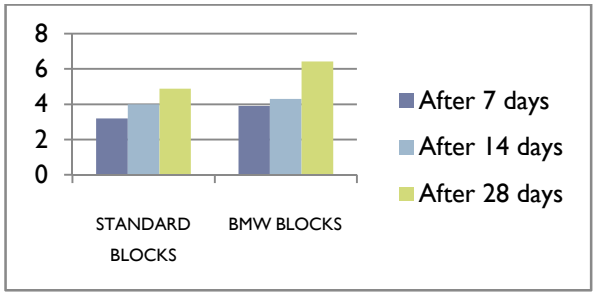
Compression strength of samples is found in the compression strength testing machine on the BMW blocks for curing times.

Sl.No.	Sample	Compressive strength after 28 days of curing
Standard Concrete Block		
01.	STD 01	4.94 N/mm^2
02.	STD 02	4.85 N/mm^2
03.	STD 03	4.85 N/mm^2
BMW Concrete Block		
01.	BMW 01	6.42 N/mm^2
02.	BMW 02	6.50 N/mm^2
03.	BMW 03	6.35 N/mm^2

Table.2 Determinationof Compressive Strength after 28 days.

The second table shows the compressive strength of both BMW blocks as well as Standard (STD) blocks. The Compressive strength is found by dividing the failure load by gross area of the sample. As it can be seen from table.2 BMW blocks has shown optimum results in comparison to Standard blocks after 28 days of curing. The maximum compressive strength obtained for Standard blocks and BMW blocks after 7 and 14 days of curing were 3.37 N/mm^2, 3.92 N/mm^{2}and 4.15 N/mm2, 4.33 N/mm2 respectively.

Figure.6 Variation of compressive strength of the blocks in N/mm^2



Block Density test:

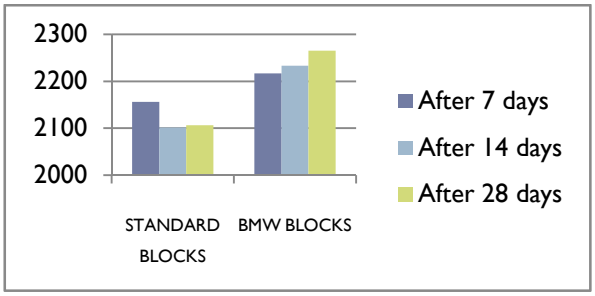
Block density of the specimens are found in accordance to IS 2185 (Part 1): 2005.

Sl.No.	Sample	Block density after 28 days of curing
Standard Concrete Block		
01.	STD 01	2106.41 Kg/m^3
02.	STD 02	2104.98Kg/m^3
03.	STD 03	2098.95 Kg/m^3
BMW Concrete Block		
01.	BMW 01	2265.38 Kg/m^3
02.	BMW 02	2275.32 Kg/m^3
03.	BMW 03	2260.77 Kg/m^3

Table.3Determination of Block Density after 28 days.

As seen in Table.3, maximum block density is obtained in BMW blocks after 28 days of curing. Similarlythe maximum block density values obtained for Standard blocks and BMW blocks after 7 and 14 days of curing were 2156.41 Kg/m^3, 2216.66 Kg/m^{3}and 2101.28 Kg/m^3, 2233.33 Kg/m^{3}respectively.

Figure.7 Variation of block density of the blocks in Kg/m^3



Water absorption test:

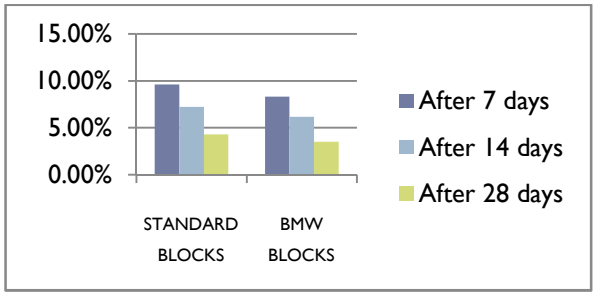
Water absorption test is found in form of percentage after 7, 14, and 28 days of curing according to IS 2185 (Part 1) 2005.

Table.4 Determination of water absorption after 28 days.

Sl.No..	Sample	Water absorption after 28 days of curing
Standard Concrete Block		
01.	STD 01	4.31 %
02.	STD 02	4.40%
03.	STD 03	4.36 %
BMW Concrete Block		
01.	BMW 01	3.51 %
02.	BMW 02	3.34 %
03.	BMW 03	3.60 %

Table.4 shows the results obtained for water absorption test. The percentage of water absorption have gradually decreased in case of BMW blocks with respect to curing period, and have shown the least water absorption percentage compared to Standard concrete blocks. The maximum values of water absorption for Standard and BMW blocks with 7 and 14 days of curing were 9.60%, 8.33 % and 7.23 %, 6.17 % respectively.

Figure.8 Variation of Water absorption test results of the blocks in %



CONCLUSION

- The addition of disposable mask with increased cement content has showmassive increase in compressive strength.
- The compressive strength of the Bio-Medical Waste blocks has increased by about 30%.
- As there is notable increase in compressive strength, these blocks can be used in construction of Load-Bearing as well as Non Load-Bearing walls.
- The BMW blocks have shown considerable increase in block density compared to Standard Concrete Blocks.
- The water absorption percentages have decreased with time and satisfy the need of IS 2185 (Part 1): 2005.
- The BMW blocks have shown good results in Field Test after 28 days of curing period.
- The addition of disposable masks has significantly improved the engineering properties of the Concrete Blocks.

From this study it can be concluded that using 1 part of Disposable Masks in Solid Concrete Blocks not only reduces Marine and Land pollution but also shows substantial results and the blocks thus obtained are economical, environmental friendly and technically sustainable.

ACKNOWLEDGEMENT

We would like to thank REVA University for their never ending support in order to carry out the research work. We sincerely thank Prof. Mrs. Sankalpasri SS, for her guidance throughout the duration of the research work. We would also like to extend our thanks to the technical staff of REVA University Civil Engineering Lab, Mr. Gopal Raju and Mr. Lakshmipathi for their help and support. We would also like to thank our parents who were with us and extended all the help they could.

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EXPERIMENTAL INVESTIGATION ON PERMEABILITY CHARACTERISTICS OF SOIL IN AND AROUND KANDAVRA LAKE, CHIKKABALAPUR, BENGALURU

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ABSTRACT

Huge amounts of Red soils are locally accessible in and around Kandavara lake are coarse grained soils. penetrability test is to find the K value which is the coefficient of porousness (K). We have gathered the dirt example around the lake and we have led fundamental geo specialized test on the dirt and we have direct the CBR test examination concentrate between with admixture and without admixture. We think about bentonite as admixture. In geotechnical designing, bentonite is utilized for self-solidifying blends utilized to assemble remove dividers, grouting mortars,and grouting. At last, bentonite waterproofing properties are best abused in natural designing, to close soil penetrations, and line the base of landfills. After the CBR test we have directed the penetrability test with and without admixture to check the porousness qualities of soil.

Keywords: *Bentonite, Coefficient of porousness, CBR test, Red soil*

INTRODUCTION

A growing us of a like India which we have massive geographic place and population, which needs extensive infrastructure like community of roads and homes. Almost all the civil engineering structures are placed on numerous soil strata. Soil is defined as the disintegration of rock materials is due to weathering action, Rolling and impact actions.The structural designing constructions like structure, connect, interstate, burrow, dam, tower, and so on are established underneath the earth or on the outside. For their dependability, reasonable establishment soil is required. To check the reasonableness of soil to be utilized as establishment or as development materials, its properties are needed to be surveyed. The properties of dirt like versatile, compressible or strength of the dirt consistently influence the plan in the development. Absence of comprehension of the properties of the dirt can prompt blunders in the development. The appropriateness of soil for a specific use are to be resolved dependent on its designing attributes and not on visual examination or evident comparability of soils from different source. The stacking ability of soil relies upon the sort of soil. By and large, the fine grained soils have a general more modest limit in orientation of burden than the soils that are coarser grained. Pliancy file and fluid cutoff are the significant variables in assisting an architected with understanding the consistency or versatility of dirt. In spite of the fact that shearing strength constants at fluid cutoff points yet fluctuates for plastic cutoff points for all muds. Porousness impacts the structural designing constructions.

Advantages of permeability of soil are as follows:

The investigation of the porousness of soil are significant in soil mechanics. Which is fundamental for figuring the amount of underground leakage under different pressure driven conditions, in like manner practiceor the penetrability coefficient is typically acquired by consistent head porousness test, and is used in filtration-waste, settlement, and strength computations. These issues are critical for ecological angles, for example, squander water the board, slant steadiness control, disintegration, and primary disappointment related with the ground settlement issues. For the hydrology, soil science, andgeotechnical designing understanding of waste and water development in fine-grained soils are essential.Permeability has a significant influence on the consolidation characteristics of soil. In geotechnical engineering fieldthe reliable information on permeability characteristics of fine-grained soils is applied in the study of the seepage through the earth dams, ground water flow,stability of slope problems , and many related topics.

OBJECTIVES

1. To find out the index properties such as atterburg limits, compaction values, CBR values of soil sample collected in and around kandavara lake.

2. To find the permeability characteristics of the soil and to divide the coefficient of porousness in Kandavara Lake Chikkabalapur.
3. We use bentonite as admixture for the stabilization of soil the current study focus on increase in soil strength, changes in surface area at microlevel.
4. Permeability strength of soil as increased, and suitable for the construction.

Materials

Red soil

In India, red soil is found in Tamil Nadu, Maharashtra, Chhattisgarh, Andhra Pradesh, and Karnataka, nearly concealing the whole space of these states. The dirt is additionally found in a few pieces of Odisha and West

Bengal. It is the third-biggest soil bunch in India, given the huge territory that it covers. It is framed by the deterioration of "metamorphic rocks".Red soils is acquired from the enduring of rock and gneiss. It contains iron oxides and subsequently it is red in shading. It is wealthy in iron, lime and salt, yet contain modest quantities of humus. It is light, has flimsy layers and it isn't extremely prolific. Its ability for dampness maintenance is less. It is broadly appropriated in Karnataka, and discovered more in south Karnataka. In India, red soils have been additionally partitioned morphologically into two classes Red topsoil soil and Sandy red soil. At the point when rocks like stone, gneiss carnotite, and diorite degenerate, red topsoil soil is framed. This dirt is less rich as it is more vulnerable to the way toward filtering. At the point when water permeates through the ground, making the water-dissolvable supplements of the dirt leak through the ground alongside it, the cycle is called draining.

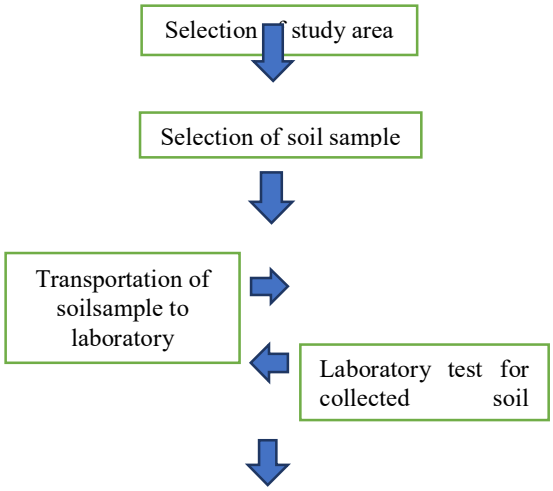
Admixture

Calcium bentonite was mixed with red soil in 8,12,16,20,24% by dry weight. To get the required hydraulic conductivity, strength characteristics and permeability characteristicsan appropriate bentonite red soil and the range of compaction parameters was determined

Study area

The soil sample collected in and around kandavara lake, chikkabalapur district, Bengaluru. To check the permeability conditions of the soil near kandavara lake and also to know the properties of that soil, we have visited the place. The soil is laterite red soil.Kandavara lake was once the largest lake in chikkabalapur and also one of the main water source of chikkabalapur city. Lake is spread across 4 villages of chikkabalapur taluk.The lake has a catchment area of 35.25 sq.km., depicts the buffer zone of75 meters. Rainfall in catchment is about 800mm. Land use in catchmentis dominated by agriculture.Due to severe crisis, the water from the sewage treatmentplant commissions by thestategovernment at hebbal in Bengaluru.

Methodology and Experimental Investigation



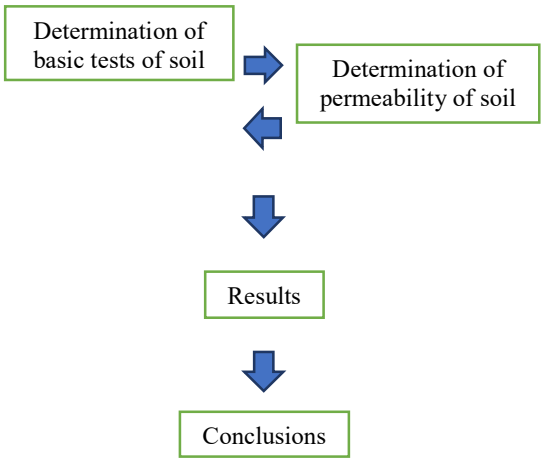


Table-1: Results of basic tests of soil

The grain size analysis of red soil	
The specific gravity of red soil	2.15
Consistency limits	
Liquid limit	30
Plastic limit	22
Compaction test	
OMC of red soil	13.1
MDD of red soil	1.45
CBR test	
Penetration values (without admixture)	2.5=3.69
	5.0=3.53
Penetration values (with admixture)	2.5=4.51
	5.0=4.40

Table-2: Results of permeability of soil (without admixture)

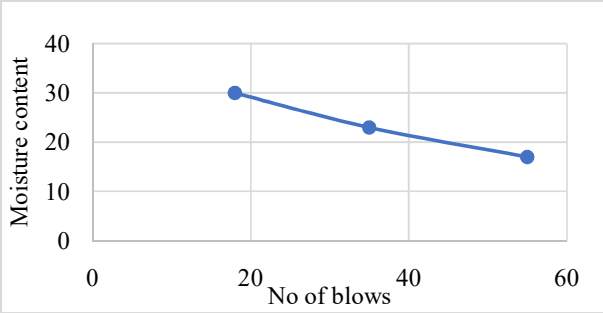
Average flow	Time of collection	Temp of water	Head difference	K cm/sec
152	60	22	11.8	0.7×10^-5

Table-3: Results of permeability of soil(with admixture)

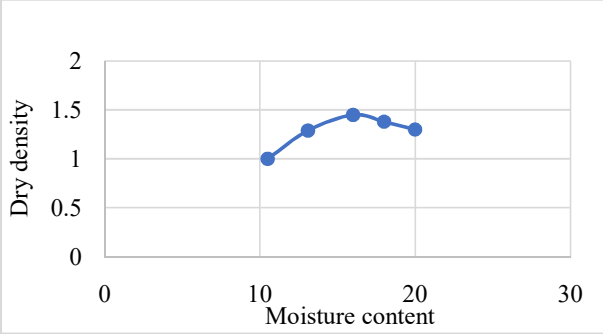
Materials	K cm/sec
Red soil +8% bentonite	0.4×10^-7
Red soil +12% bentonite	0.98×10^-8
Red soil +16% bentonite	0.55×10^-8
Red soil + 20% bentonite	0.33×10^-8

Red soil + 24% bentonite	0.31×10^-8

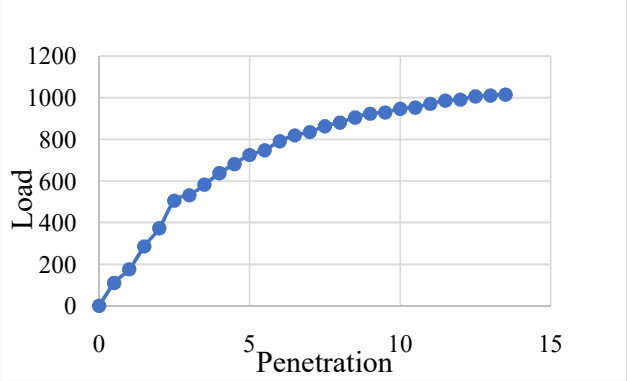
Graph-1: Liquid limit graph



Graph-2: Dry density -moisture content relationship



Graph-3: Load and penetration analysis (without admixture)



Graph-4: Load and penetration analysis (with admixture)

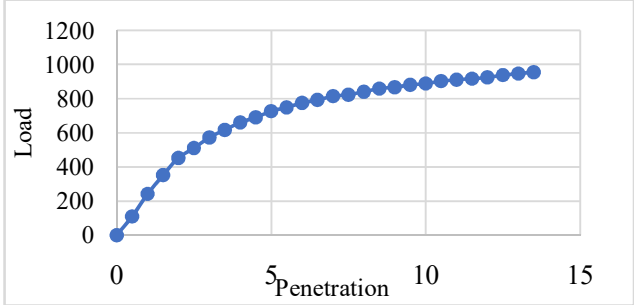


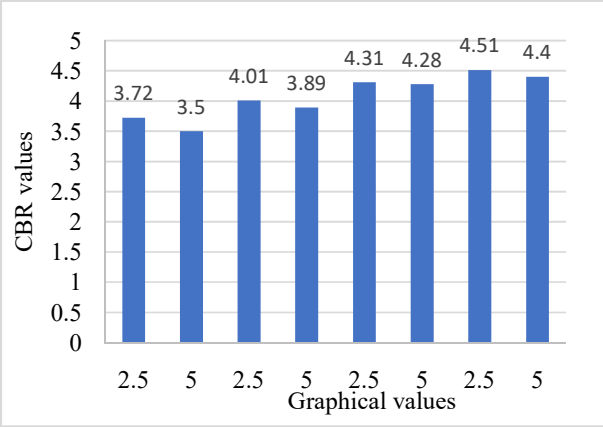
Figure 1: Collection of soil sample

Table -3: Increase in strength of soil by CBR test adding admixture

Type of soil	OMC (%)	Water content (ml)	Drydensity	Dosageofadmixture	CBR values
Red					
2%	13.1	650	1.45	100	P1=3.72
					P2=3.50
4%	13.1	650	1.45	200	P1=4.01
					P2=3.89
6%	13.1	650	1.45	300	P1=4.31
					P2=4.28
8%	13.	650	1.45	400	P1=4.

	1				51
					P2=4.40

Graph-4: CBR values



RESULTS AND DISCUSSION

- The specific gravity of BC soil is carried out by pycnometer and result obtained is **2.15**
- From Compaction test the maximum dry density is **1.45**g/cc and OMC is**13.1**%.
- The value of liquid limit is **30**%, plastic limit gained to be 22%.Hence, soil is clay with low plasticity and the soil need to be stabilized to improve its strength for usage as a base material.
- California bearing ratio test of red soil is carried out by adding admixture to increase the permeability of soil.
- Permeability of soil test is carried out by falling head method with and without admixture.

CONCLUSION

From the compaction results, it is concluded that MDD is 1.45 and OMC is 13.1% at 20% of water content.

- The CBR values of red soil has low strength before adding admixture, after adding the admixture 2% ,4%, 6%, 8% the value od CBR increases and increase the strength and permeability of soil.
- The permeability of red soil is carried out by falling head method with and without admixture. The value of permeability has increased to 0.2×10^-7 to 0.31×10^-8.
- Due to the low permeability of soil in and around the lake, the constructions near and around the lake are facing the problems related to drainage conditions, seepage conditions and specially in rainy seasons. The soil has more permeable to withstand the stability of soil and other characteristics.

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IOT BASED FLOOD DETECTION AND SUITABLE EVACUATION DURING PANDEMIC

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ABSTRACT

We aimed at identifying the location of frequently flood-affected places in Kodagu which is a District of Karnataka, India. The paper also investigated the evacuation plans for proposing suitable measures in the event of a pandemic (COVID-19). An emergency evacuation approach is proposed using google maps to assist in providing evacuation paths during emergency. It increases the chances of keeping people safe by considering the impact of the flood, reactions of evacuees' and the surroundings. The real-time information on monitoring flooded zones, the GSM module is used. The cloud data from the ultrasonic sensor and transmit the information to the module (GSM) for sending messages to alert the people. The analysis shows the capability of integration of GSM and smartphone to caution an alert to the stakeholder. The experimental validation is carried out by testing the setup for two different environmental conditions. The proposed prototype will give information to face the risk of flood evacuation during the event of a pandemic (COVID-19). The prototype developed is IoT-based on par with Cyber-Physical System, supporting the infrastructure of the Cyber-Physical System.

Keywords: *COVID-19, Cyber-Physical System, Evacuation, Flood, IoT*

INTRODUCTION

The link between floods and communicable diseases like covid-19 is frequently misread. COVID-19 first identified in December 2019 in Wuhan, China is an extremely infectious respiratory disease. Masking face, frequent hand washing/sanitization, and maintaining social distancing are the important measures required to restrain the spread (WHO, COVID-19) [1]. It is very hard to execute such measures during extreme events and the risk for spreading the infection is more likely to happen during an event of floods and cyclones [2]. Volunteered services and resources sharing is usual practice during this disaster event [3]. However, population evacuation is the risk factor during such outbreaks. The availability of proper drinking water, sanitation facilities, social distance, the health condition of the people with illness, and the availability of medical services may involve the risk of spreading the disease and may trigger the death rate. Proper precautions and methods to be followed in order to handle such dangerous disasters together [4].

Flooding is one of the disturbing disasters which causes thousands of deaths and loss of properties [5]. Floods are a common disaster in the recent times in India [6, 7, 8]. In the past few decades increasing events, such as flash floods and torrential rains, make India as flood-prone land [9]. This adds to rising temperatures and environmental pollution due to human activities [10]. Due to environmental pollution and differences in monsoon, there is a temperature inclined in the land-sea in the Indian Ocean. This resulted in extreme rainfall events [11]. Due to floods in India just in 2020, there were so many disasters and life losses all across the country. Floods in Madhya Pradesh during September almost killed 24 and more than 10,000 people were evacuated from vulnerable areas, Telangana during October 2020 almost killed 50 people, and many such events that happened parallel to the pandemic made us realize covid-19 is not just we have remembered for 2020 [12].

Pre-disaster management helps in getting information about the accuracy of the flood and helps in getting

emergency evacuation plans. The mitigation plan involves stakeholders and more importantly the decision-maker to exercise the care and precautions during the evacuation process. This work demonstrates the evacuation of people from vulnerable areas and saves them from disaster.

Case-study and Methodology

Kodagu district (Coorg) located (11° 52' N-11° 56' N and 76° 12'E -76° 22'E) with the areal extent of approximately 4,102 square kilometers in the Western Ghats of southwestern Karnataka is shown in Figure 1. Agriculture is the foremost source of income and livelihood for the people in this district [13]. Kodagu is one of the most diverse places in the area of agriculture where people grow different kinds of crops. Kodagu is famous for growing coffee, pepper, and paddy. During 2018, in Kodagu, the worst rainfall occurred is one among about many decades. Almost the entire district was affected due to rainfall and landslides. Due to this it almost destroyed the lives, houses, and agricultural lands. Thousands were evacuated and shifted to the rescue centers and hundreds have lost their lives. Not just in 2018, every year Kodagu receives rainfall and destroys the vulnerable areas which intend to affect the yearly agriculture and economy [14].

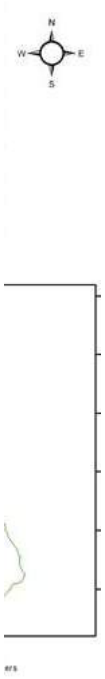

Figure 1: Location of Kodagu District, Karnataka state, India.

