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MIT-ADT UNIVERSITY
(Established by Govt. of Maharashtra by MIT ADT University Act. No. XXXIX of 2015)
(MIT Art, Design and Technology University)

3rd National Level Conference on Advanced Transportation System & Infrastructure Development in Developing India.

ORGANISED BY

MIT Art, Design & Technology, University

And

Institute for engineering research and Publication (IFERP)

यंत्र - तंत्रादि विज्ञानम ।
लोक कल्याण साधनम् ।।

A true source of Inspiration...

Prof. Dr. V. D. Karad, a renowned educationist who is known in the society for his work in human rights, spiritual advices & democracy, is a strong follower of Vivekananda. Recently (2015) he participated in “Parliament of World's Religions” at Salt Palace Convention Center, SaltLake city, Utah, (U.S.)

More than 10,000 people from all over the world, from more than 80 nations and more than 50 faiths were present for the said parliament.

He is the same person who has initiated the First International Robocon, and World Peace Eco Park in 2009.

Under his valuable guidance MAEERS's MIT group of Institutions has reached 63 institutions with more than 50000 students on the campuses. His chain of “Vishwashanti Gurukul” schools initiated in 2007 has in a short span of time come up at more than 7 locations.

His institution has received UNESCO chair in 1996 from UNESCO Paris for his extraordinary contribution towards human rights & democracy.

Hon'ble, Prof. Dr. Vishwanath D. Karad
President
MIT Art, Design & Technology University, Pune

|| न हि ज्ञानेन सदृशं पवित्रमिह विद्यते ।
तत्स्वयं योगसंसिद्धः कालेनात्मनि विन्दति||

Meaning nothing is more sacred than knowledge. He who is himself perfected in yoga or similar Sacrifice finds better opportunity for himself in due course of Time.

MIT Art, Design & Technology University, Pune offers a large number of programs both at the under-graduate and post-graduate levels. I am sure that you will be able to find a course that will meet your expectations and help you prepare yourself for future life.

The main objective of the MITADT University is imparting domain knowledge in your chosen areas and providing you hands-on learning experience through practical work/tutorials along with unmatched theoretical experience.

We, at MITADT University believe in the holistic & inclusive development of young minds, and I am sure that, you will value the time that you spend at the campus.

I am confident that you will be a valuable addition to the MITADT University community of rising stars. The MIT Art Design Technology university family is looking forward to welcome you on campus.

Dr. Mangesh T. Karad
Executive President
MIT Art, Design & Technology University, Pune

Message from Vice Chancellor

In continuing the task of nation building to promote excellence in Higher education, MIT Art, Design & Technology University is Maharashtra Government's 5th Private State University to create a vibrant, multidisciplinary society through knowledge creation & dissemination. MITADT University promotes quality education to meet national & global challenges. The University has a holistic approach to inculcate the right values among students to produce socially sensitive citizens. Thus it encourages not only curricular activities, but co-curricular and extra – curricular activities. MITADT University is equipped with number of laboratories, Training Ship Vishwanath, various studios, an amphitheatre, various seminar halls as well as auditorium to conduct events. We have a highly qualified and motivated faculty, who work with commitment & dedication for the cause of Education & Research. Academic tie-ups have been established with several reputed research institutions / organizations within India & abroad to promote research. It is gratifying to note that MITADT University is one of the top upcoming multi-disciplinary campus, where various innovative programs make this the best preferred destination of students in India and abroad.

Prof. Dr. Sunil Rai
Vice chancellor – MIT ADT University

MIT ART, DESIGN & TECHNOLOGY UNIVERSITY, RAJBAUGH, LONI KALBHOR, PUNE, INDIA ESTABLISHED BY MIT ART, DESIGN & TECHNOLOGY UNIVERSITY MAHARASHTRA ACT NUMBER XXXIX OF 2015

MIT Art, Design & Technology University is a multi-disciplinary university which provides degrees in innovative areas like ART, Design & Technology.

In 2015 MAEER's premium campus, Raj Baugh, Loni Kalbhor, Pune is declared as Private state University named MIT Art, Design & Technology University. The campus is around 24 kms away from Pune Station and has residential facilities for students as well as on campus faculty.

MIT Art, Design & Technology University, Pune provides both Undergraduate, Post Graduate as well as special industry focussed postgraduate programs. Presently more than 4000 students are enrolled and residential facilities to accommodate more than 4000 students are provided on the campus. Transport from and to the campus is also available. It is land-marked by Loni-Kalbhor Railway station.

Though the University status is achieved in 2015 the whole campus has been functional for the last 12 years. Marine Engineering ranks 5th in the list of top Marine engineering colleges. The Design institute has its own identity in the nation and holds the 5th rank amongst Indian institutes. This year, University has started novel program areas like Aerospace Engineering, School of Architecture as well as Project Construction and Infrastructure Management. A new Vishwaraj Hospital is opened on 3rd April 2016.

This multi-disciplinary campus believes in value based education system imbibed by Father Founder Trustee Dr. V. D. Karad. He believes in principles of self-disciplinary actions, healthcare, and Meditation, Yoga and Community service. Students are encouraged for various on campus activities to develop their hobbies and can participate in various forums which majorly focuses on community service and promotion of devotional activities.

Jay Hind! Jay Bharat!

ART

The Art Spectrum majorly focuses on unconventional programs in areas like Dance, Music, Performing Arts, Broadcasting and Journalism and lastly Film & Television.

Design

This Spectrum covers novel aspects of Designing and the institute has created its significant brand all over the nation.

Technology

This university focuses on conventional Technology courses including micro-specialized streams like Marine Engineering, Food Technology, School of Architecture, Aerospace Engineering & various other sector specialized Management Programs

VISION

Develop, Build and incorporate Multi-disciplinary Academic programs in innovative fields and develop Research culture in the direction of Center of Excellence on the Map of Global scenario to visualize ourselves in the format of World Class Universities.

MISSION

Incorporate value based education system along with best academic excellence with various technical as well as cultural initiatives to become future leaders. At MIT Art Design & Technology University, Students are actively involved in the various start up initiatives to contribute to economical as well as technological skills to develop the nation.

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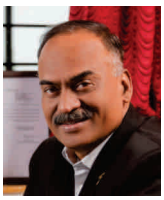

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MIT College of Management is established in the year 2007 to provide Sector specific education as per the industries demand in various sectors like Construction Management and Executive Education so as to provide leadership and entrepreneur ship qualities to the working Professional . Today industry is demanding skilled manpower in every field. India's construction industry is rapidly developing and to provide qualified professional is the need of time. Team of MIT College of management believes in on–site training, conducting workshop as well as in successful ERP training & on various construction management software.

To function as a certified organization of management education, concerned with quality teaching for the aspiring students and to accommodate the distinctive needs of all genres of students by continually developing new ways to improve programs and educational delivery systems using the latest industrial technologies for the promotion of management education in India.

Message from Director

Since information technologies (IT) have become a very important part of the construction processes, for handling Mega Town Ship Projects as well as High rise Building many research efforts approached the future of construction from IT implementation point of view. The vision was developed around seven