Detection of water level using sensors

IoT in flood monitoring involves the usage of sensors and alerting devices as part of pre-disaster management. This method of flood monitoring involves circuit connections with sensors which are called the hardware part of the system. An Arduino UNO is a microcontroller which controls the system where it receives the input signals from the ultrasonic sens sends them back to the GSM mo sensor, which is used to measu the surface of the water and message will be sent to the peopl areas using the GSM module if than the threshold and if it is less there will be no response. controlling the data in one's ow services cloud communication is device that can be connected websites. In this connection, GS gets the information from A information of the occurrence of who programmed and which mitigation plan.

Model development: Circuit and Floodwater level detection

In our proposed system, an Ultrasonic sensor with other circuit connections is made to get information about the water level as shown in figure 2. The Ultrasonic Sensor is connected to an Arduino Uno from which we get the readings. Arduino Uno is interconnected to the GSM module. Serial Communication will take place between the Arduino Uno and the GSM module. SIM is inserted in the module as the admins can receive the SMS. Then we will use a machine-learning algorithm to predict the water level as shown in figure 3. This setup is powered by a DC supply of 5V. Buzzer sound is helpful in alerting people about the water level. As shown in the below figure, the flood detection model has a miniature replica of a river that is of 7cm depth in reference to figure 4. We have the threshold value of 5cm depth. As the water level begins to rise and reaches the threshold value, the sensor detects the water level and alerts the buzzer and the alert messages administration.

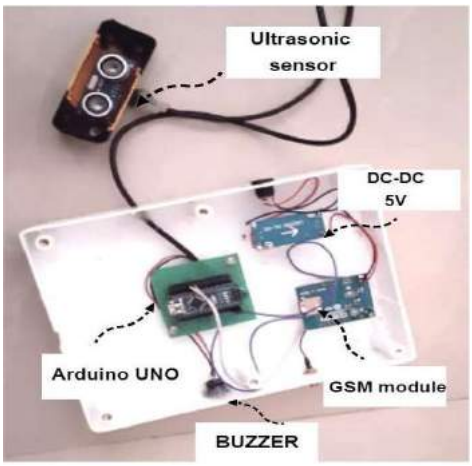

Figure 2: Circuit c

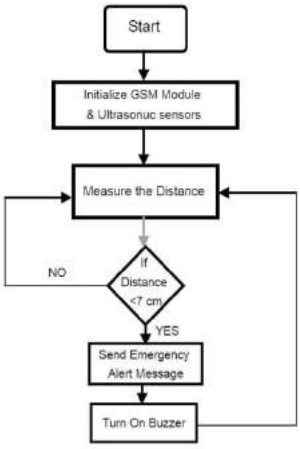

Figure 3: Arduino Program Algorithm

Figure 4: Flood Water level detection Model

Evacuation plan

In Kodagu almost all the places are properly connected by roads. The road network consists of National Highway, State Highway, and District Roads. Route to evacuate people safely is provided by an evaluation plan using Google maps which follows the steps as shown in Figure 5. As we all know Google maps are a widely used map service from all around the world. Google maps are used to know traffic updates and provide information to reach the destination within the least possible time. But one thing that we never come across in this is getting information about disasters and evacuation plans to keep people safe. The implementation of providing information about flood-prone areas can be really helpful in places like Kodagu as it receives the highest annual rainfall. The information obtained from maps can be used in mitigation plan and to know the areas where flood is likely to happen.

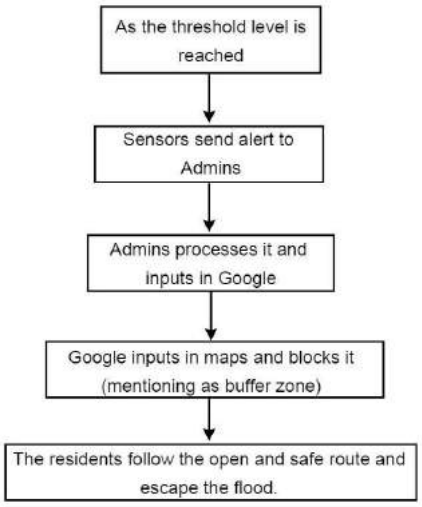

Figure 5: Process of evacuation

RESULTS AND DISCUSSION

The timestamp of various actions is shown in the screenshot from Arduino software (figure 6) showing the depth from the surface of the ultrasonic sensor and the top surface of the water.

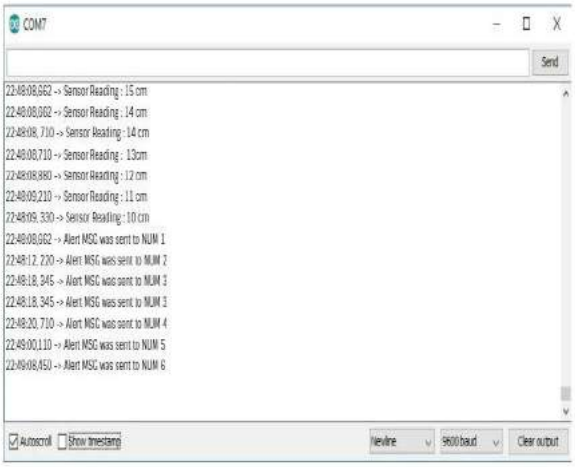

Figure 6: Arduino software results

Table 1 presented here is the results from the sensor, when the depth is below 5cm no buzzer beep was there. When it reaches 5cm that is the threshold level that we have considered in our project, a buzzer beep starts. When it rises from 5 to 7cm, the beep increases. The constant rise in water level above 7 will overflow from the river and lead to flooding on the land. Which gives a continuous and loud beep at regular intervals of time.

Table 1: Buzzer response to water level

Water depth	Buzzer response
Equal to or less than 5 cm	No buzzer beep
5 cm (threshold)	Buzzer beeps
Equal to or above 7 cm	Frequency of the buzzer increases
The constant rise in water level	Continues and loud buzzer beeps

The below screenshot shown in figure 7 is the alert messages sent by the GSM module to the administrative It shows the area in which the flood occurred

Figure 7: GSM module alert message

Evacuation map

The case study area Kodagu is subdivided into 6 zones for this experiment as shown in figure 8, assigning each a different color. After the data is fed into the Google Maps server by the admin, the evacuation routes are shown to the people depending on the zone they are from.

Figure 8: Evacuation map

CONCLUSION

The main objective of the work is to get information before the occurrence of the disaster and to evacuate people to keep them safe during pandemic situations like COVID-19 to decrease the loss that may occur in the extreme event of a flood, while also to bring about the potential challenges connected with evacuation processes during the pandemic situation. The recent literature referred for this work brought in the role of sensors in detecting floods and helped to formulate evacuation plans. Thoroughly, the experiment was carried out on how to make use of Google Maps to assist people located in disaster zones. This phase included working on and developing key factors such as safe routes, information on the oncoming flood. As part of further work, efforts were put into generating and sending SMSs regarding the flood-prone zones.

In the process of fulfilling these objectives, we construct the working model of a flood-prone zone (Kodagu). This model illustrates the working of the sensor during floods. We observe how the sensor constantly senses the rise in water level and transmits this data to the Arduino Uno. The sensor has performed as desired for varying depths of water levels and the same is reflected in the Arduino board too. Once the water level rose above the danger mark, a message was sent to the admin, which shows that the working of the model from a sensor point of view was fulfilled.

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POLITICAL STATUS OF WOMEN IN GRASSROOTS POLITICS OF MANIPUR

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ABSTRACT

In spite of advances that women had made on many fronts, women are largely either absent or barely visible in the political sphere. But, with the implementation of the 73rd and 74th Amendments, reservation of seats for women was introduced in the state of Manipur since 1996. Following this, many women representatives have started taking active interest in the political affairs of the state at the grass root level. The reservation has brought immense changes in Manipuri women's political participation at the grass root level. Reservation seems to be an effective tool to empower in political sphere. This paper analyses the performances of women representatives in the Local elected bodies in Manipur after the implementation of the women's quota according to the provision of the 73rd and 74th Indian Constitutional Amendments. The Study highlights some of the problems faced by the women representatives in Manipur at the grass root level while discharging their duties and also covers their contributions in the Local Elected Bodies. The study is based on both primary and secondary sources. Interviews conducted with some women representatives and Government publications are included in the primary sources. And for secondary sources, books and journals are used.

KeyWords: *Reservation, Women Empowerment, Political Participation, Constitutional Amendments*

INTRODUCTION

In a democratic country, everyone should be treated equally. But it is quite evident that women are excluded from several aspects of society, most notably the political sphere, in violation of the essential ideals of democracy. Women's representation in politics is extremely low in comparison to men in all political systems, from developed to emerging. Women in many nations had to fight long and hard for the right to vote. Although the number of women voting has increased significantly in recent years, their political engagement remains below that of men, and as a result, women are unable to participate equally in organisations that need decision-making. Women have traditionally been undervalued in the political sphere. Men dominate politics at all levels of participation.

The exclusion of women from decision-making bodies has a significant impact on women's ability to oppose subordination in all of its forms. Women need to be involved in politics and have power in order to participate as women and change the nature of the power that excludes them. Women, who make up over half of the population, need to be well represented in decision-making bodies. Otherwise, the development target will be impossible to achieve. Gender equality in society is critical for any society's advancement.

Since ancient times, the status of women in India has gone through many ups and downs, from equality in early history to the lowest point during the Medieval period. Women's standing in post-independence India regained strength and has been on the rise ever since. We have Indira Gandhi, India's only woman prime minister, and Pratibha Patil, the country's only woman president so far. Women make up nearly a quarter of the Indian cabinet now, with ministries such as External Affairs, Commerce, and Human Resource Development. At the local level, India has a substantial share of women in local politics, which was achieved by reserving seats for women, as women's empowerment has become a global concern.

Reservation of seats for women was adopted in the Indian state of Manipur in 1996, in accordance with the international push to eradicate discrimination against women and following the 73rd and 74th Amendments to the Indian Constitution. Manipur is located in north-east India's strategic triangle, sharing borders with Nagaland to the north, Assam to the west, and Mizoram to the south. Manipur had waves of migration from the north, east, west, and south as a result. Until the British annexation of Manipur in 1891 and subsequent union with the Indian Dominion in October 1949, the state of Manipur maintained centuries-old monarchical traditions dating back to 33 A.D. The monarchy's heritage and accompanying structure separated diverse communities along religious, ethnic, and tribal lines, preventing popular political participation until the early nineteenth century.

Table 3.3: Representation of Women in Lok Sabha of India

Year	Members in Lok Sabha		
	Total Members	Female	Percent
1952	499	22	4.41
1957	500	27	5.40
1962	503	34	6.76
1967	523	31	5.93
1971	521	22	4.22
1977	544	19	3.49
1980	544	28	5.15
1984	544	44	8.09
1989	517	27	5.22
1991	554	39	7.04
1996	543	39	7.18
1998	543	43	7.92
1999	543	49	9.02
2004	539	44	8.16
2009	543	59	10.87
2014	543	66	12.15

Source: Election Commission, 2014.

The percentage of women in the Lok Sabha in relation to the total number of seats is shown in the table above. In 1952, the figure was 4.4 percent. It climbed slightly from 5.4 percent in 1957 to 6.7 percent in 1962, 5.9 percent in 1967, 4.2 percent in 1971, 3.4 percent in 1977, and then increased slightly to 8.9 percent in 1984. After that, it improved marginally to 7.1 percent in 1991, 7.9 percent in 1998, and 9% in 1999. In 2004, however, it fell to 8.2 percent. The percentage of women representatives in the Lok Sabha is quite low, as shown in this table, with women's representation reaching only 11% in the 2014 elections. Women have a little larger representation in the upper chamber than in the Lok Sabha, owing to indirect election and nomination of women MPs.

Ethnic mélange marks the state of Manipur, where more than thirty three Notified or Scheduled Tribes inhabit, who can be broadly divided into two proto-communities: Kukis and Nagas, besides the majority Vaishnavite Hindu Meiteis and Sanamahi Meeteis with a negligible number of Meitei-Pangal(Muslim) concentrated largely in the fertile plains of Manipur.

The persisting tradition characterized by the lack of mass political participation discouraged women's active political participation in decision-making process. Yet there are notable demonstration of women's active role in social movements, tracing back to the times of British colonial rule. For instance, 1904 and 1939 *Nupilal* (Women's Uprising), Statehood Movement in the 1950s

and 1960s, where women were at the forefront demanding basic political rights, *Nishabandh* (Women's movement against alcohols) movements in the 1970s and *Meira \Paibi* movements (Torch-bearing women's association) in the 1980s. These are some significant illustration of Manipuri women's multi-faceted activities. Besides, women in Manipur continue to maintain vigil against alcoholics, drug abuse, social deviancy, acts as custodian of innocent civilians from the law-enforcing agencies--- as Manipur is marred by separatist movements. In June 2001, Manipuri women acted as the fulcrum of the male members in a spontaneous defiance against the authority during "the extension of ceasefire without territorial limits" between the Government of India and NSCN(IM).

The argument in this paper is that in spite of the active social role played by women of Manipur, the lack of mass participatory culture discourages women from taking active role in Decision-making bodies. Rather, there is no commensurate role in decision-making process, hence the role of women in self-governance have been dismal. And effective political empowerment of women can not be approached in a holistic fashion. Because even in a tiny state like Manipur regional, religious, caste and community variations are discernible.

OBJECTIVES

- This paper analyses the implementation of women's reservation in the Local Elected Bodies in India with special reference to Manipur.
- This study examines the performances of women representatives in the Local elected bodies of Manipur after the implementation of the women's reservation in the Local Elected Bodies of Manipur.
- The Study highlights some of the problems/challenges if any, faced by the women representatives in Manipur at the grass root level while discharging their duties.

METHODOLOGY

The study is mainly descriptive and analytical. The sources of data are both primary and secondary sources. Interviews conducted with some women representatives and Government publications are included in the primary sources. And for secondary sources, books and journals are used.

MANIPURI WOMEN IN LOCAL ELECTED BODIES

Manipur has 61 Zilla Parishads and 165 Gram Panchayats seats and women's quota are as par the 73rd and 74th Amendments of the Indian Constitution is fixed at 33.3 per cent. There appears to be a renewed interest in local bodies elections following the 73rd and 74th Amendments. This interest is influenced by the perception that the initiation of Panchayati Raj heralds the beginning of the devolution of the power to the people.

To assess the performance of women in self-governance, a survey was undertaken in the plains of Manipur, the areas where women's seats were reserved. The survey has been carried on since early the part of 2001 covering some districts in the valley of Manipur which includes Imphal East, Imphal West, Thoubal and Bishnupur, Kakching districts. The survey also covered Panchayati Raj elections since the implementation of women's reservation.

FINDINGS AND OBSERVATIONS:

The survey was conducted in a free-and-informal atmosphere without following any structured questionnaire, and persons selected for interviews are women elected representatives as well as ordinary electorates who were chosen randomly to avoid repetition and any bias creeping in. The areas covered can be broadly categorised into rural and urban areas. In the urban category, Nagar Panchayats are grouped with the urban with the intention to understand the differences if any, between the capital city Imphal and other urban elected-bodies and small towns in other areas of Manipur plains. There is a difference between rural areas members and urban areas women members regarding their views, perspectives and agendas. In rural areas, six pockets were also covered which are also predominantly inhabited by the Muslims, Nepalese and Bangladeshis.

Besides, two Scheduled Castes pockets were also covered, the distance of these two Scheduled Caste pockets are around 45 kms. One is situated along the National Highway and the other in the secluded area behind a hillock.

Serou Gram Panchayat under Thoubal district has a mixed ethnic communities ie. Nepalese, Bengalis. Meiteis as well as specs of kukis. The population of Nepalese as well as Bengalis combined are equivalent to the Meiteis electorates in a Panchayat which has about 2500 electorates. With a sizeable Bengalis who have settled here even during the British colonial administration, Bangladeshis have been flocking in this area. Until the implementation of reservation of seats for women, this Panchayat has been successively represented by Nepalese and majority Meiteis's participation were insignificant. However, since 1996

Meiteis are taking keen interest in the Panchayat elections probably in anticipation of the devolution package through Panchayat. For the first time, a women candidate from Meitei community have contested election. But how does Meiteis, who have never successfully fielded candidate for the last so many terms, balance the ethnic polarization in their favour needs to be seen. What is noteworthy is how could Nepalese manage to divide the Meiteis in their favour.

In Kanglatongbi Gram Panchayat situated on the National Highway about 2 kms from Sekmai, a Scheduled Caste community. It has mixed community of Nepalese, Meiteis and Liangmei Nagas. For the first time after 20 years, a meitei women has been fielded as a candidate. Kanglatongbi Gram Panchayat has about 3600 electorates where electorates of Meiteis is about 300 and Nagas has almost the same electorates as Meiteis. Though Meiteis are the majority community in Manipur, in this Gram Panchayat Meiteis are the minority. Kanglatongbi is divided by a pontoon bridge and there are reports of neglecting the areas on the southern side of the bridge where the Meiteis as well as the Nagas are settled. The Meitei candidate is relying her prospects of winning the election on the combine electorates of these three communities as well as cross-voting from the Nepalese community from across the bridge. For the first time, caste system in its variegated rigidities were seen in this Gram Panchayat. Nepali upper caste are numerically strong in this Gram Panchayat. Thus, the upper caste Nepalese resent representation from the lower caste. Thus, they have fielded an inexperienced woman. The Meitei candidate's chances of winning is also influences by the fact that as Meiteis are the majority, a Meitei representative can deliver results or goods in this Panchayat which have been denied for so many years and also of her mix lineal ie., her father is a Nepali and mother, a Naga and her husband, a Meitei. An underlying current were revealed in a situation where various insurgent groups are operating. Representation from the majority community would be beneficial. A unique phenomenon could be observed in the Kanglatongbi Gram Panchayat is that personal slandering, rumour mongering, cutting of snide remarks against women candidates are absent.

In Laipham Khunou Gram Panchayat which is interestingly reserved for Scheduled Tribe women. Though the majority are Meiteis who are Vaishnavite Hindus. There are also Nagas as well as Kukis who practiced Christianity. The electorates in this Gram Panchayat were roughly 7000-8000 electorates are Meiteis and about 1000 electorates of both Kukis and Nagas. Since the seat is reserved for Scheduled Tribe women, majority Meiteis have shown lack of interest in this Panchayat election. Kukis and Meiteis are traditional political alias. Thus, chances of fielding Kuki women candidate winning this election is very bright. In this Panchayat, local issues and problems seems to be over shadowed by the general political trend of the state. Thus the ceasefire extension in which the Government of India is perceived as appeasing the Nagas in total disregard of the majority Meitei sentiments will play a decisive role in the outcome of the Panchayat election. Elderly women-folk when interacted with in village kiosk have shown preference to vote for candidate who speaks good Manipuri and appearance of accessibility.

The state of Manipur is marred by persistence of separatism, insurgency, communalism, ethnic cleansing and one of the highest ratio of HIV/ AIDS patients. Against this background, some of the task elected women representatives in Manipur encounter, cutting across both urban and rural bodies is unique. Thus, besides their electoral responsibilities in the elected local bodies many women have to address the above-mentioned day to day problems.

Like in other parts of India or may be in South Asia patrilineal domination continuous thus confining women's role in the private domain. Bad-mouthing, snide remarks and character assassination and overriding of women representatives continues, in spite of the reservations. Besides, there are designs to segregate women representatives both socially and politically while formulating and executing policy. Yet, among the Scheduled Caste communities, there are no instances of gender segregation but while formulating policy male generally snub women. The community solidarity is strong among the Scheduled Caste women in Manipur and there is unanimity that the status of women among the Scheduled Castes communities are on par with other male counterparts, unlike in other parts of Manipur.

In the Lilong Muslim pockets, basically agricultural Muslim women representatives complained about gender-bias attitude, discrimination and "sarcastic attitudes of male members." Such "intolerable" attitudes make many women representatives felt "like quitting" the councillorship. However, in Kshetrigao Gram Panchayat in the Imphal sub-urban area no women complained about gender-bias attitude from the male counterparts. In this juncture what is pertinent is the higher level of education among Muslim women. But it is simply not mere, ritual and formalistic education among Muslim women but quality education is important. Muslim women representatives strongly advocate education of the girl-child as the primary step, at least among the Muslim community, for the eventual role of women in self-governance. Cultural, religious restrictions and gender segregation, thus preventing free intermingling and persistence of the system of *Purdah,* which prohibits exposure to other communities as a major factor responsible for the backwardness of Muslim women.

Women representatives, particularly in the Imphal Municipal Corporation, have a wider perspective, priorities and agendas on various women-related issues. However, urban women representatives have scant awareness about the problems faced by rural women. On the other hand, women representatives in the rural areas largely orient themselves in tackling local issues, thus a spectra of parochialism creeps in.

Higher educational backgrounds as well as wider exposure to media make urban women representatives often take the initiative while framing policies. Whereas the lack of education and exposure of the rural women including women representatives in the plain areas of Manipur suggest that there is an unbridgeable gap between the urban and rural representatives. Unless this gap is rectified, particularly the undue dominance of the urban women, in the capital city of Imphal, effective policy formulation and implementation would not have the desired result.

Thus, even if a state policy, to enhance the participation of women in self-governance is to be formed, over representation of women from Imphal city should be counter-balanced by giving proper and proportionate representation from different communities and region.

Party affiliation is not appreciated both in urban and rural elected bodies. However, there is a wide consensus to increase the women's quota to 50 per cent. Regarding the extension of the rotating quota system for two consecutive terms there is difference of opinion among the members. But many rural women representatives felt that the rotating quota system should be in force at least for two consecutive terms.

Uncooperative, meddlesome attitudes of politicians, bureaucratic red-tapism, withholding information regarding developmental programmes, and taking advantage of the ignorance of newly-elected women representatives, in a situation where the just imposed "new responsibilities" creates a friction in the smooth functioning of women representatives. These problems can be checked, many women representatives argued, if the funds are transferred directly to the elected local bodies.

The discriminatory attitude of male are compounded by the lack of respect for women candidates by women electorates. "Women are the only one who discriminates women. Unless and until the attitude of women electorate are changed there can be no substantive improvement in the status of women", echoed by many women councilors. Women's problems like maternity, hygiene, child-bearing, instances of rape and cases of incestuous relationship are still a taboo for open discussion. It is where the role of women figures in for effective role in self-governance.

Most of the women representatives agree that quota system is an epoch –making steps towards a meaningful role of women in the political decision-making process and the consequent role in self-governance. Many women representative felt the need to stem "duplicate," "proxy" or surrogate representatives. An effective mechanism should be developed to combat these fissiparous tendencies. Accordingly a fixed tenure for women representatives for a maximum of two terms like in the presidential election of the United States of America are being mooted to negate criminalisation of politics, influence of money and muscle power in political process. A conducive political culture can be nurtured if women's quotas are introduced in every political parties.

CONCLUSION

As a result, we may conclude that the presence of women in local governments encourages other women to pursue careers in a variety of fields and leads to the dismantling of stereotypes about women's responsibilities in society and public space. After watching women make a positive influence in other people's lives, people began to believe that women might be good public managers and local government representatives. Women's earnestness and commitment to their responsibilities, as well as their resistance to political criminality, are recognised by society.

Women's participation in decision-making has become more important as a result of the decentralisation of government that has occurred over the last two decades. The Indian government has placed a strong emphasis on improving gender budget measures in order to get the country closer to achieving gender equality.

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THE BENEFIT OF GOOD ACADEMIC LEADERSHIP TO TSHWANE NORTH DISTRICT PUBLIC SCHOOLS

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ABSTRACT

The research was a result of the need to critically assess and evaluate the quality of school level leadership in Tshwane North District public schools. Assessment of leadership skills was made by measuring the perception held by 147 teachers working in Tshwane North District public schools by using criteria set out by the standards of Skarlicky, Kay, Aquino and Fushtey (2017) for effective teaching and learning at the level of schools. About 82% of teachers indicated that the quality of school level leadership was adequate, whereas the remaining 18% of teachers indicated that the quality of school level leadership was inadequate. The results showed that the perception held by teachers on the quality of leadership was significantly influenced by a clear understanding of job description, the availability of helpful teaching materials and resources, and punctuality at work, in a decreasing order of strength.

Keywords: *Tshwane North District public schools, Quality of school level leadership, Odds ratios*

Introduction to Study

The study aimed to measure the perception held by teachers on the quality of school level leadership in Tshwane North District public schools. The population size of Tshwane is estimated at 3.6 million (Statistics South Africa, 2020). Tshwane North District is a suburb of Tshwane. The annual rate of growth of the population of Tshwane is equal to 3.76%.

The main purpose of study was to critically assess and evaluate the quality of school level leadership in Tshwane North District public schools by the standards of Skarlicky, Kay, Aquino and Fushtey (2017) for effective teaching and learning at the level of schools. There is a shortage of studies conducted in this area of research in Tshwane North District. As a result, it has not been possible to make decisions on leadership styles that are helpful for improving the quality of school level teaching and learning and job satisfaction among teachers working in Tshwane North District public schools. The aim of study was to fill the gap in the literature by conducting empirical research by collecting data from Tshwane North District public schools. Studies conducted by Motsodisa (2019), Worku (2019) and Shibiti (2020) have shown that the quality of teaching in the fields of English, mathematics and science is below standard in Tshwane North District public schools. The report shows that some of the key underlying causes of underperformance by educators are shortage of adequately skilled educators, lack of discipline at work, poor motivation at the workplace, lack of devotion to the basic needs of learners, lack of job satisfaction, and lack of work-related incentives for top-performers such as tailor-made training opportunities. The study conducted by Yang, Klotz, He and Reynolds (2017) shows that employees underperform in the absence of motivation and good leadership. Yang (2013) has argued that work ethics and discipline depend upon the quality of leadership at the workplace. Public schools that operate in resource-constrained working environments often employ educators who lack specialised skills and motivation (Zhang, 2017).

Zang, Wu, Yan and Peng (2014) have pointed out that failure to assess, evaluate and monitor the quality of performance by educators working in public schools is a key obstacle to the ability of public schools to provide affordable quality education to pupils who are enrolled in poorly resourced institutions of learning. Yadav and Yadav (2016) have listed down key indicators of underperformance in public schools that suffer from poor leadership and resource constraints. Based on a study conducted in Kuala Lumpur, Malaysia, Al Fahad (2013) has shown that leadership style and motivation at work are significantly associated with each other. Abbas, Raja, Darr

and Bouckenoogh (2014) have reported that political appointments, undue influence from trade unions and failure to adhere to discipline-related academic requirements often lead to poor education and the abuse of school resources. Arz and Farahbod (2014) and Batista-Taran (2016) have found that poor leadership at school level leads to poor academic quality. The authors have pointed out various negative consequences of poor academic quality in the teaching of mathematics and science to secondary school pupils. Turabik and Baskan (2015) have highlighted the numerous socioeconomic consequences of lack of motivation by educators. Sturman and Park (2016) have pointed out that the ability of educators to respect their working conditions and operational requirement is a critical factor for success. Srivastava and Banerjee (2016) have reported that the ability of pupils to master science and mathematics at primary and secondary school levels is the basis for adequate vocational and artisan skills in any society. Van der Westhuizen, Phacheco and Webber (2012) have listed down predictors of underperformance among public school educators and principals. The authors have shown that the quality of education deteriorates in schools where there is lack of leadership by good example. Based on a study conducted in Turkey, Top, Adkere and Tarkan (2015) have found that English writing skills are essential for mastering science and mathematics subjects in both public and private schools.

Public schools in Tshwane North District are relatively under-resourced in comparison with private schools (Motsodisa, 2019). Wang, Hall and Rahimi (2015) have listed down common causes of burnout and lack of job satisfaction among public school teachers working in developing nations. Trepanier, Forest, Fernet and Austin (2015) have proposed remedial actions for alleviating job dissatisfaction, low employee morale, lack of commitment to needy learners, low pass rates among learners, loss of productivity and lack of interest among public school teachers who work under stressful and resource-constrained working conditions. The need for intervention by the South African Government in underperforming public schools has been pointed out by Swanepoel, Erasmus, Schenk and Tshilongamulenzhe (2014), Webster (2015) and Taylor (2014). According to the authors, the stakes are quite high considering high failure rates in mathematics and science subjects and the lack of interest among senior secondary school pupils in mastering vocational and artisan skills.

Background to study

Spaull (2019), Clercq (2020), Motsodisa (2019) and Booysens (2020) have shown that the quality of education in South African public schools has deteriorated due to lack of leadership and poor competence in disciplines such as English, mathematics and science. Willis (2015), Motsodisa (2019) and Leppan, Govindjee and Cripps (2016) have shown that South African teachers' unions are responsible for frequent strike actions and absenteeism in poorly resourced public schools and low matric level pass rates in English, mathematics and science subjects. Studies conducted by Bush and Glover (2021) and Mosoge and Mataboge (2021) have shown that failure to monitor, evaluate and control teaching and learning activities has undermined the quality of teaching and learning in disciplines such as English, mathematics and science. Empowerment of the school management team by secondary schools principals in Tshwane Mukherjee and Uzzi (2020) have shown that success in mastering the art of writing English with proper grammar and syllables is a key requirement for success in mastering the art of mathematics and science subjects in elementary and secondary schools in developing nations.

Prinsloo and Harvey (2020), Chinn (2020) and Reus (2020) have shown that the ability of public school learners to write in English properly is a key indicator of success in subjects such as mathematics and science. There is a need for assessing and evaluating the ability of public school learners in Tshwane North District public schools to write English with proper grammar and syllables. The research conducted in the Netherlands by Verheijen, Spooren and Van Kemenade (2020) has found that the use of excessive social media undermines the ability of learners to write English properly with accurate grammar

use and syllables. Barrot (2021) has shown that social media is helpful for teaching English to learners of all ages effectively. However, the author has shown that social media must be used with strict discipline, purpose and focus in order to minimise distraction and potential harm to learners. The author has shown that adult supervision is essential.

Baloyi, Swanepoel and Venter (2019) have shown that lack of vocational and artisan skills are a result of failure to teach learners English, mathematics and science subjects properly at primary and secondary school level. Mosoge and Mataboge (2021) have shown that not enough is being done for alleviating the acute shortage of suitably qualified and adequately motivated teachers, mentors and educators in the fields of English, mathematics and science. Bush and Glover (2021) have shown that there is a dire need for highly skilled and motivated teachers and administrators in Tshwane North District public schools. Mosoge and Mataboge (2021) and Motsodisa (2019) have found that public schools operating in Tshwane District are characterised by lack of resources, inability to attract or retain talented and top-performing teachers in the fields of English, mathematics and science. Inability to teach English, mathematics and science properly undermines the quality of teaching vocational and artisan disciplines such as woodwork, metalwork, electricity, auto mechanics, industrial engineering, home economics, agriculture, carpentry, welding and painting. Mokgohlwe (2016) has pointed out that the teaching and mastery of mathematics, science and English is poorly prioritised and supported. There are very few partnerships and linkages between public schools in Tshwane North District and industry, business and government. Not enough research has been conducted in this area of research. There is a shortage of studies in which the relationship between social media use and English writing skills has been assessed and evaluated in Tshwane North District public schools. The study aims to fill the gap by conducting an empirical study in Tshwane North District.

Objective of study

The aim of study was to assess the quality of school level leadership in Tshwane North District public schools by the standards of Skarlicky, Kay, Aquino and Fushtey (2017) for effective teaching and learning at the level of schools. There is a shortage of studies conducted in this area of research in Tshwane North District. As a result, it has not been possible to make decisions on leadership styles that are helpful for improving the quality of school level teaching and learning and job satisfaction among teachers working in Tshwane North District public schools. The aim of study was to fill the gap in the literature by conducting empirical research by collecting data from Tshwane North District public schools.

Literature review

Msezane (2017) has conducted a study in Tshwane North District schools, and has found that there is an acute need for good leadership in all public schools. Doussy and Doussy (2015) have shown that matric pass rates in English, mathematics and science subjects are low in Tshwane North District public schools due to lack of good governance among members of School Governing Boards, the abuse of financial resources and the acute shortage of suitably qualified and motivated teachers in English, mathematics and science. Studies conducted by Motsodisa (2019) and Worku (2019) in Tshwane North District public schools have found that School Governing Boards in Tshwane North District public schools need to play a proactive role in the proper management of public schools, the recruitment of suitably qualified and highly motivated teachers on merit, and the enforcement of workplace discipline and ethical conduct. Mokgohlwe (2016) has argued that such a measure is essential to protect the rights of learners who are enrolled in public schools to be taught well and efficiently. The authors have pointed out the need for improving the quality of teaching subjects such as English, mathematics and science.

There is a shortage of adequately skilled and qualified teachers in the fields of English, mathematics and science in Tshwane North District public schools (South African National Department of Basic Education, 2021). Mokgohlwe (2016) and Motsodisa (2019) have recommended the provision of rewards and

incentives to dedicated teachers in Tshwane North District. Matric level pass rates in English, mathematics and science are low. Mtshali and Ramaligela (2020) have shown that high school graduates often lack vocational and artisan skills that are helpful for finding jobs upon graduation.

Huhta, Alanen, Tarnanen, Martin and Hirvela (2014) and Wang, Hall and Rahimi (2015) have reported the presence of a robust relationship between the quality of teaching English and the overall performance of learners at school level. The authors have pointed out that the ability to teach English properly leads to the ability to excel in the mastery of mathematics and science subjects.

Mabuza, Ogunbanjo, Hlabyago and Mogotsi (2018) have found that good writing skills in English are helpful for overall awareness and academic competence among school going learners in Tshwane District. Mafora (2018) has shown that the availability of good School Governing Bodies is highly helpful for ensuring proper teaching and learning in poorly resourced South African public schools. The author has argued that it is the duty of School Governing Bodies to work with teachers and learners effectively by way of showing responsible leadership and accountability to learners. Hallinger (2018) has argued that good leadership is essential in all South African public schools for ensuring value for money, high matric level pass rates, the proper teaching of English, mathematics and science.

McCarley, Peters and Decman (2016) have shown the potential benefits of transformational leadership in public schools operating under resource-constrained working environments. Northouse (2021) has argued that it is not possible to ensure quality teaching and learning without ensuring due respect for good leadership and accountability to learners. The author has argued that strict monitoring and evaluation as well as performance appraisal are essential in all South African public schools in order to restore quality education and accountability to learners.

Skarlicky, Kay, Aquino and Fushtey (2017) have shown that good school level leadership often results in the proper teaching of English in public schools. Sulaiman, Mohamad, Aziz, Khairuddin, Mansor and Alias (2020) have shown that good leadership enables English language teachers to work harder. The productivity of educators is significantly dependent upon the degree to which educators are led by example by their line function managers. Showing respect for the law and being persuaded by the best interest of learners are key elements of good leadership (Tatlah, Saeed & Iqbac, 2011). Educators are required to report for duty punctually, prepare up-to-date lesson plans, read and utilise updated teaching materials in class, mark assignments and tests promptly, provide feedback to learners, and attend workshops that are necessary for career path growth and professional development. They should also respect the basic rights of learners and abide by ethical and professional principles. Hallinger (2018) has pointed out key indicators of good leadership in public schools. Examples of such indicators are punctuality, devotion to learners, willingness to lead by example, the ability to mobilise parents and members of the community in order to improve pass rates among learners, and respect for the basic principles of good leadership.

Based on a comprehensive survey, Venter, Levy, Bendeman and Dworzanwski (2014) have provided examples of common causes of poor academic performance at school level. One of the key causes of underperformance is poor leadership style. Quality leadership is a key requirement for sustained academic performance and productivity at school level. Sound leadership at the level of schools is crucially needed for ensuring adequate performance by educators working in Tshwane North District schools. Good leadership at school level requires the ability to lead pupils by good example (Sullivan, Lonsdale & Taylor, 2014), commitment to learners (Tatlah, Saeed & Iqbac, 2011), the ability to enforce school level guidelines and regulations in the best interest of learners (Trepanier, Forest Fernet & Austin, 2015) and the ability to adhere to good governance principles (Skarlicky, Kay, Aquino & Fushtey, 2017). Venter, Levy, Bendeman and Dworzanwski-Venter (2014) have shown that good leaders balance labour rights fairly and objectively with the rights of learners and schools in order to ensure adequate performance at school level.

Wang, Hall and Rahimi (2015) have pointed out that the rights of pupils must be given priority by all stakeholders in order to ensure the mastery of critical skills. The mastery of skills in mathematics and science is a key performance indicator to South African pupils at primary and secondary schools.

Shared success at school level is a result of highly efficient leadership, the total commitment at work by educators, and the ability to follow local and international best practice on the principles of learning and teaching (Yadav & Yadav, 2016: 13-40). Yang (2013: 44-46) has argued that respect for the rule of law is helpful for achieving successful outcomes. Welter, Mitchel and Muysken (2014: 34-44) have found that the mastery of critical skills at the right age and school level is a key requirement for a productive youth population. The authors have argued that enforcing work discipline and total commitment to quality service delivery are essential for societies to be productive.

Schools in Tshwane North District have a duty to the youth in terms of enabling the youth to acquire and master quality school level education in all academic disciplines. Educators working in Tshwane North District schools have a duty to perform adequately for the sake of the youth. In order for educators to perform adequately, it is vital to institute good leadership and accountability. The study conducted by Shashaa and Al Taher (2020) shows the numerous benefits of teaching English properly at school level. The key benefits are the successful understanding of English grammar and syllables, the ability to read and understand textbooks in mathematics and science, and the development of self-confidence in presenting oral book reports in class. Azar and Tan (2020) have shown that the ability to write English well has the added benefit of doing well in writing computer programming languages. The authors have shown that the mastery of English grammar and syllables is a key requirement for developing self confidence among school going learners.

Methods of data analyses

Data was collected from 147 teachers working in Tshwane North District public schools by conducting a census of all eligible teachers working in Tshwane North District public schools. The study was quantitative in nature. The questionnaire of study was adopted from a questionnaire developed by Skarlicky, Kay, Aquino and Fushtey (2017) for conducting a similar study. Non-linear regression analysis (Bates and Chambers, 2017) was used for estimating parameters. Residual analysis was performed in order to ascertain the reliability of fitted models.

Results of data analyses

Table 1 shows the general profile of participants of the study. About 82% of respondents felt that the quality of school level leadership was good enough by the standards of Skarlicky, Kay, Aquino and Fushtey (2017) for effective teaching and learning at the level of schools. The percentage of teachers who were happy with the quality of school level leadership was equal to 82%. The remaining 18% of teachers were happy with the quality of school level leadership. The percentage of teachers with Master's degrees was 7%. The percentage of teachers with Bachelor's degrees was 47%. The percentage of teachers with Honours degrees was 10%. The percentage of teachers with diplomas was 30%. The percentage of teachers with post-matric certificates was 6%. About 51% of respondents had served for 5 years or shorter duration of time. Seven percent of teachers had served for 16 to 20 years at the time of study. Seven percent of teachers had served for 21 years or more at the time of study. All 147 educators who took part in the study were South Africans.

ssTable 1: General characteristics of respondents (n=147)

Variable of study	Frequency (Percentage)
Perception held by educators on the quality of leadership by the standards of Skarlicky, Kay, Aquino and Fushtey (2017) for effective teaching	**Adequate: 120 (81.63%)** **Inadequate: 27 (18.37%)**
Gender of respondent	Male: 88 (59.86%) Female: 59 (40.14%)
Age category of respondent	20 years or less: 17 (11.56%) 21 to 30 years: 18 (12.24%) 41 to 50 years: 44 (29.93%) 51 years or more: 8 (5.44%)
Highest level of education of respondents	Grade 12 or less: 1 (0.68%) Post-matric certificate: 9 (6.12%) Diploma: 43 (29.25%) Bachelor's degree: 69 (46.94%) Honours degree: 14 (9.52%) Master's degree: 10 (6.80%) Doctoral degree or above: 1 (0.68%)
Duration of service as educator in years	5 years or less: 75 (51.02%) 6 to 10 years: 34 (23.13%) 11 to 15 years: 18 (12.24%) 16 to 20 years: 10 (6.80%) 21 years or more: 10 (6.80%)
Nationality of educator	South African: 147 (100.00%) Foreigner: 0 (0.00%)

Table 2 shows frequency counts and percentages for the extent to which educators take pride in the teacher's profession. About 91% of educators take pride in the teacher's profession. About 92% of educators feel appreciated enough as an educator. About 91% of educators feel adored as an educator. About 88% of educators feel that they are provided with enough resources at the workplace so that they can do a good job. About 90% of educators do not feel stressed out in the course of their duties at schools. About 90% of educators uphold their values and guiding principles at all times. About 53% of respondents felt that they were being led by competent leaders at the workplace.

Table 2: Taking pride in the teacher's profession (n=147)

Variable of study	Frequency (Percentage)
Taking pride in the teacher's profession	Yes: 134 (91.16%) No: 13 (8.84%)
Feeling appreciated for work done as an educator	Yes: 135 (91.84%) No: 12 (8.16%)
Feeling adored for work done as an educator	Yes: 134 (91.16%) No: 13 (8.84%)
Enough resources are provided to educators at the workplace so that they can do a good job in their classrooms	Yes: 130 (88.44%) No: 17 (11.56%)
Educators are not stressed out in the course of their duties at school	Yes: 128 (89.80%) No: 15 (10.20%)
Educators uphold values and guiding principles at all times	Yes: 128 (89.80%) No: 15 (10.20%)
Educators are led by competent leaders at the workplace	Yes: 77 (52.38%) No: 70 (47.62%)

Table 3 shows frequency counts and percentages for the extent to which educators viewed their leaders at the workplace as objective leaders. About 73% of educators viewed their line function managers as objective leaders. About 44% of educators viewed their line function managers as considerate leaders. About 56% of educators

viewed their fellow colleagues as good team players. About 91% of educators viewed their line function mangers as honest leaders with personal integrity. About 92% of educators viewed their line function mangers as courageous leaders who take appropriate disciplinary action against underperforming subordinates. About 88% of educators viewed their line function managers as leaders who take decisions in the best interest of learners with no fear or favour at all times. About 52% of educators look for guidance from their line function managers at all times.

Table 3: Objective leadership at the workplace (n=147)

Variable of study	Frequency (Percentage)
Recognition of line function managers as objective leaders	Yes: 107 (72.79%) No: 40 (27.12%)
Recognition of line function managers as considerate leaders	Yes: 64 (43.54%) No: 83 (56.46%)
Recognition of educators as good team players	Yes: 83 (56.46%) No: 64 (43.54%)
Recognition of line function mangers as honest leaders with personal integrity	Yes: 134 (91.16%) No: 13 (8.84%)
Recognition of line function mangers as courageous leaders who take appropriate disciplinary action against underperforming subordinates	Yes: 135 (91.84%) No: 12 (8.16%)
Making decisions in the best interest of learners with no fear or favour at all times	Yes: 130 (88.44%) No: 17 (11.56%)
Looking for guidance from line function manager at all times	Yes: 77 (52.38%) No: 70 (47.62%)

Table 4 shows significant two-by-two crosstab associations (Montgomery, 2020) obtained from bivariate analyses. The table below shows that all 6 factors are significantly associated with inefficiency in the management of municipal solid waste at the household level.

Table 4: Significant bivariate associations (n=147)

Factors associated with good academic leadership at school level	Observed chi-square value	P-value
A clear understanding of job description	14.9039	0.000
Availability of helpful teaching materials and resources	12.6572	0.000
Punctuality at work	10.3286	0.000
Duration of service	8.9039	0.005
Availability of laboratory equipment	5.6572	0.008
Availability of library materials	4.3286	0.015

Table 5 shows the top 3 significant predictors of good leadership at school level obtained from multivariate analysis. Adjusted odds ratios (Pardoe, 2020) were used for identifying influential predictors of good leadership. The table shows that good academic leadership at school level is influenced by a clear understanding of job description, the availability of helpful teaching materials and resources, and punctuality at work.

Table 5: Predictors estimated from ordered logit analysis (n=147)

Predictors of good academic leadership at school level	P-value	Odds Ratio	95% C. I.
A clear understanding of job description	0.0000	8.14	(5.09, 11.47)
Availability of helpful teaching materials and resources	0.0000	7.36	(4.94, 9.87)
Punctuality at work	0.0000	5.19	(3.89, 7.14)

The theoretical reliability of the fitted logit model was tested by using standard goodness-of-fit tests (the likelihood ratio test, the percentage of accurate classification, and the Hosmer-Lemeshow goodness-of-fit statistic). The fitted logit model classified 80.88% of all cases accurately. The Hosmer-Lemeshow goodness-of-fit test gave a P-value of 0.1612.

This P-value is greater than 5%. It follows that the fitted logit model was reliable enough.

Discussion of results

The study has found that good academic leadership at school level depends upon the extent to which teachers have a clear understanding of their job descriptions, the availability of helpful teaching materials and resources at schools, and the extent to which teachers are punctual at work. A good leader must have the necessary skills, dedication, and good character, to mould the school community, but most importantly have the ability to manage the talent of its staff. Schools spend money on the development of its employees and want to benefit from their improved skills. It will be cost-effective for schools to retain their employees and benefit from their improved skills. There is a great need to recruit and retain good teachers because the ability of public schools to attract and retain talented teachers is a key predictor of productivity and sustained growth in the education sector (Keles, McCrae & Grealish, 2020).

The study has found that 18% of the 147 respondents of study were not happy with the quality of school level leadership in their public schools. School leaders must interact with their subordinates and fellow colleagues alike in a professional and ethical manner. They need to be consistent, friendly, open, transparent and truthful about key issues that affect the quality of teaching and learning. They must be humble and easily approachable to all during working times. They must be loyal to their learners and their parents in terms of ensuring proper teaching and learning. They must be prepared to lead by example. Good school level leaders often mobilise enough resources that are required to do well on the line of duty. Although doing so often comes at a huge personal sacrifice, good leaders are quite happy to pay such a price for the pleasure of achieving tangible success and high pass rates.

The ability to administer and lead public schools has a significant influence upon the future of South African youth. The case of South African public schools is unique in light of the legacies of apartheid and the apparent failure of the South African Government to close the gap between private and public schools with regards to the teaching and mastery of key disciplines such as mathematics, science, and vocational, technical, industrial and artisan subjects. In comparison with private schools, South African public schools are relatively poorly resourced and administered. The failure of public school graduates to master and internalise practical skills makes it impossible for them to be employed in industry and business. Utama and Hidayatullah (2020) have shown that poor quality of education in public schools is a key obstacle to sustained growth and development in developing economies. Wollscheid, Sjaastad and Tomte (2016) have shown the benefits of adhering to rules and guidelines in public schools. The author has shown that good leaders often encourage educators to respect the rights of learners and their parents. At present, public school educators working in Tshwane North District feel demoralised due to lack of support from the relevant stakeholders. Public schools in Tshwane North District have failed to retain good teachers. Incentives must be provided to educators working in Tshwane North District public schools as a means of retaining good and talented educators (Mafora, 2018).

The study conducted by Prinsloo and Harvey (2020) has shown that the provision of incentives to top-performing educators is quite helpful for staff retention. Examples of good incentives are workplace skills based training opportunities. Northouse (2021) has shown that the provision of specialised training opportunities to top-performing teachers is helpful for encouraging productive employees in service delivery institutions. Public schools often lose their talented teachers to well-resourced private schools. This is mostly because public schools lack the financial resources for competing with private schools. Effective school leadership is an important solution to teacher retention, which has been proven by its consistent appearance, as the most important subject in working conditions in a survey conducted by Hallinger (2018). The author has shown that educators must be able to experience job satisfaction in order to show loyalty to their learners. It follows that the

working environment must be economically enabling and productive. Educators must be provided with clear job descriptions so that they can focus on their key performance indicators.

One of the biggest difficulties experienced by public schools operating in Tshwane North District is inability to attract and retain talented teachers. Incidents of abuses among educators and learners, the destruction and abuse of library books, laboratory equipment, chairs, desks, classrooms and computers, and lack of respect for principals and school administrators have been reported in the media. Talented teachers have left public schools in Tshwane North District in large numbers for better resourced and well managed schools. Schools are used to convey values to people. Chinn (2020) has argued that the ability of public schools to teach mathematics well depends upon the degree of commitment shown by individual teachers and their learners. The author has argued that teachers must be able to motivate their learners to appreciate mathematics classes. The author has highlighted the need for enthusiasm in the teaching of mathematics to public school learners. Having an effective school can be seen as the lifeblood of every principal and highlights the type of leadership style used by the principal to bring about an effective school. An effective school results in high academic achievement and teacher satisfaction. The Principal as the leader of a learning institution plays a pivotal role in making his or her school effective and functional. The principal is the centre of attraction to the school community. Principals in their roles as head of the institution must lead by example (Hallinger, 2018).

The annual report issued by the South African National Department of Basic Education (2021) for the financial year 2019/2020 highlights the key obstacles to satisfactory performance and pass rates in South African public schools. Examples of such obstacles are low morale of educators, lack of good school level leadership, shortage of resources and teaching materials, and the absence of an enabling working environment. The report acknowledges the basic needs of under-resourced and poorly equipped public schools, especially in rural areas. Based on a study conducted in Vietnam, Truong, Hallinger and Sanga (2017) have shown that failure to adhere to recommended rules and guidelines in public schools often leads to anarchy, poor pass rates and the loss of employee morale. A lot of money and time has been spent on the new hire with a view that he will be an investment which will bring returns in future. When the employee leaves the organizational investment is not realised. In Tshwane North District public schools, customer services are often poor and less than professional. The degree of work ethics shown to learners by their educators is often less than professional. Public schools have failed to retain good educators. Educators have been characterised by loss of morale, lack of punctuality and failure to upgrade their levels of knowledge and education. Lack of professionalism and inability to care for educators often leads to the loss of productive educators. Vangrieken, Meredith, Packer and Kyndt (2017) have argued that productive educators working in public schools must be provided with opportunities to upgrade their level of knowledge on a regular basis, and that their employers should support such educators by creating an enabling working environment in which they are duly respected and valued. According to Leu, Kinzer, Coiro, Castek and Henry (2017), the task of retaining productive educators working in under-resourced public schools is a key challenge in most developing nations such as South Africa. The retention of productive educators is a key priority of the South African National Department of Basic Education (2021). The study conducted by Alfahad, Alhajeri and Alqahtani (2013) in Malaysia shows that investing in the career paths of productive educators working in public schools is a proven strategy of retaining highly productive educators working in public schools. Private schools often compete with public schools with regards to talented and hardworking educators. Private schools that operate in the various parts of Gauteng Province are known for poaching talented educators from public schools by offering them better salaries and improved working conditions.

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TRAFFIC IMPACT STUDY OF PROPOSED DEVELOPMENT- CASE STUDY OF PORT JUNCTION ON NH-17

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ABSTRACT

A Traffic Impact Assessment (TIA) is done to analyse the effect of proposed developments on existing road condition at present and future conditions of traffic in roadways and junction identified in study area. The traffic surveys and O-D surveys have been done to collect primary data. The peak hour volumes and Average Daily Traffic has been worked out from these surveys. The data is analyzed to find out the existing traffic & travel characteristics of project influence area and to determine the travel demand on the existing transport network & junction due to development of various industrial developments i.e. [MSEZ].

The Traffic Projection has been carried out to workout Capacity of all road links leading to Port junction and to propose recommendations on how to relieve and accommodate such impacts in an efficient and effective manner. Improvement proposals for junctions to be recommended based on junction traffic, adjoining land use and physical constraints.

Keywords: *TIA, MSEZ, ADT, Traffic Projection*

Introduction

Any proposed development both residential and commercial influence changes in the traffic conditions in adjoining areas and all roads leading to highway including highway junctions nearby proposed developments. The micro level analysis will change the junction designs to a great extent and avoids huge capital loss and expansion of junctions at early period. The effect of proposed developments has to be analyzed before the proposed development is implemented to check its severity on traffic conditions for public transport and private vehicles. The proposed Mangalore Special Economic Zone (MSEZ) and Existing developments near port junction will be a case where in the future traffic leading and diverging from will influence the port junction on National Highway.

About Study Area

The project is planned to be developed across approximately 4000 acres, about 1800 acres of which is already in possession of the developer - Mangalore Special Economic Zone Limited (MSEZL). Development of the sector-specific SEZ in the 1800 acres is in progress as part of Phase-I of the project implementation is well underway with some of works already completed and some ongoing. A number of works packages are in the procurement stage at present. They are also working to be planned and designed and implemented. The project site is shown in Figure 1

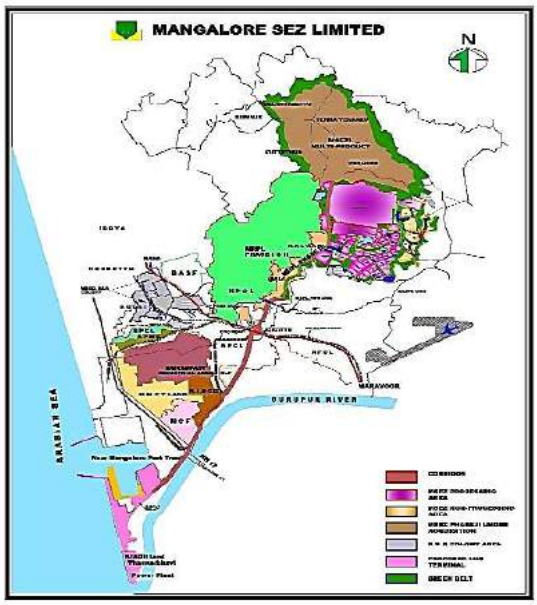
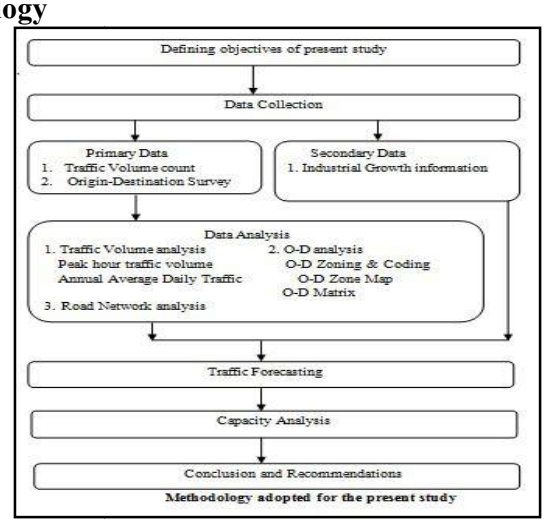


Figure 1 Mangalore Special Economic Zone Processing Area

Objectives of the Present Study

1. Studying of traffic and travel characteristics of project influence area.
2. To determine the travel demand on the existing transport network & junction due to development of various industrial developments. i e. MSEZ.
3. To evaluate the impact of future travel demand on existing road network.
4. Capacity analysis of port junction on NH-17 and all road links leading from various industrial developments. And deciding the priority for improvement and expansion of roads.

Methodology



Methodology adopted for the present study

Data Collection

The traffic characteristics plays an important major role in planning, design and management of highway system, in order to analyse the traffic and travel characteristics of the traffic movement of the all-vehiclesdata's are collected at the port junction. The data collection which includes primary and secondary data.

The traffic from all arms (roads) leading to the port junction is divided in to 4links, link A is the road from mangaluru to junction, link B is NMPT to junction, link C is udupi to junction and link D is MSEZ to junction. The link A and link B are from mangaluru to udupi (i e NH-17) road have 4lanes divided two

directional flow and link C and link D **have** 2lane undivided two-way traffic.

Figure 2 Survey Locations & Directions at the Port Junction

a)Traffic Volume Count Survey: Traffic surveys are conducted in order to get primary traffic data from the study area i e. port junction. Traffic surveys like traffic volume count for all links and O-D survey for link D (i.e., Towards MSEZ and from MSEZ) were carried out to assess the traffic characteristics and creating the data base for development of traffic forecasts. The vehicle classification system adopted for conducting the traffic volume counts along with respective Passenger Car Unit (PCU) factors, as recommended by Indian Road Congress in "Guidelines for Capacity of Roads in Rural Areas" (IRC: 64-1990)are presented in Table 1.

Table 1 Recommended PCU Factors for Vehicles as per (IRC: 64-1990)

Sl. No	Vehicle Type	PCU
1	Two-wheeler	0.5
2	Car, Auto-Rickshaw, Van	1.0
3	Mini Bus / LCV	1.5
4	Standard Bus/Trucks	3.0
5	Multi Axle Vehicle	3.0
6	Truck-Trailer	4.5
7	Agriculture Tractor	1.5
8	Agriculture Tractor & Trailer	4.5

b) Road Side Interview (O-D Survey): In order to understand the travel pattern of the all the vehicles which are entering in to project corridor, the Origin and Destination (O-D) survey was carried out at the port junction. The vehicles moving towards MSEZ and from MSEZ are interview to get the required information. The survey was conducted by adopting roadside interview method by stopping all fast-moving vehicles on a random sample basis. Roadside interview method, as recommended in IRC: 102-1988, was used.

Secondary Data

The secondary data is important to forecast the traffic. So, it is required to collect economic growth information from each industry, which are well connected to the project corridor and industry growth information for both passenger and goods vehicles were collected.

Industrial Economic Growth Information (Based on Industrial Output)

The growth rate of vehicles in the project corridor is collected by visiting to the industries and interviews them regarding the economic growth rate based on industrial outputs. For link A and C, the growth rates are workout from the past traffic records. The following industries are well connected to the project corridor. The industrial growth information is listed

Table 2 Growth Rates

Sl No	Links	Growth Rates (%)

		Passenger Vehicles	Goods Vehicles
1	Mangaluru to Junction	8-10	5-8
2	NMPT to Junction	6-8	5-10
3	Udupi to Junction	8-10	5-8
4	MSEZ	5-9	5-10
5	OMPL	7-8	5-7
6	MRPL	5-8	5-7
7	Katipalla-MRPL Gate E	5-8	5-8
8	HPCL	5-8	5-8
9	Jokatte	6-9	5-8
10	Thokur	6-7	5-7
11	Total Oil India Pvt. Ltd.	5-7	5-7

Data Analysis

Peak Hour Volume Analysis

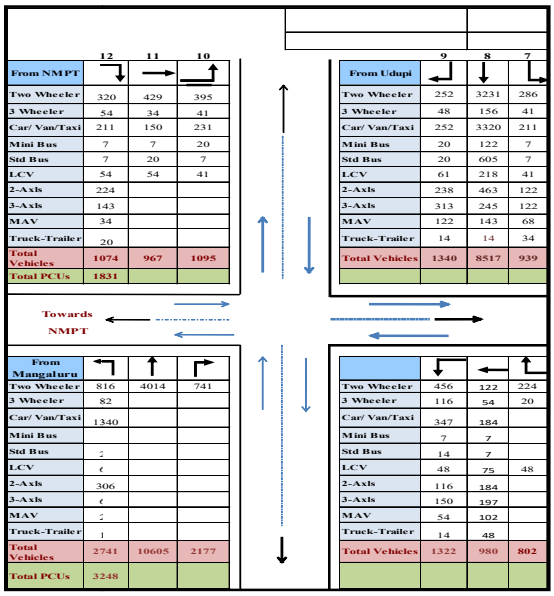
In order to assess the type of junction treatment needed, turning volume counts are essential.

Peak Hours at Junction: Peak hour volume count survey were conducted at the port junction. The classified volume count survey was carried out for a period of 6 peak hours in the morning 3 peak hours and evening 3 peak hours at all directions on a normal 2 working days and 1 week end during the month of February 2015.

Peak Hour Traffic Composition:

volume traffic composition at
from the traffic enters in to the
the various traffic vehicles per
passenger vehicles traffic is
vehicles traffic is 24%. Shown

Table 3 Annual Average Daily Traffic (AADT)



	12	11	10
From NMPT			
Two Wheeler	320	429	395
3 Wheeler	54	34	41
Car/ Van/Taxi	211	150	231
Mini Bus	7	7	20
Std Bus	7	20	7
LCV	54	54	41
2-Axls	224		
3-Axls	143		
MAV	34		
Truck-Trailer	20		
Total Vehicles	1074	967	1095
Total PCUs	1831		

	9	8	7
From Udupi			
Two Wheeler	252	3231	286
3 Wheeler	48	156	41
Car/ Van/Taxi	252	3320	211
Mini Bus	20	122	7
Std Bus	20	605	7
LCV	61	218	41
2-Axls	238	463	122
3-Axls	313	245	122
MAV	122	143	68
Truck-Trailer	14	14	34
Total Vehicles	1340	8517	939

Towards NMPT

From Mangaluru			
Two Wheeler	816	4014	741
3 Wheeler	82		
Car/ Van/Taxi	1340		
Mini Bus			
Std Bus			
LCV			
2-Axls	306		
3-Axls			
MAV			
Truck-Trailer	1		
Total Vehicles	2741	10605	2177
Total PCUs	3248		

Two Wheeler	456	122	224
3 Wheeler	116	54	20
Car/ Van/Taxi	347	184	
Mini Bus	7	7	
Std Bus	14	7	
LCV	48	75	48
2-Axls	116	184	
3-Axls	150	197	
MAV	54	102	
Truck-Trailer	14	48	
Total Vehicles	1322	980	802

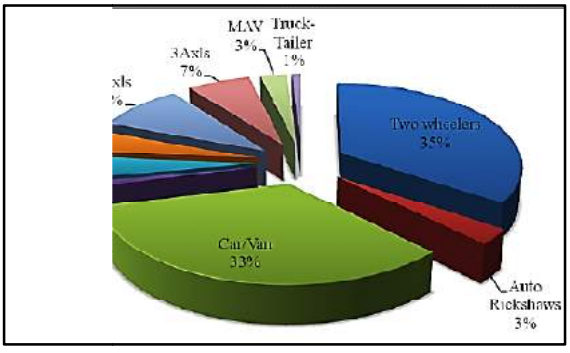


Figure 3: Peak Hour Vehicle Compositions at the Junction

Average Daily Traffic (ADT)

To calculate ADT it is necessary to collect 7days 24hours data at port junction. Due to restrictions we theirself's, difficult to collect the 24*7 hours data. So for calculating ADT the peak hour % volume is taken from 24*7 hours traffic volume data which is collected near the study area, because the traffic flow characteristics for junction and highways are same, so as the peak hour % volume is workout from 24*7 hours data (i e, 14.7%).

Where,

ADT- Average Daily Traffic

Peak Hour % volume - Collected from the 7days 24 hours data (i e.14.7%)

Peak hour volume – Present junction peak hour volume data.

Annual Average Daily Traffic (AADT): To calculate AADT the ADT is multiplied with seasonal factors. So, in the present study we are assuming seasonal factor is 1, because the fuel sales data were not available, so the in this study ADT=AADT.

Table 4 Annual Average Daily Traffic (AADT)

AADT(No's) 32559

AADT in PCU 43572

From NMPT	12	11	10
Two Wheeler	320	429	395
3 Wheeler	54	34	41
Car/ Van/Taxi	211	150	231
Mini Bus	7	7	20
Std Bus	7	20	7
LCV	54	54	41
2-Axis	224	143	156
3-Axis	143	75	129
MAV	34	41	48
Truck-Trailer	20	14	27
Total Vehicles	1074	967	1095
Total PCUs	1831	1390	1703

Towards UDUPI

From Udupi	9	8	7
Two Wheeler	252	3231	286
3 Wheeler	48	156	41
Car/ Van/Taxi	252	3320	211
Mini Bus	20	122	7
Std Bus	20	605	7
LCV	61	218	41
2-Axis	238	463	122
3-Axis	313	245	122
MAV	122	143	68
Truck-Trailer	14	14	34
Total Vehicles	1340	8517	939
Total PCUs	2690	10033	1577

Towards NMPT

Towards MSEZ

From Mangaluru	1	2	3
Two Wheeler	816	4014	741
3 Wheeler	82	265	41
Car/ Van/Taxi	1340	3701	735
Mini Bus	7	129	14
Std Bus	20	707	7
LCV	68	605	102
2-Axis	306	585	279
3-Axis	68	415	150
MAV	20	143	88
Truck-Trailer	14	41	20
Total Vehicles	2741	10605	2177
Total PCUs	3248	12810	2983

Towards Managluru

From MSEZ	4	5	6
Two Wheeler	456	122	224
3 Wheeler	116	54	20
Car/ Van/Taxi	347	184	190
Mini Bus	7	7	14
Std Bus	14	7	7
LCV	48	75	48
2-Axis	116	184	136
3-Axis	150	197	109
MAV	54	102	34
Truck-Trailer	14	48	20
Total Vehicles	1322	980	802
Total PCUs	1839	2108	1363

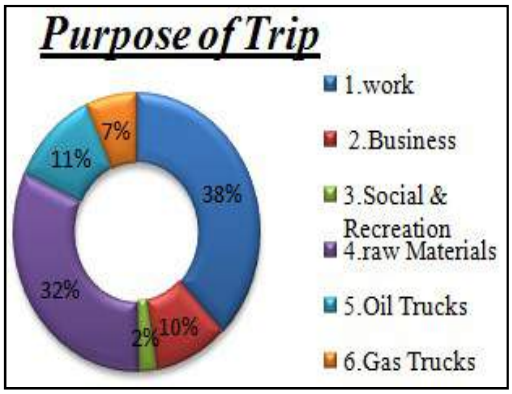
Origin-Destination Survey Analysis

In order to know the travel pattern of each vehicle entering in to the project corridor Link D (i e Towards MSEZ and from MSEZ) in the study area, origin and destination survey is carry out at the junction.

Trip Purpose: The trip details collected were analyzed for the purpose of travel. The distribution of trips by purpose is presented in Table 5.

Table 5 Purpose wise Distribution of Vehicles

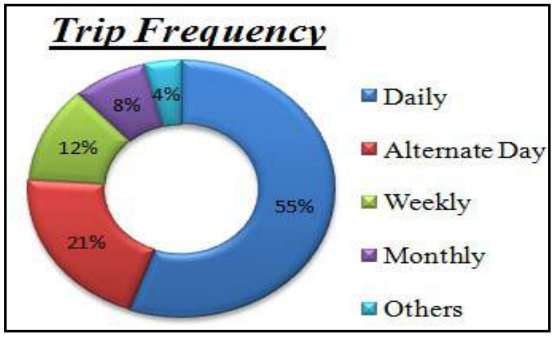
Sl No	Purpose	Share (%)
1	Work	37.6
2	Business	7.3
3	Social & Recreation	3.0
4	Raw Materials	31.8
5	Oil Trucks	11.8
6	Gas Trucks	8.5
	Total	**100.00**



Trip Frequency: The trip frequency details are collected were analyzed for the usage of mode. The distribution of trips by frequency is presented in Table 6.

Table 6 Trip Frequency Wise Distribution of Vehicles

Sl No	Trip Frequency	Share (%)
1	Daily	55.5
2	Alternate Day	20.6
3	Weekly	12.1
4	Monthly	7.9
5	Others	3.9
	Total	100.00



Road Network Analysis: The trip analysis is a process of the assignment of trips from various developments to nearby road links, from the trip matrices to know the capacity of the links.

The road network analysis is done based on the dividing the study area road network into 4link. As shown in Figure 4

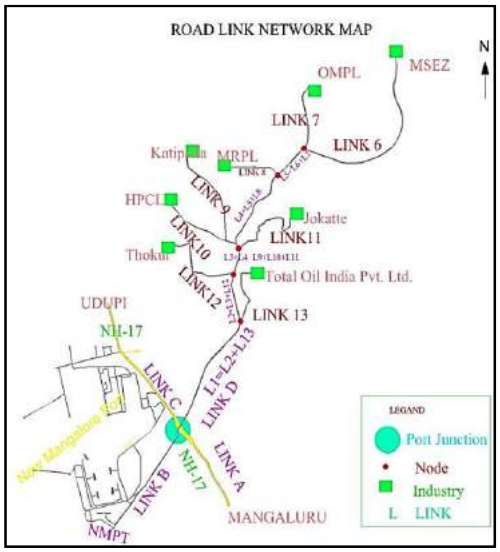


Figure 4 Road Link Network Map

Traffic Forecasting

Link Wise Traffic Forecasting: In the present study traffic data is forecasted analyse know the existing traffic in the links & travel characteristics of project influence area and to determine the travel demand on the existing transport network and junction due to development of various industrial developments. As per IRC: 108-1996 the traffic if forecasted by using the following formula.

$Pn=P0\ (1+r)\ n$

Table 7 Trip Frequency Wise Distribution of Vehicles

Sl no	Direction	Link	AADT in (No's)	AADT in (PCU)
1	Mangaluru to Port Junction	A	26436	32740
2	NMPT to Port Junction	B	8197	12968
3	Udupi to Port Junction	C	23298	30173
4	LINK1=(L2+L17)	1	7187	11259
5	LINK2=(L3+L12)	2	6664	10278
6	LINK3= (L4+L9+L10+L11)	3	5932	9263
7	LINK 4=(L5+L8)	4	3567	5821
8	LINK 5=(L6+L7)	5	2182	3375
9	MSEZ (LINK 6)	6	1406	1977
10	OMPL (LINK 7)	7	776	1398
11	MRPL (LINK 8)	8	1385	2446
12	Katipalla-MRPL Gate E (LINK 9)	9	758	1240
13	HPCL (LINK 10)	10	933	1255
14	Jokatte (LINK11)	11	674	947
15	Thokur (LINK 12)	12	732	1015
16	Total Oil India Pvt. Ltd. (LINK 13)	13	523	981

Capacity Analysis

The Capacity analysis has been essential for Link A, B, C, & D, Capacity analysis was intended to provide information on a set of performance measures for each link, and the capacity-related performance measures include traffic volume and future travel demand and performance measures were estimated for a period of 30 years. As per IRC: 64-1990, IRC SP: 84 & IRC SP: 87 have been used for limiting design service volume for two lanes, four lane, six lane and eight lanes as shown in below.

Table 8 Capacity of Port Junction

Direction	AADT (No of Veh/day)	AADT (PCU/day)
Mangalore to Junction	26436	32742
NMPT to Junction	8197	12968
Udupi to Junction	23298	30175
MSEZ to Junction	7187	11260
Capacity of Port Junction	**65118**	**87144**

Conclusion

1. The traffic at the port junction by combining all links in year 2015 is 3631 PCU/hour.
2. The port junction will reach 10,000 PCU/hour by combining all links in the year 2028.
3. As per IRC: 92-1985 An interchange may be justified when an at-grade intersection fails to handle the volume of traffic resulting in serious congestion and frequent choking of the junction.
4. This situation may arise when the total traffic of all arms of the junction is exceeds of 10,000 pcu's per hour. Hence it is recommended an interchange in terms of grade separation at port junction have a full clover leaf or a partial clover leaf is not possible due to land availability restriction hence a simple grade separated with restriction control on right turning rams.
5. The grade separated is provided to improve the facilities without interfering the traffic flow on NH-17.

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SMART BUS TERMINAL STATION – A CASE STUDY IN YELAHANKA OLD TOWN SATELLITE BUS STATION

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ABSTRACT

Because of stochastic traffic conditions and changed interest, travel passengers regularly endure with the inconsistent administrations. Mainly for buses, keeping on-time plans is challenging as they share the option to proceed with non-transit traffic. people who utilize the inner-city public transportation vehicles need to know the data about the current status of the public transportation vehicles and they need to get the movement time of the vehicles both while waiting and going at the smart bus station. Predicting and giving information about bus appearances time to travellers precisely is a very vital part of advanced public transportation frameworks, a major functional area of intelligent transportation systems. However, the information provided to passengers ought to be dependable. The road chosen for this specific study fall under the comparable issues looked by the areas of Bangalore are Kempegowda Bus station (KBS), Basaveshwara Bus Station (BBS) and Shantinagara Bus station (SBS). In this road stretch have no traffic signals, even with the presence of intersection. So, the present study, traffic volume count was conveyed to identify the which routes are used most, and to improve the excessive amount of traffic. For this passenger car unit and vehicle composition is calculated, curves, bar charts, pie charts are plotted. The performance of Smart bus station is considered rather than on-time performance, passenger travel time among others. The project will help to reduce the significant waiting time for buses at the bus station and detect the over speed of the buses thereby reducing the road accidents and traffic jam.

Keywords: *KBS, BBS, SBS, PCU*

Introduction

The bus station is a structure where intercity buses stop to pick up and drop off passengers. While a bus station can also be referred to as a bus depot, it is also referred to as a bus garage. The bus stop is smaller than the bus station, which is usually merely a place on the side of the road where buses can wait. Smart bus stations are made from repurposed metals and other recycled materials, and they respond in real time to customer inquiries, bus schedule changes, and traffic conditions to keep passengers informed about their journey's progress. LED signs displaying bus numbers and a continuous “next buses” appearance time are among the smart bus station's amenities. Trip planner, map of nearby bistros, Restrooms, flagons, booking work environments, latrines, drinking water, Enquiry counter, public region structure, seats, benches, and so on; Restrooms, flagons, booking work environments, latrines, drinking water, Enquiry counter, public region structure, seats, benches, and so on; Fare Collection System that is Automated. Reactions to changes in bus schedules in real time: In a smart bus stop, computerised screens showing the details of impending bus travels are a typical element.

Objectives of the Study

1. To identify the existing bus routes network in the study area and enhance bus tracking system along with the routes to improve smarter bus transport system.
2. To provide accessibility of bus timings for public by displaying digital boards with seating capacity as like smart digital boards.
3. To know the impact of satellite bus station on vehicular traffic of adjoined roads.
4. To check the passenger’s facilities at terminal station and its optimum usage and

recommending for smarter facilities like online ticketing system by using mobile application / website and other facilities such as children play area, food court, smart parking space, automized lift for physically challenged people.

Study Area Location

The study area of smart bus station at satellite Yelahanka old town is of 32000sft and parking available of 40000sft. Near by the railway station of 1.8km. It is in a Bangalore city. Yelahanka old town bus station near by bus stops are Yelahanka Santhe, Yelahanka NES, Yelahanka police station, and Sheshadripuram college. Yelahanka old town bus station is geographically located at latitude 13 degree and longitude 13degree.

Figure 1Yelahanka Old town Bus Station Map

Figure 2 Photo of Yelahanka Old town Bus Station

Methodology

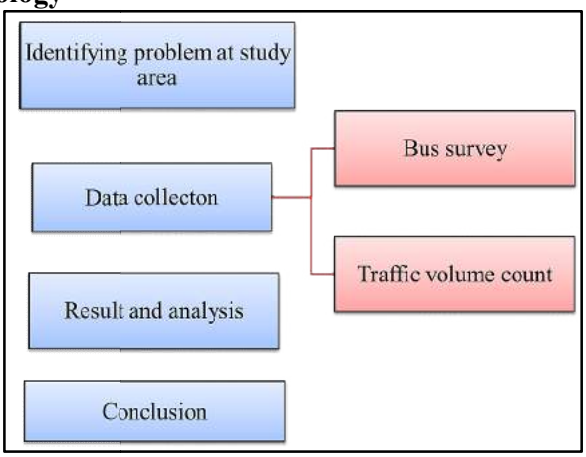


Figure 3 Flow Chart of Study

Data Collection

• Bus Survey: Self-completion questionnaires can be filled in by numerous passengers at the same time, which considers a far greater number of responses to be collected. For this bus survey the Self-completion questionnaire distribution method, by questioning the bus conductor, drivers, and to TTC. To find the details of the bus routes, trips, total buses, bus stops, costs and the distance.

Table 1 Bus Details in Yelahanka Old Town

SL No	Routes	Bus No's	Total Buses	Bus Stops	Trips
1	Yelahanka To Yeswantpur	401E,401k,401R, 401B	19	25	30
2	Yelahanka To R.P.C Layout	401RB	17	51	72
3	Yelahanka To Kengeri	401kA,401JB	50	80	22
4	Yelahanka To R.R. Nagar	401R	21	65	74
5	Yelahanka To Chandra Layout	401E	3	54	21
6	Yelahanka To Bapuji Nagar	401B,401R	2	53	4
7	Yelahanka To Nelamangala	401AN,407R	9	53	6
8	Yelahanka To Nagawara	290E,290Z	20	18	-
9	Yelahanka To Shivaji Nagar	290E	51	35	50
10	Yelahanka To K.R. Market	284 K,410	10	30	10
11	Yelahanka To Majestic	290EY,402B	6	25	6
12	Yelahanka To Hoskote	289F,280F	8	41	13
13	Yelahanka To K.R. Puram	507ADY	6	14	8

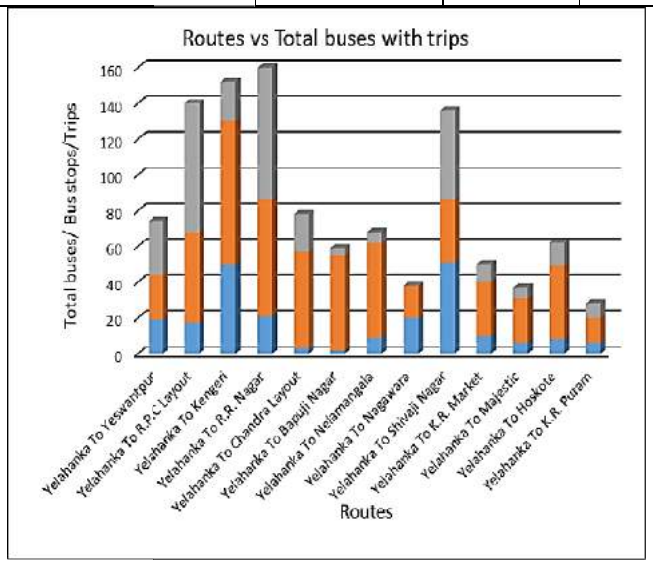


Figure 4 Graph of Route vs total buses with Trips

• Traffic Volume Count: Traffic Volume Count is checking of numerous of vehicle passing through a street over a period of time. The main objective of traffic survey is to determine of vehicle composition in traffic stream and Passenger Car Unit (PCU) to find out the Level of Service of the street and related characteristics like traffic jam, conveying limit,

Data on Total Number of Vehicle and PCU Value

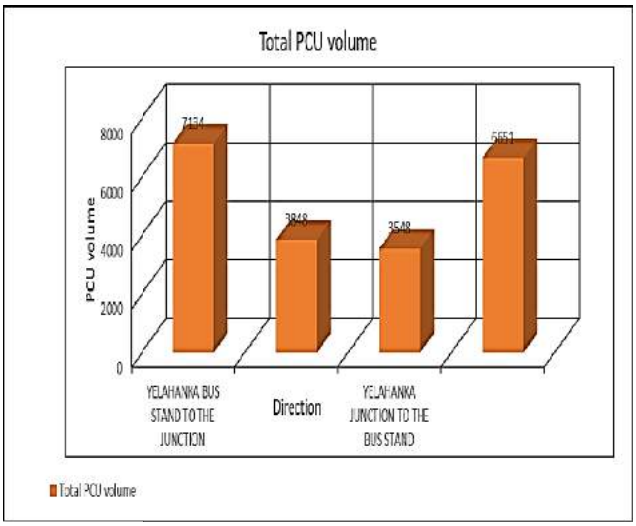


Figure 5 Graph .1

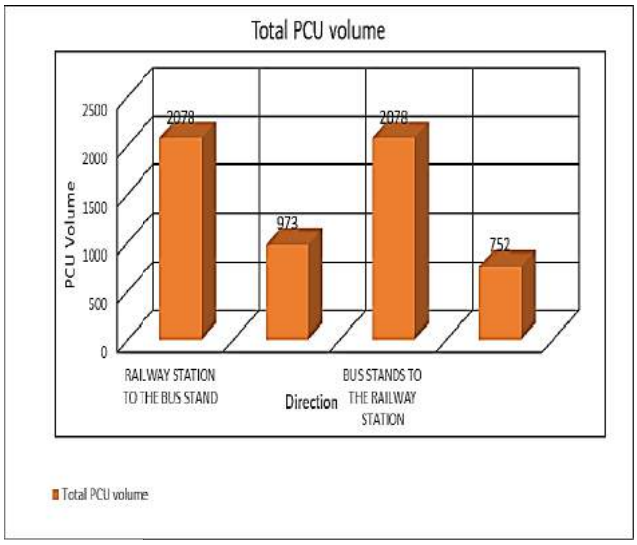


Figure 6 Graph .2

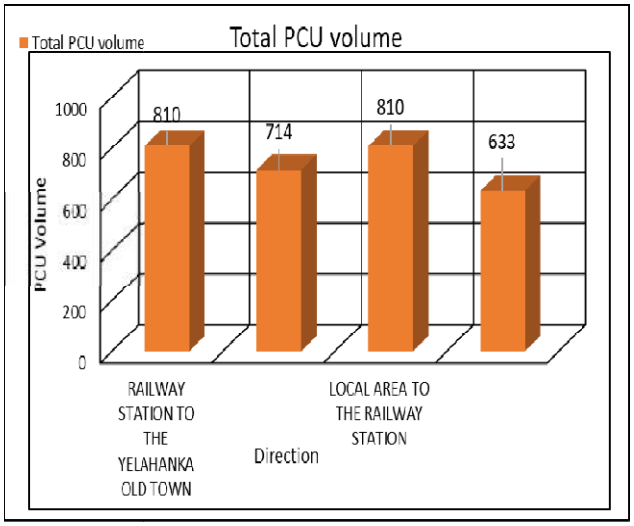


Figure 7 Graph .3

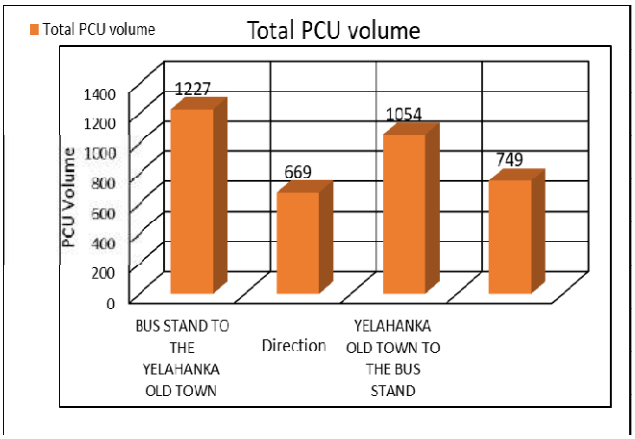
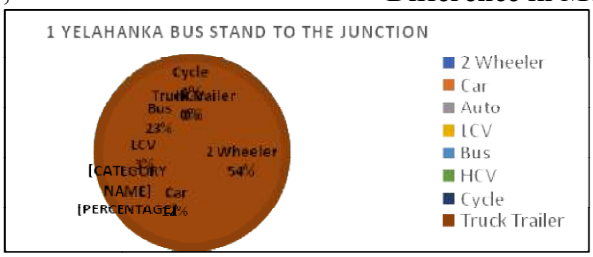
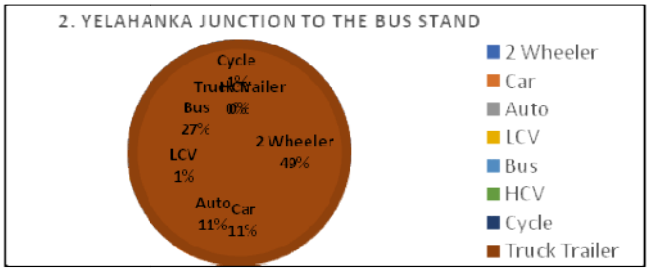


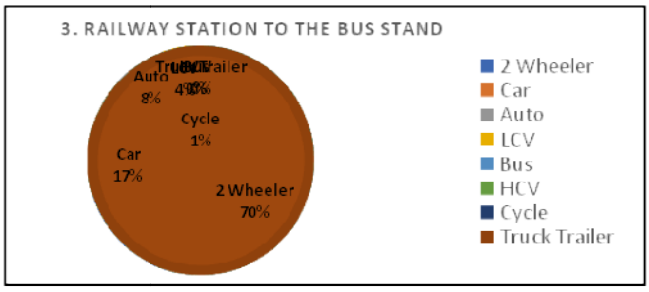
Figure 8 Graph .4

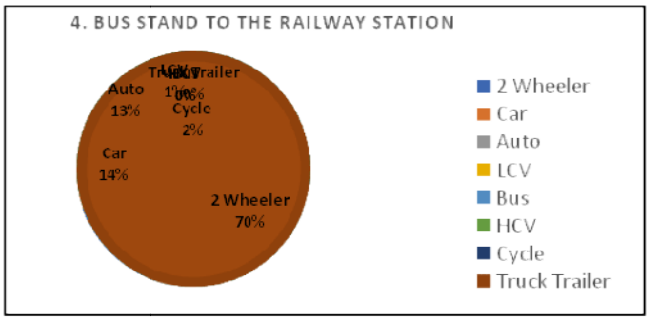
As per this bar graph and data collection, the PCU is more in these directions only, from the routes of Yelahanka junction to the bus station and the bus station to the Yelahanka junction. In peak hours, more vehicles are moving from the train station to the bus terminal, whereas during non-peak hours, less vehicles are moving. On weekends, we see even more vehicles. Graphs 1,2,3,4 showing directional traffic volume with respect to weekend and weekday traffic.

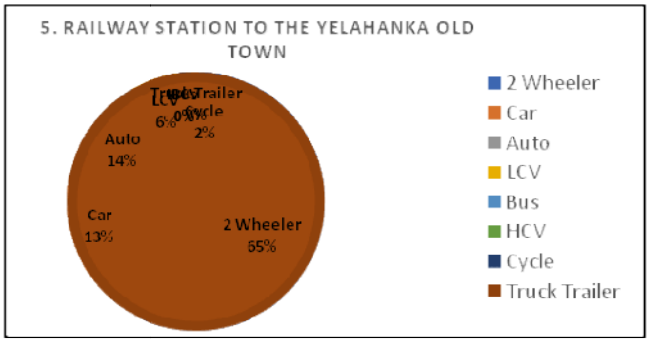
Graphical Representation on Vehicular Composition
Difference in Morning Peak Hours

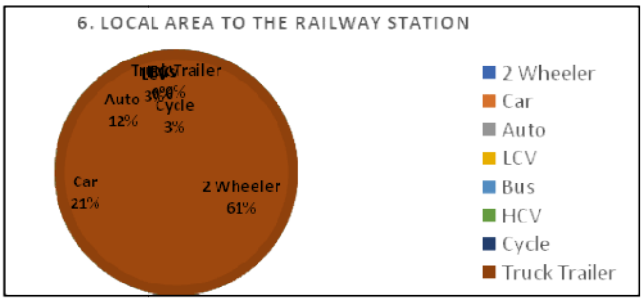


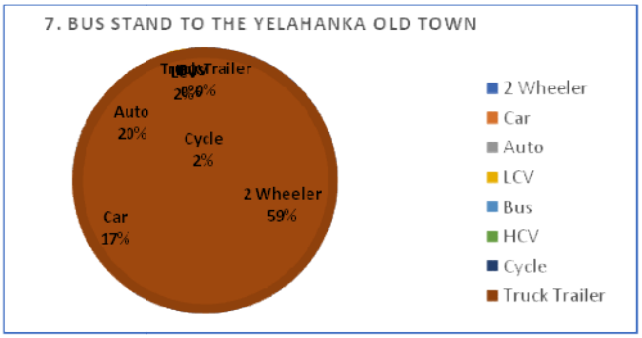


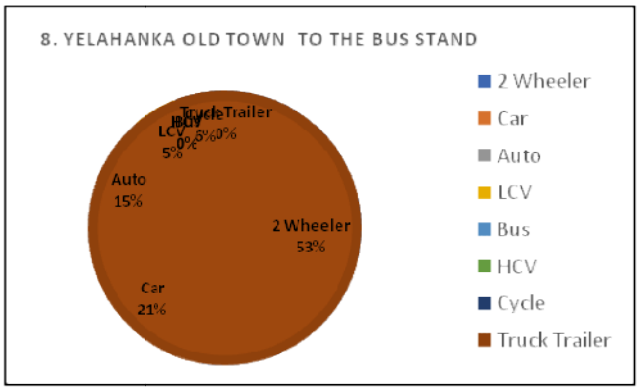



4. BUS STAND TO THE RAILWAY STATION
Auto 13%
Cycle 2%
Car 14%
2 Wheeler 70%
2 Wheeler
Car
Auto
LCV
Bus
HCV
Cycle
Truck Trailer

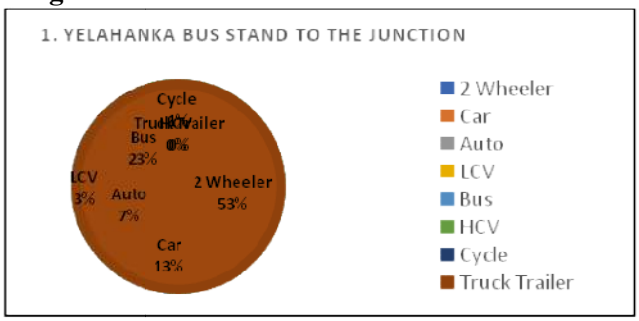

5. RAILWAY STATION TO THE YELAHANKA OLD TOWN
Auto 14%
2%
Car 13%
2 Wheeler 55%
2 Wheeler
Car
Auto
LCV
Bus
HCV
Cycle
Truck Trailer

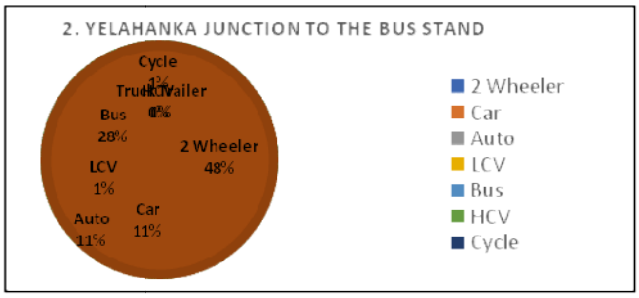

6. LOCAL AREA TO THE RAILWAY STATION
Auto 12%
Cycle 3%
Car 21%
2 Wheeler 61%
2 Wheeler
Car
Auto
LCV
Bus
HCV
Cycle
Truck Trailer

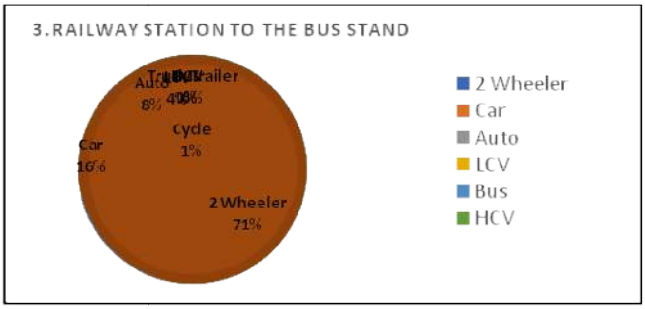

7. BUS STAND TO THE YELAHANKA OLD TOWN
Auto 20%
Cycle 2%
2 Wheeler 59%
Car 17%
2 Wheeler
Car
Auto
LCV
Bus
HCV
Cycle
Truck Trailer

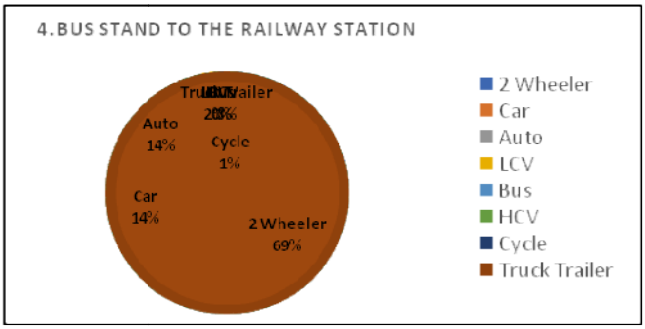


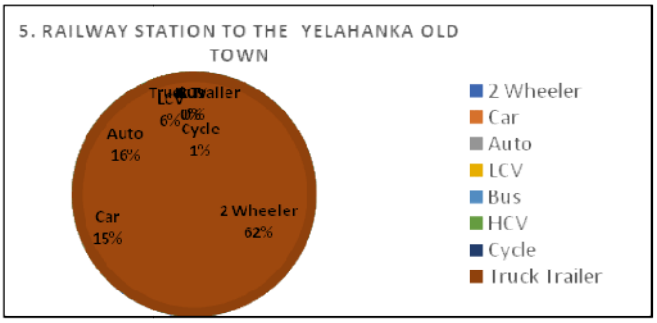
Difference in Evening Peak Hours

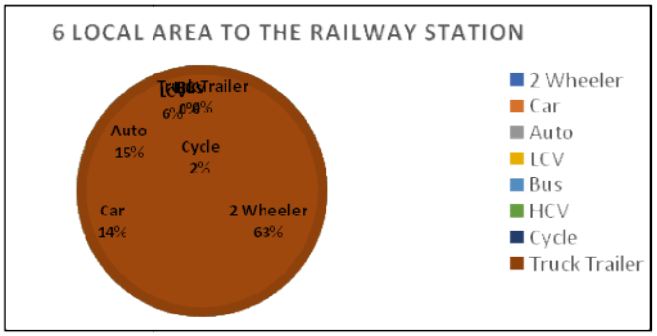


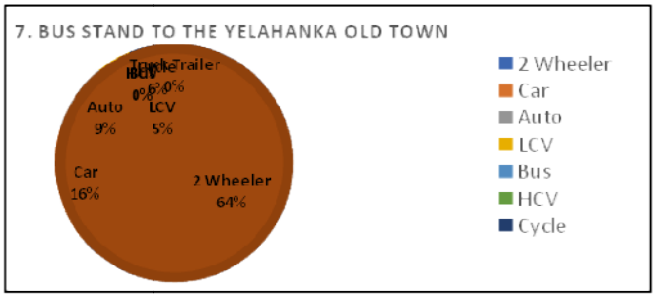


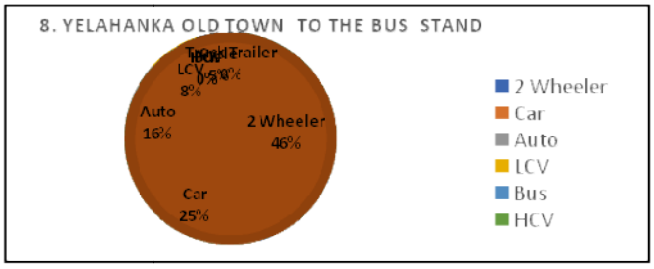












Photos During data Collection like Traffic Volume Count

Conclusion

1) Passengers will receive information regarding bus arrival and departure times, and bus waiting times will be reduced.
2) We can acquire information about the showing specifics of Arrival and Departure information of the buses in Kannada and English by installing the LCD Display unit.
3) No signals are given; nevertheless, by installing the signals, there will be an improvement.
4) The study is advised in order to improve the quality of transfer/interchange amenities such as student passes, canteens, Wi-Fi, medical care centres, lights, fans, book stores, and fare chart displays.
5) Automated fare collection systems, such as smart cards, RFID tokens, and RFID coins, are installed in smart bus stations..

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COMPETENCY MAPPING – NEED OF THE HOUR

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ABSTRACT

In order to achieve a competitive advantage in today's dynamic environment over competitors, highly skilled workforce is essential to an organization. As the organizations are moving from product based to customer-centric, it is mandatory for an organization to maintain a competent workforce to cope up with expectations of customers. Competent workforce differentiates organizations with superior performance and organizations with average performance. They plays a critical role in not only achieving success but also gives a cut throat competition globally to other companies. This paper focuses on components of competency mapping. Competency mapping is a process an organization uses to identify and describe competencies that are most critical and required for a particular position or role. This paper seeks to understand the concept of competency, its history and the linkage of competency with Human Resource Functions.

Keywords: *Competency, Competency Mapping, Competency Framework, Human Resource functions.*

Introduction

In the dynamic and the competitive environment, the key to gain a competitive edge over the competitors is the ability of the manpower of an organization to maximize the benefits of state-of-art technology, superior products and steady source of capital to enter into the market place. Out of the four M's i.e., manpower, material, machinery and money of business, it is only the manpower who can use their ability to employ remaining resources for the achievement of organizational goals. Manpower represents number of people required to perform the process not the capabilities **(Seema Sanghi, 2016)** and materials, methods and machinery are part of the process designed. These are the tools not competence. Competencies are the skills and behaviors that organizations expect their staff to practice at work **(Rankin,2002).** In a nutshell, competencies are a cluster of related knowledge, skills and attributes that affect a major part of one's job. Determining whether the workforce possesses the abilities that place a key role in achieving success to organization is difficult. In order to deliver superior and successful performance organizations are going for competency based practices which builds organizational culture, empower employees and maintain consistency in all Human Resource activities like hiring, development and succession planning. Organizations try to understand how they could effectively utilize competencies of their employees to help them reach the optimum growth level and also increase productivity. Competency Mapping refers to the process of identifying key competencies for a particular position in an organization. It is a way of assessing the strengths and weaknesses of an employee in a company. It identifies key attributes necessary to increase productivity, evaluate suitability of an individual for a particular role or a position and anticipate developmental needs to keep organizations ready for future.

History of Competencies

The original use of competencies was conceived by **David McClelland (1973)**, Professor of Psychology at Harvard University and founder of McBer and company (now part of Hay group). He used it as an alternate for the replacement of trait and intelligence tests with criterion reference testing. He argued that intelligence tests were not valid predictors of intelligence and irrelevant to the Human resources. He selected to work with U.S state department to improve their failing selection process which was based on best from elite universities. McClelland developed competencies for each position based on behavioral interviews with superior performing service officers. But, the state department never implemented his findings as it challenged their fundamental view that

manpower came from top schools, thus they were personally committed to upholding the status quo rather than improving their selection process **(Berger,Berger,2003)**.

However, he was successful in implementing similar programs in U.S.Navy and other large organizations. In his seminal article of 1973 "Testing for competence rather than intelligence", he asserted intelligence and aptitude tests and school grades are not good predictors of success in education and in life. He came up with several their features like communication skills, realistic goal setting, achievement orientation etc., are better predictors. As they are related to competence, for referring to them McClelland came up with word "competencies".

Eg:- Many of Binet's original tests are based on exercises that teachers used in French schools they highly correlate with grades in schools.

When he researched a manual of Differential aptitude test of psychological corporation, he found most of the coefficients involved are estimating grades in courses which became difficult for researchers to demonstrate that grades are related to behaviors of importance, except for doing well on aptitude tests. The research carried on students graduated from high school and college shown that students who did poor in school did just as well in life as the top students. He focused on criterion sampling i.e., special test scores such as motor ability for vehicle operators, finger dexterity for typists etc.,

McClelland argues that test should be designed in such a way that it should reflect changes in what people have learned. He say if you move towards criterion based job analysis, there is a danger that the test will become more specific for each job. Therefore one could end up with hundreds or thousands of specific tests for each job which become useful to assess competencies that are more useful in "clusters of life outcomes" which include leadership, interpersonal skills etc., Firstly, he moves away from general aptitude testing to criterion referenced testing. Second, he did cluster personality or traits into competencies, rather than separate them into attributes. Thirdly, competencies are identified by what superior performers do.

The use of term competency and its meteoric rise is credited to **Richard Boyatzis (1982)** and his book "The Competent Manager". He defines competency as an underlying characteristic of an individual which can be motive, skills, traits and knowledge which results in observable behaviors required for the job.

Spencer. L.M. JR & Spencer. S.M (1993) in his book "Competence at work: Model for Superior performance." Defined competency as an underlying characteristic of an individual that is causally related to criterion referenced effective and/or superior performance in a job or situation.

In 1982, Richard Boyatzis wrote first scientific and well researched book on competency modeling, namely The Competent Manager – A model for effective performance.

Competency - Definition

The word competencies mean different to different people. For an individual, a competency can be defined as a group of related knowledge, skills and abilities that influence job performance **(Prahalad and Hamel,1990)**.

R.W. White(1959) used the term competence in his article as a concept for performance motivation. Competence is a set of demonstrable characteristics and skills that enable and improve the efficiency or performance of a job.

Parry (1996) – Competencies are a set of interrelated knowledge, skills and attitudes that represents a key component of a person's job role and responsibility, that associates with performance in a job, that can be measured against well established standards and that can be reinforced through training and development.

Hayes (1979) – competencies are knowledge, motive, trait, social role or a skill of a person linked to superior performance on the job.

According to **Woodruff (1991)**

Competency - a person related concept that refers to dimension of behavior lying behind competent performer.

Competence – a work related concept that refers to area of work at which person is competent.

A competency is a set of skills, related knowledge and attributes that allow an individual to successfully perform a task or an activity within a specific function or a job **(UNIDO, 2002)**

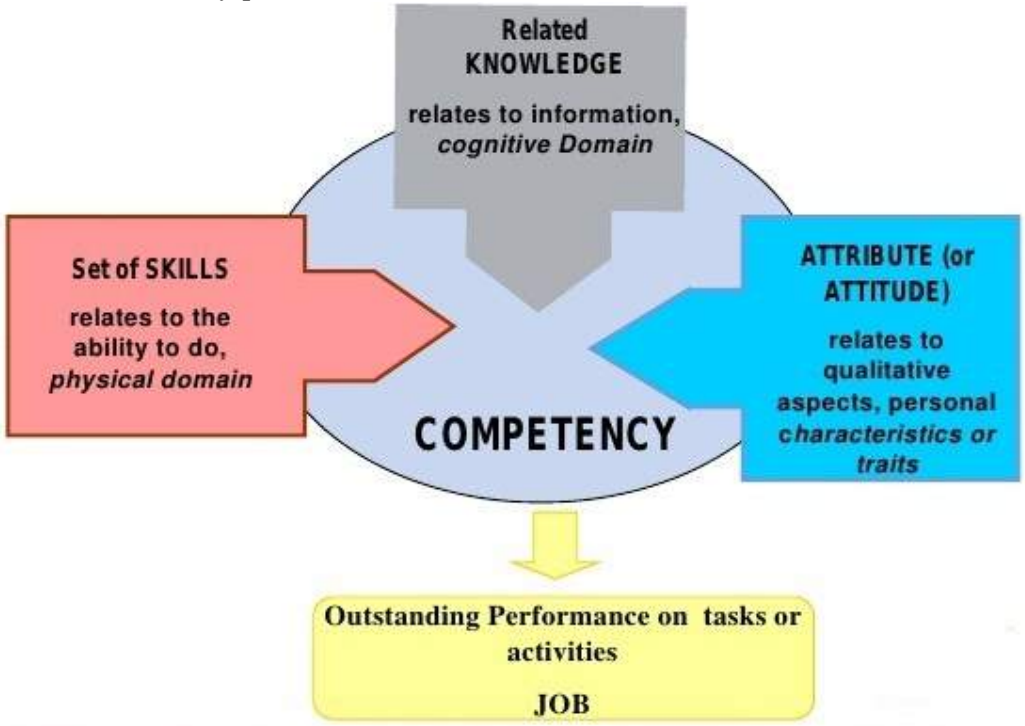


Figure: Competencies: The KSA framework

Source: UNIDO

Competencies are a person's capabilities in the form of knowledge, skills and abilities which gets reflected through person's behavior in form of actions, thoughts, feelings and finally manifests itself in outputs which are products and services.

Albanese (1989) – competencies are personal characteristic that contribute to effective managerial performance.

The Oxford concise dictionary defines competence as the ability to do something successfully or efficiently **(Stevenson & Waite, 2011)**

Athey and Orth (1999) competencies refer to a set of observable performance dimensions, including individual knowledge, skills, attitudes and behavior as well as collective team, process and organizational capabilities that are linked to high performance and provide the organization with sustainable competitive advantage.

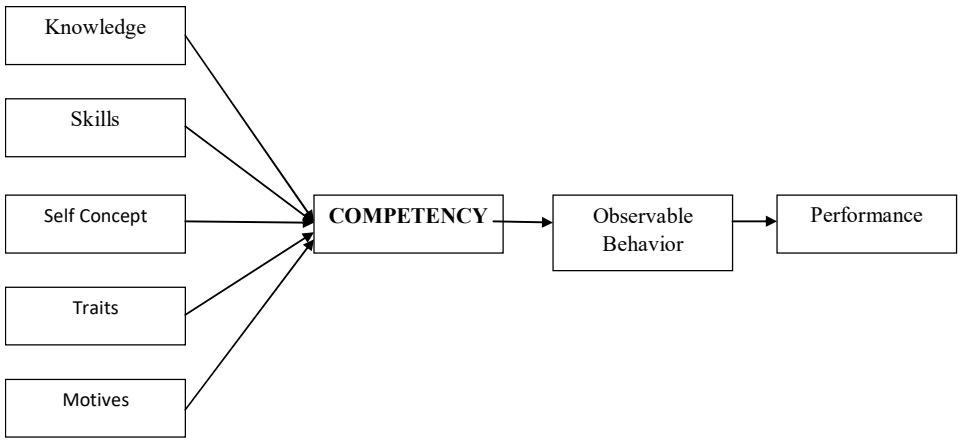


Fig: The General Concept of Competency

Adapted from: Vikram Singh Chouhan and Sandeep Srivastava (2014). Understanding Competencies and Competency Modeling – A Literature Survey

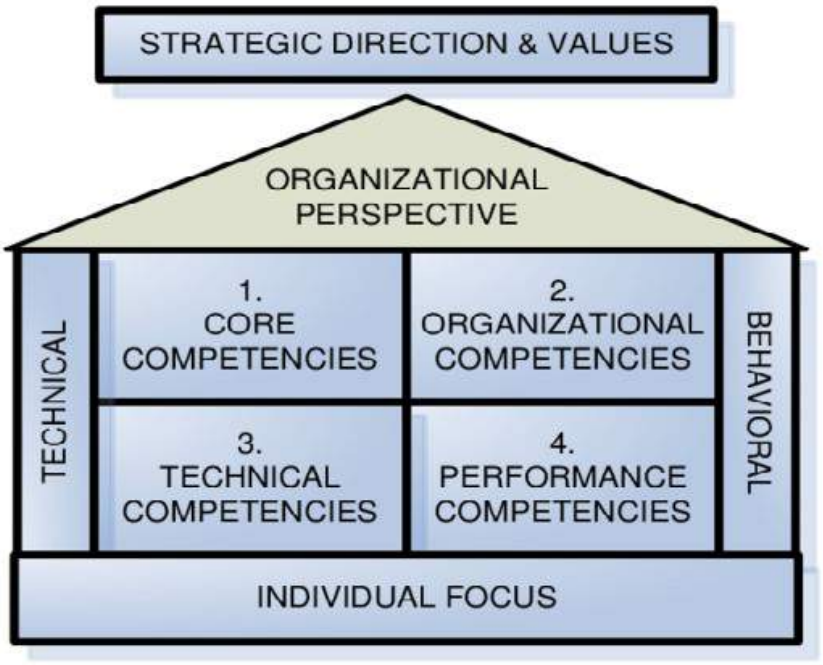
Classification of Competencies

Prahalad and Hamel (1990) classified competencies in to four types. The below figure represents the type of competencies in the form of quadrants.

Core competencies are the technical skills and expertise that differentiate an organization from its competitors. They include methods, procedures and technologies that create a competitive advantage for an organization. Prahalad and Hamel (1990) defined the core competency as " the collective learning in the organization especially how to coordinate diverse production skills and integrate multiple streams of technologies."

Examples of core competencies: Apple's Core competency is innovation. They have a long history of developing unique and innovative technology products, including The Mac computer, iPod, iPhone, iPad, Apple TV and Apple Watch.

Organizational Competencies: They include list of competencies that describe what an organization expects from employees in accomplishment of organizational objectives. According to Ledford (1995) organizational competencies include decision making, risk taking, problem solving, innovation, strategic perspective, team work, and leadership.



Source: Prahalad and Hamel, 1990

The bottom half of the figure depicts the application of competencies at individual level. Both technical and performance competencies are important to achieve success in an organization. At the time of promotions, hiring new employees, succession planning, organizations take in to consideration both technical and performance competencies. Ledford (1995) defined competencies as "demonstrable characteristics of the person, including knowledge, skills, and behaviors that enable performance." Individuals link these competencies to their job roles in accomplishing organizational goals.

Technical competencies: These are specific knowledge, skills and abilities that are applied in completing a specific task or job.

Example: Operating a computer, developing software, preparing financial statements.

Performance Competencies: When an organization identifies its organizational competencies, they are generally intended to apply to all employees. Employees apply their skills to fulfill those competencies. Individual performance competencies play a major role in achieving organizational goals.

Eg:- performance competencies for a team leader is leadership and good communication skills. Similarly for an accountant they need analytical problem solving and attention to detail.

As competencies are developed and implemented in organization, there are three key factors **C. K. Prahalad and Gary Hamel, (1990)**

1. The competencies that are to be applied at the individual level need to be linked to the organizational level – core and organizational competencies.
2. All competencies need to be specific and those that are to be applied in the work environment need to be behaviorally defined.
3. The methodology for identifying the competencies need to include structure, balance, participation, organizational context, job content, linkage and validation.

Competencies are identified for various roles by subject matter experts, HR specialists, Job analysts, psychologists etc., in consultation with line managers, current and past role holders, supervising seniors, reporting and reviewing officers. The objectives of the competency mapping are Gap analysis, role clarity, succession planning and growth plans.

Competency Mapping

It is a process of identification of the competencies required to perform successfully a given job or role or a set of tasks at a given point of time. It is not only meeting expectations of the organization but also performing beyond expectations. Competency mapping exercises are been carried out in order to identify gap in the talent knowledge and skill base, so that organizations can go for some interventions to ensure that it can achieve higher level of competencies in order to perform well. It consists of breaking a given role or job into its constituent tasks or activities and identifying the competencies (technical, managerial, behavioral, conceptual knowledge, attitude and skills etc.) needed to perform the same successfully. In identifying the competencies we create a list of competencies across categories which could be related to job and see that what kind of competency level would be required to achieve higher performance not the average performance.

Competency map is a list of an individual's competencies that represent the factors most critical to success in given jobs, departments or organizations that are part of the individual's current career plan. The use of competencies can include assessment during recruitment, assessment during further development needs; succession planning and promotion; organizational developmental analysis. Techniques used to map competencies include Critical Incident Analysis and Repertory Grid.

Steps in Competency Mapping:

1. Position Information Questionnaire (PIQ) is used to gather inputs on the key behaviors essential to perform their respective work. A 360 degree view is also taken in to account.
2. Making use of the results of job analysis, a competency based job description is created. This is then reviewed by HR and is developed further by transforming it to standard competencies.
3. Once the competency based description is in place, the process of competency mapping begins. The set may have a combination of both behavioral as well as functional competencies.

Competency Framework/Model

In order to develop a competency framework, the first step is to prepare list of competencies required for effective job performance which depicts specific behaviors for each of it. Proficiency levels under each competency are prepared and the target job or role is considered. The competency model should be aligned with organizations objective and culture. It should be developed through research and should be validated by small, medium and top management. The competency

model should lend itself to multiple HR programs. It should be clear and compelling and easy to communicate.

Design Principle of competency model is

i. Use if pre-set list of common standard competencies and customize it to the specific needs of the role/ organization.
ii. Seek help of consultants to develop the framework for the organization, if required.
iii. Involve all the relevant stakeholders into the process – HR and business experts to gain organization wide understanding.
iv. Work towards deriving at a uniform framework across organization

Integrating HR with Competency Model

All that separates the organization from its competitors are skills, knowledge and abilities of people working with organization

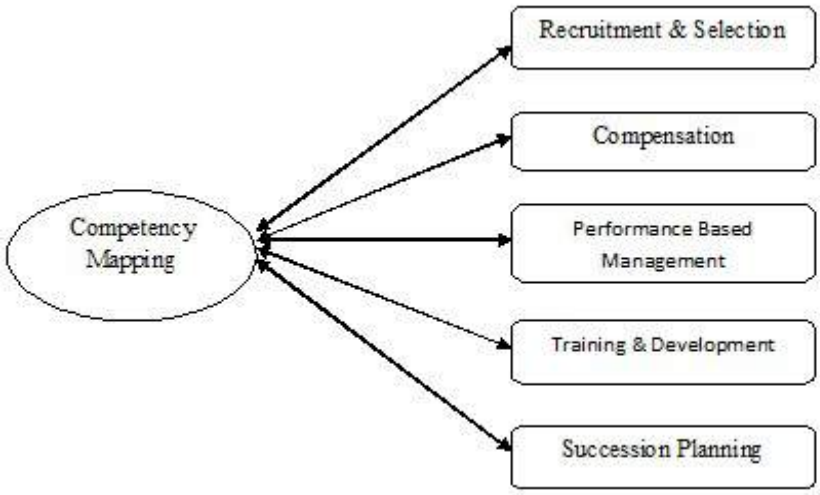


Fig: Linkage of Competency Mapping with HR Functions

Competency Based Recruitment and Selection:

Getting the right people in the right jobs is a lot more important than developing a strategy (**Jack Welch**). One method to ensure the right person is selected for right job is competency based recruitment and selection. It focuses on identifying those candidates who have behaviorally defined characteristics which leads to successful performance in the position that an organization is looking for. A Behavioral based interviewing process designed to provide employers with specific data that allows them to predict future job related behavior. Questions are designed on specific and pre-determined competencies that focus on personal experience and practical work exposure of the candidate. Standard scoring system which refers to behavior indicator will be used.

Competency Based Compensation:

Rewarding the individual's abilities and behaviors that are critically important to the organization. Competency based compensation is a pay structure which rewards employees on the basis of knowledge, skills, abilities and experience rather than the job title or position. The primary objective is to maximize employee motivation which results in competent employee retention. It helps to inspire employees to perform better and contribute to the organization. It helps an employee to understand their potential and skill set and paves a way to enhance it. Enables employees to step out their comfort zone as they feel they can earn more on basis of their competencies. Subordinates can earn more compared to seniors based on competency levels.

Competency Based PMS:

David Martone(2003) defined a competency based performance management system as a documented and well-structured model that considers the skills and behaviors for successful performance in the present and so also the future job roles. It helps employees to understand the job expectations from their organizations and becomes framework to align employee's job performance with organizational goals. It links results, expectations and behavior objectives to the business plan. It provides employees with clear understanding of the behaviors and skills to use in accomplishing results. It provides feedback to employees only on 'what' they have accomplished (i.e., Performance goals) but also on 'how' the work was performed. It provides direction with regards to specific areas of improvement.

Competency Based Training and Development:

Competency based training is a training that is focused on specific competencies or skills. It is designed to allow a learner to demonstrate their ability to do something. Eg:- to make a coffee, to guide a tour etc., It identifies the gap between current skill set of the workforce and the required skill set. Provides an opportunity to identify, develop specific training programs by mapping them to competency gaps, identifies the area where the organization should spend its training budget to achieve the greatest impact. It gives the manager a tool to empower and develop employees. This will help an organization to retain competent people for a longer period of time.

Competency Based Succession Planning:

An effort designed to ensure the continued effective performance of an organization division, department or work group by making provisions for the development and replacement of key people for key positions and work activities over time. Competencies link and align the organizations' core competencies (strategic strengths) to job competencies. They define high potentials and clarify present and future competencies needed for corporate culture. A list of positions is identified. Decision makers will decide what is required for success in each position. A list of employee who is ready now and why is developed.

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MODIFICATION AND ANALYSIS OF SPARK IGNITION ENGINE USING ACETYLENE AS AN ALTERNATE FUEL

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ABSTRACT

Considering the fact that non-renewable resources use had been increased world-wide despite of their abundance in availability. As ages ahead this could bring up a huge disaster and there will be lack of non-renewable resources. Alternatives need to be emerged as a solution to the above problem. Some of the non-renewable resources that need an alternative are fuels. Some studies exhibit that Acetylene could be one of the alternatives that can build up the requirements of power and efficiency in SI engines. Acetylene is highly flammable and produced from lime-stone (CaC_2) whose resources are huge and available in abundant. The compounds that produce acetylene gas are abundantly available. So this makes acetylene gas as alternate fuel because it has the ability to replace the fossil fuels. Acetylene use reduces smoke, soot, and exhaust temperature. Acetylene being a fuel produces less pollution and smoke and eco-friendly to nature. The acetylene gas is produced on board and stored in a storage tank. This research investigates how acetylene could replace the regular fuel through a 100cc 4stroke SI engine modified prototype. Evaluation of engine performance using parameters like engine speed, brake power, brake specific fuel consumption, brake thermal efficiency.

ABBREVIATIONS

BSFC: Brake Specific Fuel Consumption
BP: Brake Power
CC: Cubic Centimeter

NOMENCLATURE

L: Stroke Length
D: Bore Diameter
N: Speed
V: Volume
$\eta_{bth:}$ Brake Thermal Efficiency

Keywords: *Brake power, Cubic centimeter*

INTRODUCTION

There is world-wide usage of non-renewable resources of energy and present world is not self-sufficient to reproduce the used non-renewable resources so hence there need to be some alternatives produced before the non-renewable sources get extinct. There is some data showing the usage of fuel resources world-wide.

Acetylene is the chemical compound with chemical formula C2H2. It is an unsaturated hydrocarbon and the simplest alkyne group. Acetylene gas in the cylinder is dissolved in acetone which is absorbed by the porous mass through a cylinder.

Jai vardhan srivastava et al, studied and presented the total emissions magnitude due to the combustion of acetylene gas in the combustion chamber. From their calculation it was clear that 1.403 × 10−4 metric ton of $CO2$ is emitted per 1 cubic feet of C2H2 combustion.

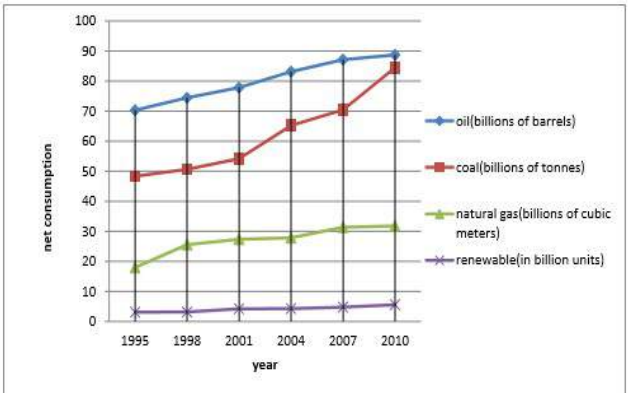


Fig 1: **World-wide use of fuels**

The above result shows that the amount of CO2 emitted is nearly minimum and other if we consider emissions like NOx, SOx are highly negligible compared to CO2. This indicates that acetylene is environmental friendly compared to gasoline. SI engine using acetylene as fuel emits less amount of CO2 comparable to fossil fuels thus its use can be very beneficial. Acetylene can also replace L.P.G. with similar minor manipulation in the engine [1] and Brusca et al, investigated IC engine running with acetylene and alcohol. They replaced engine carburettor with an electronic injection control system (ECU). Their analysis shows that engine running on acetylene and alcohol has about 25% reduction in engine performance because of the reduced global low heating value and likely because of the use of a combustion chamber optimized for gasoline combustion. They also proved that"acetylene-alcohol BSFC" is lower than "gasoline BSFC". [2]. Swami nathan, conducted experiments on sole acetylene fuel in HCCI mode and shown the results with high Thermal efficiencies in a wide range of BMEP. The thermal efficiencies were comparable to the base diesel engine. [3]. Som kumar et al, Studied the Performance Characteristics of Acetylene Gas in Dual fuel engine with Diethyl Ether Blends. They carried out experimental investigation in single cylinder, direct injection (DI), and compression ignition (CI) engine with diesel- Acetylene dual fuel mode with oxygenated additive. They found that Brake power and Brake thermal efficiency was maximum with Acetylene addition into blend of Diesel and diethyl ether for all loads, however resulting into lower BSFC. [4]. Gowtham prabhu et al, studied Emission and Performance Characteristics of Hydrogen-Acetylene Fuel in IC Engine. They evaluated the acetylene and hydrogen performance with emission characteristics in a single cylinder engine. They proved that at an average speed of 35kmph the Mileage is 73.5km . [5]. Peter zentay said that Burning acetylene gives off a significant amount of energy and it burns at a very high temperature and with a great light. That is why for a long time it was used for welding and also for lighting (in mines and in caving).The problem of producing and storage of acetylene in portable quantities and the very high burning temperature has many problems, these are some of the reasons why it did not caught up in the automobile industry [6]. Iranmanesh in his research, conducted tests on a single cylinder diesel engine fuelled with neat KOME as a base fuel and blends of 5, 10, 15 and 20% DEE on a volume basis. Use of DEE addition to KOME increased BTE in general due to its oxygen content and its effect on lowering the viscosity of the blend, which led to improved spray formation and finally an improvement in the combustion. BTE increased 5.5% with 15% KOME-DEE blend. Smoke opacity slightly reduced with KOME-DEE blends. The effect of DEE on NOx reduction was more effective than on other emissions. Addition of 15% and 20% DEE reduced NOx by 40% and 51% respectively. [7Rushikesh d. Jadhav et al, built an equipment to evaluate the acetylene characteristics at various loads. They observed that as load increases brake thermal efficiency increases and then decreases. Brake thermal efficiency for acetylene is greater than petrol. Thermal

efficiency is minimum at low load and maximum at high load [8]. saravanan et al, carried out an experimental study on a single cylinder water cooled engine using hydrogen in the dual fuel mode. It was reported that the brake thermal efficiency increases from 23.59% to 29% with an optimized start of injection and duration. The peak pressure increases rapidly when hydrogen is used in the dual fuel mode. The emissions such as NOx, CO, CO2 and HC are reduced drastically. [9]. Dhandayuthapani kumaran et al, conducted test on three-fuel mixture in a 4-stroke single cylinder diesel engine. They used one such type of oil called turpentine in a regular DI diesel engine along with blends (60% diesel 40% turpentine) and acetylene gas of fixed quantity supplied to the inlet manifold closer to the intake valve. They noted that maximum brake thermal efficiency obtained in the three-fuel mixture concept is 33 % and it is by 3% higher than that of the standard fuel operation and the amount of CO emissions of the three-fuel mixture is lower than in the case of standard fuel. [10]. Veankatesh K. Deshmukh et al, done a review on Power Generation and Making Pure Water using Acetylene Gas. They used Acetylene as a main fuel which is stored in a tank, which is supplied to gas turbine then power produced in device.[11] John W.H. Price, described the explosion of a cylinder containing acetylene gas, which occurred in 1993 in Sydney. In this paper, he describes the failure and the conditions that affected with it. The assessment says that the explosion, which occurred, needs an explanation of the events

An in-depth review of the previous investigations on various aspects of acetylene gas using as alternate fuel in IC engines. From the past investigations we came to know that among all the alternate fuels, acetylene gas is the best possible fuel that suits to the characteristics of IC engines. Recent investigation were carried out on the diesel engines or multi-cylinder engines and the results were very satisfying by using acetylene as alternate fuel. Also the exhaust gases emitted by the combustion of the acetylene gas in the combustion chamber has less amount of harmful particles that are dangerous to the environment.

The study of literature papers reveals that acetylene gas has suitable characteristics to serve as Internal-combustion fuel so the present work consists of two phases. Fabrication of a prototype with single cylinder spark ignition engine and sending acetylene gas a fuel into it. Evaluation of engine performance using parameters like engine speed, brake power, brake specific fuel consumption, brake thermal efficiency.

EXPERIMENTATION

$CaC_2+2H_2O \rightarrow C_2H_2+Ca(OH)_2$ and $CaO + 3C \rightarrow CaC_2 + CO$

This is the equation used to produce acetylene from lime-stone and production of lime-stone(Calcium-carbide)

Fig 2: Prototype of the experiment

Engine specifications

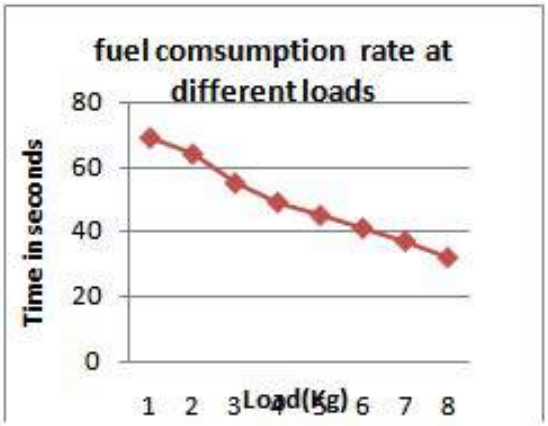
Engine type: Air cooled, 4-stroke

Displacement: 97.14CC
Maximum power: 6.15Kw@8000rpm
Maximum torque : 0.82 kg-m@5000rpm

Maximum speed: 87 kmph
Bore: 50mm
Stroke: 49.5 mm

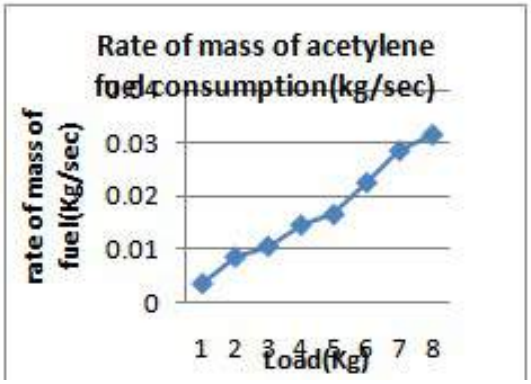
RESULTS AND DISCUSSION

The time for 10ml fuel consumption is observed at different loads by using volumetric type of analysis using burette method.
The relation between the load and the time for the 10ml petrol consumption by the engine is shown in the graph 1



Graph 1: Fuel consumption rate at different loads

From the graph,it is concluded that petrol consumption rate by SI engine at increasing loads is increasing in nearly linear manner.The relation between the load and the rate of mass of acetylene fuel consumption by the SI engine is shown in the graph 2.From the graph, it is concluded `that rate of mass of acetylene gas consumption by SI engine is higher compared to petrol.

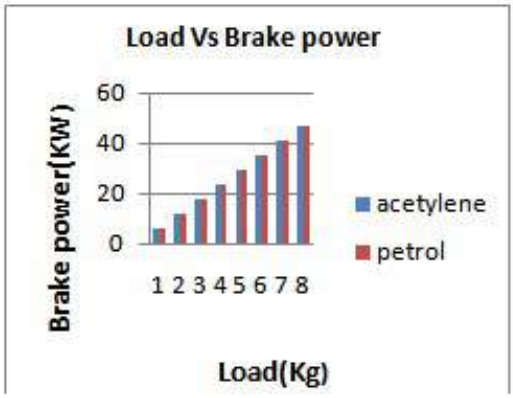


Graph 2: Rate of mass of acetylene gas consumption at different loads

Brake power test

Brake power is calculated for the different loads when acetylene and are used as fuel separately and the values are noted in the table respectively.

The relation between brake power and load when acetylene and petrol used as fuels separately are compared by plotting the values in the graph 3



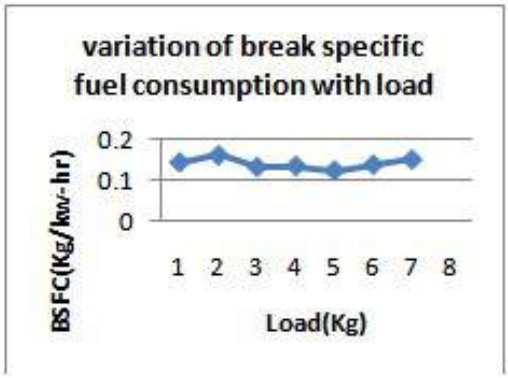
Graph 3: Brake power of petrol and acetylene as fuels at different loads

From the graph, it is concluded that brake power of acetylene gas is equal to that of petrol.

BSFC and η_{bth} of SI engine when acetylene used as fuel

The brake specific fuel consumption (BSFC) and brake thermal efficiency (η_{bth}) for acetylene as fuel is calculated and the values are noted in the table. The sample calculation of respective parameters is shown in the experimentation chapter.

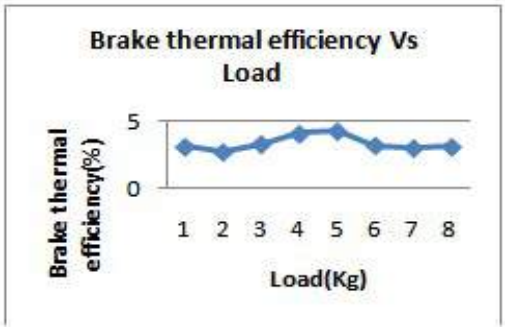
The relation between the BSFC and load when acetylene is used as alternate fuel is plotted in the graph 4.



Graph 4: BSFC of SI engine at various loads when acetylene used as fuel

From the graph, it is concluded that BSFC of SI engine using acetylene as fuel, decreases initially but as the intensity of load increases the BSFC also increases.

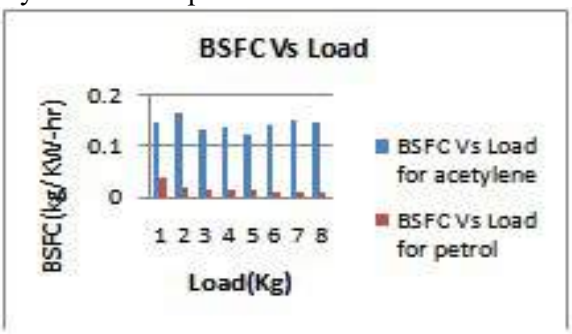
The relation between the η_{bth}(%) and load when acetylene is used as alternate fuel is plotted in the graph



Graph 5: Brake thermal efficiency of acetylene at various loads

From the graph, it is concluded that η_{bth}(%) of SI engine using acetylene as fuel increases to maximum point and then decreases.

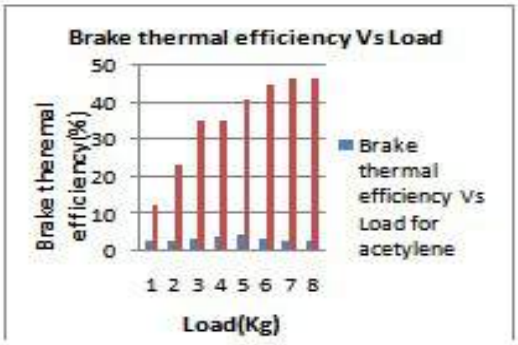
The relation between BSFC and load of SI engine using both acetylene and petrol separately is compared by plotting a graph with respective magnitude at different loads is shown in graph 6.



Graph 6: Comparison of BSFC of acetylene and petrol at different loads

From the graph, it is concluded that BSFC using petrol is less compared to acetylene because the consumption of fuel plays a major role in the BSFC.

The relation between η_{bth} and load of SI engine using both acetylene and petrol separately is compared by plotting a graph with respective magnitude at different loads is shown in graph 7.



Graph 7: Comparison of η_{bth} of acetylene and petrol at different loads

From the graph, it is concluded that using petrol is comparatively very high than acetylene because the consumption of fuel and Calorific value of fuel plays a major role.

Results And Discussions

From the graph 6, we can infer that BSFC of acetylene gas is high compared to petrol as a fuel that means, the acetylene gas as a fuel completely burns in the combustion chamber and there are no un-burnt particulates left in the chamber. Thus this leads to improvement in engine performance. From the graph 7, we can infer that acetylene gas brake thermal efficiency is low compared to petrol. By this we can conclude, at very high loads the fuel efficiency is low.

CONCLUSION

During the experimentation of prototype, the 4-Stroke single cylinder engine was made to run by using both acetylene and petrol as fuels. During the usage of acetylene gas as fuel we observed that BSFC magnitude is high compared to standard magnitude of petrol engine using petrol as fuel. So this indicates complete combustion of acetylene gas in the combustion chamber therefore, the NOx, SOx and other carbon particles coming out of exhaust port are comparatively lower than conventional fuel. But it was also observed that using acetylene as fuel the load taking capacity of engine is poor compared to the convectional fuels. However, in remaining aspects the

acetylene gas would suit as best alternate fuel for IC engines.

FUTURE SCOPE OF WORK

Acetylene gas could serve as best alternate fuel in the field of agriculture, transportation, electricity generation, industrial purposes etc.

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RAISING THE POSITION OF RAILWAY TRANSPORT OF THE REPUBLIC OF AZERBAIJAN IN THE GLOBAL COMPETITIVENESS REPORT (GCR)

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ABSTRACT

The article is devoted to the issues of raising the position of the railway transport sector of the Republic of Azerbaijan on the international rating indicators in the Global Competitiveness Report (GCR). The article examines the modern condition of transport infrastructure, the density of railways, the efficiency of railway services, the methodology of its determination and analyses the position of other post-soviet and developed countries in the international ranking, including the Republic of Azerbaijan. Based on the analysis, the problems hindering the development of railway transport in Azerbaijan, as well as the main directions for its development, were identified. The primary purpose of the research is to analyses the role of the private sector in the activities of railway transport and realization of economic measures, their effectiveness, and positive economic results, to show the application of this experience in the Republic of Azerbaijan. The practical significance of the article is to realize the statistical, econometric analysis of the key indicators of the country's railway transport in recent years and substantiate to reduce the share of the public sector in railway transport and to create a private sector. The main novelty of the study is the reduction of the share of the public sector in this type of transport and implementation of serious structural reforms, creation of new private railway companies, the attraction of private investment in the development of this sector, etc. in the Republic of Azerbaijan.

Keywords: *transport, development, national economy, sustainable development, rating indicators, railway transport.*

Introduction

The Global Competitiveness Report (GCR), published by the World Economic Forum, has been available worldwide since 1979. The Competitiveness Index allows government leaders, scientists and business people to compare the strengths and weaknesses of the national economy. By analysing different indices and sub-indices, it is possible to identify ways to achieve economic development in each country. The Global Competitiveness Report (GCR) covers the economic policy of individual countries, the factors that determine the level of productivity of the country, information about various organisations and their situation[13].

In the Global Competitiveness Report, the annual statistics prepared by the World Bank, the International Monetary Fund, etc. and the results of surveys conducted by the World Economic Forum. The Global Competitiveness Report also examines the factors that play an important role in creating an effective business environment in the Azerbijan. At the same time, this report ensures the competitiveness and level of production of each country. The report identifies the country's political and economic strengths and weaknesses. As a result, the main directions for the implementation of political reforms in the country are determined [13].The reports of the World Economic Forum examine the level of use of resources by countries to improve their welfare, increase the salaries of citizens, the level of specialization of the labour force, and productivity. The World Economic Forum informs countries, identifies problems and their solutions to ensure economic development. The annual report, which reflects the results of the Global Competitiveness Index for all countries of the world, provides detailed information on the activities of the public and private sectors [14]. The relevant index is often used to compare the competitiveness of countries around the world. Othercountries closely followed the fact that any country moves forward or backwards in the international rankings on this index. A rating of 141 countries is formed in this report. The compiled index allows leaders to pay more attention to important factors of economic growth, income levels, productivity, analyse and compare the results of reforms in different countries. The competitiveness index allows us

to identify the current downturn in the national economy and determine the direction of development [15].

In general, research shows that the economic policy pursued by the state plays an important role in increasing the competitiveness of the national economy. From this point of view, implementing this task should be considered a top priority [16]. As international experience shows, countries that have a simple strategy for the optimal implementation of existing competitive advantages are stable and competitive. Therefore, an effective state strategy should be developed based on international experience to increase the competitiveness of the national economy [17].

The financial system, which is one indicator that plays an important role in the competitiveness's development of the national economy of the post-Soviet countries, requires the existence of capable stock exchanges, the securities market.

The role of economic competitiveness is accumulating in modern integration. From this point of view, it is important to study the economic competitiveness of countries, to analyse and evaluate competitive areas. We should note that competitiveness is also grouped according to several factors, which distinguish between international and domestic competitiveness [18]. While domestic competitiveness is more a feature of competing for produced goods and services with imported goods and services in the domestic market, international competitiveness is a feature of selling produced goods and services in the world market. As integration processes expand at the international level, competitive processes in the world market increase [19].

Research shows that one of the main directions of ensuring competitiveness at the national level is to increase productivity through the application of modern innovations [4].

The key measures taken by the state to increase national competitiveness are: improving the management of economic activities; stimulation of innovation activity; development of scientific and production potential; determination of long-term economic development priorities, etc [20].

Competitiveness refers to the ability to use existing economic resources, organise the production of goods and services by the needs of the market, achieve revenue growth, and outperform competitors in the domestic and foreign markets. The competitiveness of products and services means a set of consumption and value (price) characteristics that ensure its success in the local and foreign markets. In today's globalised world, it is important to improve the quality and competitiveness of products and services in international markets [21].

The major factor shaping the level of competitiveness is that the price and quality of transport services meet the needs of consumers. The competitiveness of transport services shows, first, that they meet the consumer in terms of commercial and sales conditions. In this regard, customer requirements should offer the transport services. Transport services must meet international standards that guarantee their quality so that the consumer has a prime choice [22].

Foreign scientists, experts from international financial and transport organisations, etc., who research some countries around the world have discussed some important theoretical, conceptual and practical issues on the development of private entrepreneurship in the railway transport sector. illuminated by. Creation of private entrepreneurial activity in railway transport, an increase of competitiveness of private companies, expansion of activity in the international transport services market, liberalisation of transportation tariffs, etc. illuminated by Penyaz I.M, Rachek S.V., Gorbunov A.A., Humpreys M.T. and so on. has been touched upon more in the works of scholars. We have conducted no detailed research in recent years on the development of private entrepreneurship in the railway transport sector in the Republic of Azerbaijan [1]. That is why this article, unlike other authors, focuses on the development of private entrepreneurship in railway transport, improving the international position in this field, increasing its role in transit.

The method and concept of state regulation in the transport sector depend on the general economic situation and the role of different modes of transport in solving socio-economic problems [2]. The model of structural reforms

in railway transport depends on the conditions of operation of this mode of transport in each country. It should be noted that 80% of the world's rail freight and railways, their infrastructure and interconnected transport activities carry more than 50% of passenger traffic out. The experience of some developed countries shows that its reformation and privatisation play an important role in solving the problem of increasing the efficiency of railway transport [12].In the conditions of market relations, competitiveness and efficiency characterize the degree of development of society. The higher the competitiveness of the country, the higher, the more stable economic growth and living standards of the population and economic stability [23].

Harvard University professor Porter M. has an exceptional role in creating the theoretical basis for the national competitiveness of countries [7]. According to Porter, the country's national competitiveness is determined by the productivity of human, natural and capital resources. This determines the standard of living in the country. According to Danna M., competitiveness is the ability to expect and adapt to structural changes in the national economy [8]. In general, there are many theories about the formation and development of a competitive economy. The experience of developed countries shows that the most effective form of economic growth is the theory of the cluster mechanism. They base the theory of the cluster mechanism on the interrelation of successful competitive systems that allow creating a fully competitive economic model, the existing economic system of the state, its competitive position in the industry, national and world markets [24].

A cluster is an industrial complex that is concentrated, forming a joint network of specialised senders and major commodity producers. For example, when firms reach a high level of competitiveness in the world market, the surrounding subjects – senders, consumers, economic competitors - are in their sphere of influence. Such coverage has a direct impact on increasing the competitiveness of the enterprise. As a result, it formed a union of related industries and companies as a cluster, which ensures the competitive development of each other [25].

The cluster system forms the basis to expand the domestic market for the country's economy, as well as international expansion. As a result, they form new cluster sectors in the national economy based on economic processes, and the competitiveness of the country's economy increases. The high competitiveness of the country is formed on the solid foundations of various clusters. Enterprises that enter the field formed based on economic relations are interconnected in terms of production, in which case it distributed the income in all directions of relations [18]. The formation of a cluster area ensures the implementation of the necessary measures for implementing a new economic strategy. One advantage of the cluster system is the gradual increase in investment activity in different economic sectors [24].

We should note that the competitiveness of the national economy depends on the level of development of various clusters. The formation of the competitiveness of the national economy creates the need to implement some measures that can create conditions for economic growth in the country.

The development of modes of transport around the world ensures the variability of transport costs. From this point of view, the price, quality and conditions of sale of goods and services play a key role in the process of international competition. One of the primary factors that increase the competitiveness of the world is the increase in the international movement of capital in the world economy, as well as the expansion of multinational companies. We should note that transnational companies produce high-quality goods and services by investing in countries around the world and attracting innovative technologies. As a result, existing manufacturing companies in local countries provide efficient and quality production of goods and services to adapt to a high level of competition.

In general, we classify the competitiveness process as follows: competitiveness of goods and services; competitiveness of firms; competitiveness of production and service spheres; international competitiveness of the state. The competitiveness of goods and

services is initially determined by four indicators: quality of goods and services; price; usage life of goods and services; level and conditions of delivery of goods and services to consumers [19].

We should note that the technical level of production, the high quality of the services offered, depends on the competitive performance of companies. One of the key features of companies that dominate in the international market is that they more use of modern innovations.

The primary principle of competitiveness of firms specialising in the production of goods and services is to ensure the strengthening of competition in both domestic and foreign markets. According to the basic principles of the universally accepted theory of comparative advantage, for individual economic sectors to be competitive, countries must first have the factors of production that ensure their participation in the world market.

In modern integration, we consider the competitiveness of countries a key factor in international economic theories, as well as in the study of international financial institutions. For example, until the 1990s, a country's competitiveness was determined by macroeconomic indicators such as the exchange rate, interest rates, and the state budget deficit. However, recent experience shows that despite the large budget deficits in countries such as South Korea, Italy and Japan, the real value of the national currency in countries such as Switzerland and Germany, and interest rates in South Korea and Italy are high. In these countries, the dynamics of rising living standards are observed every year [22].

2. Data and Methodology

The infrastructure level in the Global Competitiveness Report covers the quality and expansion of transport infrastructure (road, rail, sea and air) and service infrastructure upgrades for each country.

Countries with high-level geographical connections have more development opportunities. Developed infrastructure in each country reduces transportation costs for different modes of transport. In addition, it simplifies the movement of various types of goods and passengers, as well as the delivery of transport data within and outside the country. Transport infrastructure can provide access to certain modes of transport at high speeds and to water sources, which is an important condition for economic activity.

In the Global Competitiveness Report, the railway density index (km/sq km) is determined based on the kilometre length of a railway line per 1,000 square kilometres of land in each country. The Railway Services Efficiency Index (1-7 points) is based on the World Economic Forum's executive opinion poll. 1 point assesses the low efficiency of railway services in the country (frequency, accuracy, speed, price). They award 7 points to the leading countries offering the best (efficient) railway services [13].In addition, the article examines the correlation-regression relationship between revenues and expenditures of railway transport. The article refers to many foreign works of literature, statistical reports provided by international organisations, and information sources.

The linear regression model is used more in the field of transport. Through this model, it is possible to further analyze the current situation in transport.Prediction of a single variable Y based on values of 2-x or more variable X is called multiple regression [Promoxina,2009]. Multiple Linear Regression Model has type

$$Y=\beta_0+\beta_1*X_1+\beta_2*X_2+\ldots+\beta_k*X_k+\varepsilon(1)$$

Here, the variable Y depends on the number of variables X, ie. regressors. ε is a random error (1). The model is linear with relatively unknown parameters β.We first introduced the meanings and concepts of multiple regression.The description of the dependence Y from the 2-x variable linear model has the following types:

$$Y = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \varepsilon(2)$$

The parameters of this model β_i are unknown to us, but they can be evaluated using a random sample (measured values of variable Y from set X) (2). Therefore, evaluation of the parameters of the model (β_0, β_1, β_2) is usually calculated by the method of the least-squares (LS), which minimises the sum of the squares of the forecasting error (criterion of minimisation in the English literature SSE-Sum of Squared Errors). We will denote the corresponding estimates of parameters as b_0, b_1 and b_2.

Error ε has a random nature and has its distribution function with average value 0 and variance σ^2.Ratings b_1 and b_2 are called regression coefficients.They determine the effect of the corresponding variable X, when all other independent variables remain invariant.

Move (intercept) or constant memberb_0, determines the predictive value of Y, when all the explained variable X equations 0 (often the shift does not have a physical meaning in the model's framework and is conditioned only by mathematical).By calculating the grades obtained by the LS method, allow to predict the value of the variable Y (3):

$$Y= b_0 + b_1 *X_1 + b_2 *X_2 (3)$$

3.Results and Discussions

A study of the position of some countries on the infrastructure sub-index in the International Competitiveness Index shows that the Republic of Azerbaijan ranks 38th out of 141 countries. We should note that Singapore, Germany and the United States are. Due to its position, Azerbaijan is ahead of regional countries, especially Russia, Kazakhstan, Turkey, Georgia, Ukraine, Kyrgyzstan, Moldova, and Iran. The main reason for this is the increase of investment in the transport sector of Azerbaijan in recent years, including transport infrastructure, ensuring the creation of new infrastructure in this area (Figure 1).

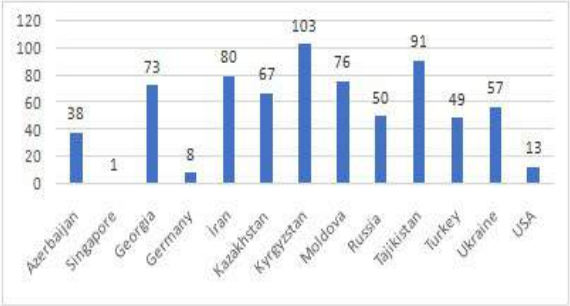

Figure 1. Position of some countries on the changing dynamics of the infrastructure sub-index in the International Competitiveness Report

Source: WEF, compiled by the author based on 2019 data.

According to the International Competitiveness Report in 2019, we can see that the position of some post-Soviet countries differs in terms of railway density among 141 countries. For example, in 2019, the Republic of Azerbaijan ranked 34th out of 141 countries in terms of railway density. According to this indicator, Azerbaijan was ahead of post-Soviet countries such as Georgia (44), Kazakhstan (66), Kyrgyzstan (86), Russia (64), Tajikistan (72). Only countries such as Ukraine (25) and Moldova (27) were ahead of Azerbaijan in terms of railway density. Although countries such as Singapore (1), Germany (7) are ahead of Azerbaijan, the United States (48), Iran (67), Turkey (52) and others. countries have lagged behind our country (Figure 2)

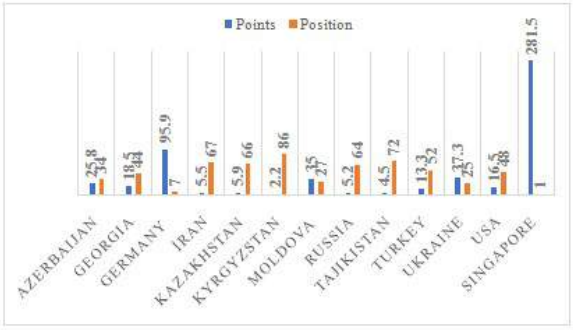

Figure 2. Dynamics of position density of railways in some countries (km/1000 square km)

Source: WEF, compiled by the author based on 2020 data.[13]

In the 2019 International Competitiveness Report, Japan (1), Singapore (5), Azerbaijan (11) and the United States (12) were in the leading position among 141 countries in terms of the efficiency of railway services. It should be noted that the efficiency of railway services of the Republic of Azerbaijan was ahead of such countries as Georgia (43), Germany (16), Iran (52), Kazakhstan (33), Kyrgyzstan (77), Moldova (69), Russia (17), Tajikistan (37), Turkey (56), and Ukraine (34) (Figure 3).

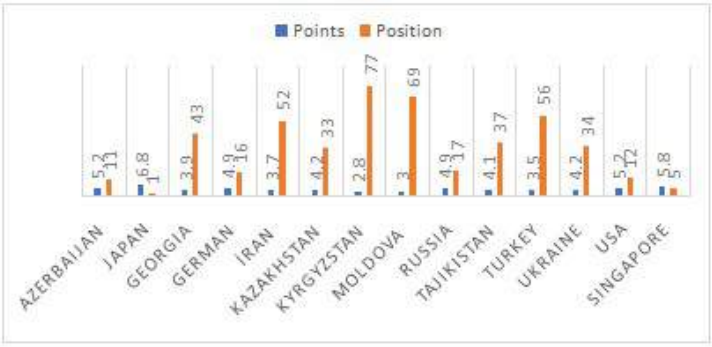

Figure 3.Dynamics of position change on the efficiency of railway services in some countries
Source: WEF, compiled by the author based on 2019 data.

For example, an analysis of recent reforms in rail transport in the United Kingdom, a former member of the European Union, shows that it is possible to achieve positive economic results in this area through private entrepreneurship. Because of the privatisation of rail transport in England, it completely separated the infrastructure from the field of operation. As a result, "Railtrack" and more than 70 commercial companies have been established in railway infrastructure and operation. In addition, they have achieved positive results as a result of the implemented reforms. In the UK, annual financial performance for rail transport has improved, state budget revenues have increased, and capital investment in infrastructure has increased. Because of privatisation, investment in the British railway network has increased through the sale of shares and private sector loans [3]. Because of the implemented reform programs, labour productivity, efficiency and safety of railway work have increased.

Since 1994, it has established independent economic entities in Germany for railway transport. For example, joint-stock companies have been established under the established Deutsche Beteiligungs AG (DBAG) railway holding [8]. These companies have gained the right to provide independent transport services such as freight, long-distance passenger transport, regional passenger transport, maintenance of infrastructure and maintenance stations. The management of the German holding company DBAG focused on general management, coordination and control.the company plays an important role in the economic development of the country by implementing projects for the development of intermodal transport systems in the country [9]. The analysis shows that the reforms in the German railway transport sector have increased its competitiveness compared to other modes of transport. As a result, labour productivity has doubled.

In France, in 1997, they passed a law on implementing economic reforms in the national railway transport. As a result, a new structure called the French Railway Network (RFF) was created. This organisation became the owner of the railway network in the country. The traffic management function remained with the French Railways National Society(SNCF), a state-owned railway company.this organisation handled all railway operations, but now it is exempt from a large tax burden and investment in infrastructure [11].

In addition, it formed most of the income of the SNCF due to the development of the logistics business (30%). RFF handles the

modernisation and development of infrastructure, as well as the planning, financing and implementation of investment projects [5].

There are more than 500 private freight and passenger companies in the United States. We consider only 7 of them to be the most profitable companies (Cowie, 2015). American railway companies carry out all complex transportation works. This includes the maintenance and development of their infrastructure, the operation of rolling stock, traffic management and dispatching services. The competitive environment between the companies leads to a decrease in the cost of transportation. This is due to introducing new technologies for the maintenance of infrastructure and the efficient organisation of transportation [10]. The analysis shows that the entry of new operators into the market of railway transport services in countries such as the United Kingdom, Germany, France and the United States allows them to attract additional volumes of freight [7]. In recent years, compared to other modes of transport in the Republic of Azerbaijan, there has been a significant decline in the volume of rail transport. For example, in the last 2015-2019, we can observe this decline. For example, 17,090 thousand tons of cargo was transported in 2015, while in 2017 this figure decreased to 14,558 thousand tons. Compared to 2018 (13,594 thousand tons), the volume of cargo transportation in 2019 increased to 15,222 thousand tons (Figure 4). However, in general, compared to 2015, the decrease in 2019 amounted to 1868 thousand tons. If we take1 a ton of cargo volume min. $30, we can see that the reduction in freight traffic is $56040. As a result, the state budget does not receive large enough funds.

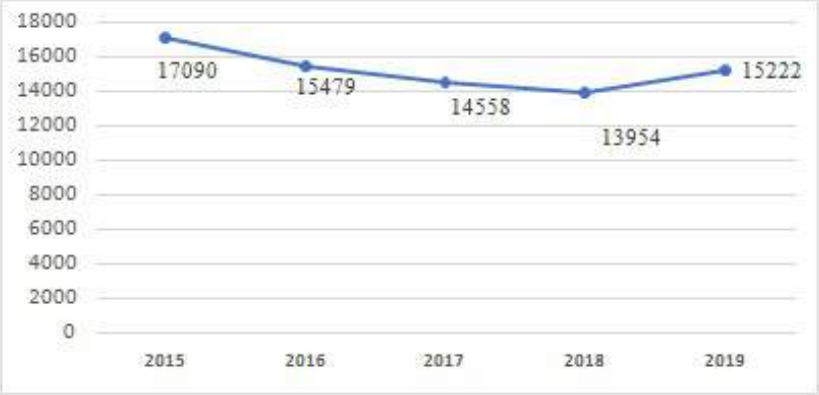

Figure 4. Dynamics of freight transportation by railway transport in the Republic of Azerbaijan in recent years (thousand tons)

Source: Compiled by the author based on State Statistical Committee of the Republic of Azerbaijan (2020) data.

In Azerbaijan, there have been significant changes in the statistical indicators of income and expenditure on railway transport (including freight and passenger transportation), investments in fixed assets (in thousands of manats) in recent years. For example, compared to 2015, the annual incomes from rail transport in 2019 increased and amounted to 299,772 thousand manats. Compared to 2015, expenditures on rail transport in 2019 increased by 138,720 thousand manats and reached 340,696 thousand manats. Compared to 2018, the volume of investments in fixed assets in railway transport in the Republic of Azerbaijan in 2019 decreased by 5831 thousand manats and amounted to 1254 thousand manats (Table 1). The analysis shows that the cost of transportation in recent years by rail exceeds revenues. That is why it is necessary to create and develop the private sector in this area.

Table 1 Incomes and expenses on railway transport (including freight and passenger transportation) in Azerbaijan in recent years (thousand manats, AZN)

Years	Incomes (X)	Expenditures (Y)	İnvestment to Fixed Capitals
2015	232077	201976	1594
2016	262435	327401	1911
2017	279202	460350	2088
2018	270841	323427	7085
2019	299772	340696	1254

Source: Compiled by the author based on State Statistical Committee of the Republic of Azerbaijan (2020) data (1$=1.70AZN).

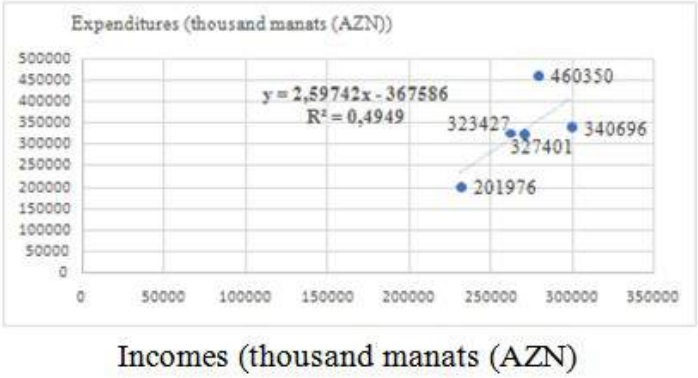

Figure 5.Correlation between incomes and expenditures on generaltransportation by rail in the Republic of Azerbaijan in recent years

Source: Compiled by the author based on State Statistical Committee of the Republic of Azerbaijan (2020) data

In recent years, we can determine the trend line, determination and correlation between revenues and expenditures on general transportation by rail in the Republic of Azerbaijan (Figure 5). If we look at the graph, we can see that this relationship comprises a regression model expressed by the equation y = 2,5974x-367586. That the coefficient of determination R^2 =0,4949 means that the corresponding regression equation is explained by 49.49% of the variance result, and 50.51% by the influence of other factors. The low coefficient of determination shows that the regression equation is less expressive of the initial data and that the factors explain a smaller portion of the outcome factor (49.49%) included in the model. The correlation coefficient R = 0.70 shows that the link between the two indicators is at a noticeable level[6].

The analysis shows that increasing costs is more intensive and exceeds revenues. That is why the creation of a private sector in railway transport can play an important role in overcoming economic setbacks in this area. That is why serious economic reforms in this area, the development of private entrepreneurship, can not only increase the volume of investments but also reduce annual costs.

Table 2 Incomes from railway transport services in the Republic of Azerbaijan and some factors affecting it

Years	Expenditures to good transportation, thousand manats (AZN), (x_1)	Expenditures to passenger transportation, thousand manats (AZN), (x_2)	İnvestment to fixed capitals, thousand manats (AZN), (x_3)	Putting into operation of fixed assets, thousand manats (AZN), (x_4)	İncomes from transportation, thousand manats (AZN), (Y)
2015	151482	50494	1594	144	232077
2016	245551	81850	1911	1911	262435
2017	345263	115087	2088	2089	279202
2018	248608	74819	7085	7085	270841
2019	260646	80050	1254	1254	299772

Table 3 .The regression relationship between incomes on railway transport and the factors affecting it

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	1					
R-Square	1					
Adjusted R Square	65535					
Standard Error	0					
Observations	5					
ANOVA						
	df	**SS**	**MS**	**F**	**Significance F**	
Regression	4	2460702637	615175659,3	29.17106	0.002907	
Residual	0	0	65535			
Total	**4**	**2460702637**				
	Coefficient	**Standard Error**	**t-Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	229349,1724	0	65535	0.113426	229349,1724	229349,2
X1	1,690943614	0	65535	0.069662	1,690943614	1,690944
X2	-4,539215396	0	65535	0.0135	-4,539215396	-4,53922
X3	-16,15061218	0	65535	0.007518	-16,15061218	-16,1506
X4	10,60781394	0	65535	0.237664	10,60781394	10,60781

Source: Based on the data analysis of table 2 conducted by the author, compiled in MS Excel 2019 software package.

If we analyse the regression relationship between revenues from rail transport in the Republic of Azerbaijan for 2015-2019 and the factors affecting it (Table 2), we can see that the linear model of multiple regression, which expresses the relationship between revenues from rail transport and factors affecting it, is as follows (Table 3):

$$Y=10.6078x_4- 16.1506x_3 - 4.5392x_2+ 1.6909x_1+229349.1 \quad (3)$$

From the goat contact equation (3), we can conclude that a single increase in freight costs by rail increases revenue from transportation services by 1.6909 units, a single increase in passenger transport costs reduces revenue from transportation services by -4.5392 units. One unit increase in investments in fixed assets reduces revenues from transportation services by 16.1506 units, one unit increase in fixed assets increases revenues from transportation services by 10.6078 units. That the coefficient of determination $R^2 =1$ shows that the approximation is very high. That the coefficient of determination $R^2 =1$means that the corresponding regression equation is explained by 100% variance results. The high coefficient of determination is because the regression equation better expresses 100% of the factors explained the initial data and the resulting factor included in the model. Since F = 0.002907, the regression model under the condition p <0.05 is important.This means that the regression equation is completely significant. This means that the model is adequate.

For the linear regression equation $Y=10.6078x_4-16.1506x_3 -4.5392x_2+ 1.6909x_1+229349.1$, if we calculate the coefficient of elasticity, which represents the percentage change in the dependent variable as a result of a 1% change in the free variable, we obtain the following results:

$$E_1 = \frac{\alpha_1\overline{x_1}}{\bar{y}} = \frac{1.6909 \times 250310}{268865.4} = 1.57 \quad E_2 = \frac{\alpha_2\overline{x_2}}{\bar{y}} = \frac{4.5392 \times 80460}{268865.4} = 1.35$$

$$E_3 = \frac{\alpha_3\overline{x_3}}{\bar{y}} = \frac{16.1506\times2786.4}{268865.4} = 0.16 \qquad E_4 = \frac{\alpha_4\overline{x_4}}{\bar{y}} = \frac{10.6078\times2496.6}{268865.4} = 0.09$$

The calculated prices of the elasticity coefficient can be shown in the following table:

Table 4. İncomes from railway transport services in the Republic of Azerbaijan and the elasticity of the factors affecting it

İncomes from transportation, thousand manats (AZN),	Expenditures to good transportation, thousand manats (AZN),	Expenditures to passenger transportation, thousand manats (AZN	İnvestment to fixed capitals, thousand manats (AZN),	Putting into operation of fixed assets, thousand manats (AZN
1%	+1.57	-1.35	-0.16	+0.09

A study by MS Excel software package shows that a 1% increase in transportation costs leads to a +1.57% increase in transportation incomes. An increase of 1% in the cost of passenger transport and investment in fixed capital leads to a decrease in incomes of transportation by -1.35% and -0.16%, respectively. An increase of 1% of putting into operation of fixed assets leads to an increase of + 0.09% in incomes from transportation. Based on the analysis, it is concluded that the factors that have the greatest impact on the growth of incomes from rail transport are the expenditures to good transportation and the putting into operation of fixed assets (Table 4).

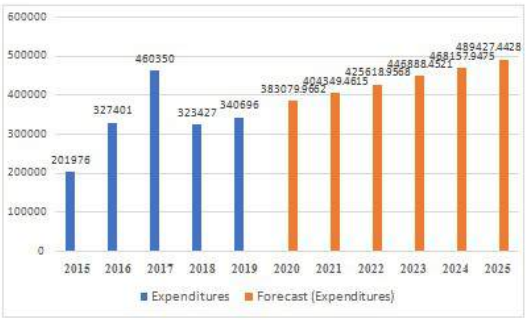

Figure 6. Forecast indicators of railway transport expenditures in the Republic of Azerbaijan for 2020-2025

Source: Based on the report conducted by the author, compiled in MS Excel 2019 software package.

Considering the above, according to the trend model for the period covering 2015-2019, the forecast indicators for 2025 based on the existing costs and economic conditions according to the MS Excel 2019 software package will be as in the graph above (Figure 6). According to the forecast, the expenditures on railway transport in the Republic of Azerbaijan will increase in 2020 to 383079.9 thousand manats, in 2021 to 404349.4 thousand manats, in 2022 to 425618.9 thousand manats, in 2025 to 489427.4 thousand manats (AZN). As seen from the analysis, the cost of maritime transport will increase every year during 2020-2025 (Figure 6). That is why it is necessary to carry out serious structural reforms in this area of transport and create a private sector.

3. Result and Disscusion

It should be noted that the Republic of Azerbaijan plays an important role in the implementation of projects in the region, such as "East-West", "North-South", "North-West" transport corridors. In these corridors, the railway transport of our country is more intensively involved in transportation. Launched in 2017, the Baku-Tbilisi-Kars railway transportation line can connect countries such as Turkey, Georgia, and Central Asian countries, including China. In the coming years, if this railway line is operational, it will have 3 million passengers and 15 mln. tons of cargo is planned to be transported.

Figure 7. The activity of railway transport in the Europe-Caucasus-Asia transport corridor in recent years (in the Azerbaijan part)

Source: Compiled by the author based on State Statistical Committee of the Republic of Azerbaijan (2020) data.

In the Europe-Caucasus-Asia transport corridor (Azerbaijani part) there has been a significant decline in the activity of railway transport in recent years. For example, in 2015, 15521 thousand tons of cargo was transported by rail on this corridor. In 2016, this figure decreased to 13830 thousand tons, and in 2018 to 12564 thousand tons. Compared to 2015, the volume of reduction in 2019 was 2194 thousand tons. During 2015-2019, the volume of transit cargo transportation by rail decreased to 3796 thousand tons (Figure 7). As seen from the analysis, in the Europe-Caucasus-Asia transport corridor (part of Azerbaijan) there was a process of reduction in the volume of both freight and freight transportation by rail. That is why it is necessary to develop the private railway transport sector, eliminate the state monopoly, and develop the activities of private companies.

The "East-West" corridor connecting Asia with European countries through the territory of the Republic of Azerbaijan can be further developed as a transit. For this, it is necessary to increase the political and economic influence on the opening of the "Zangazur" transport corridorto the neighbouring Republic of Armenia. The operation of the relevant corridor will increase the reputation of the Republic of Azerbaijan as international transport and logistics centre in the region. In addition, there will be a direct rail connection to Nakhchivan by land. We should note that the Azerbaijan-Nakhchivan-Turkey railway transport route is on average 344 km shorter than the Baku-Tbilisi-Kars railway route. As the transportation distance is shortened, transportation costs by rail in this direction of the transport corridor will be reduced. This will ensure that some regional countries carry cargo and passenger traffic (especially international tourism) from Europe to Asia along this corridor. That is why it is necessary to carry out serious reforms in this area, as the growth rate of rail transport is likely to increase

4.Conclusion

In general, the analysis shows that in recent years in the Republic of Azerbaijan there has been a significant decline in the main economic indicators of railway transport. That is why it is expedient to carry out serious economic reforms in this area, eliminate state monopolies, and develop private entrepreneurship. As a result, it is possible to make progress in the main economic indicators of the country's railway transport in the international rating reports. It is necessary to take the following measures shortly to develop the private sector for railway transport in the Republic of Azerbaijan and to establish private entrepreneurship:

- Azerbaijan Railways CJSC should be gradually privatised, transformed into an open joint-stock company, its assets should be revalued, it should involve international transport experts and consultants from the European Union and the World Bank in these processes. Should be offered to foreign and local investors as an open auction, competition or placement of a part of shares of the company on the stock

exchange. It is possible to increase the financial efficiency of Azerbaijan CJSC and the quality of service in the domestic and international markets.

- Low-budget (small, medium and large-scale) legal entities with the status of a legal entity owned by the state or the private sector (mixed - public and private joint ventures are possible) as part of "Azerbaijan Railways" CJSC or separate shares, stocks it is important to establish private railway transport companies, including freight and passenger transportation, infrastructure maintenance and repair enterprises;
- It is necessary to stimulate investments in this area by local and private entrepreneurs and the gradual transition to free tariffs for domestic and transit transportation of private entrepreneurship activities to be established in the sector.
- It is necessary to increase the speed of freight and passenger transportation by rail, to build new high-speed railway lines in the regions for this purpose, to modernise the existing infrastructure for this purpose;
- The strategy of digital transformation (transition) on railway transport should be adopted in our country and it should stimulate its development;
- The role of private entrepreneurship in the organisation of freight and passenger transportation by rail in the liberated territories, especially within the "Zangazur" transport corridor, should be increased, it should liberalise transportation prices, etc.

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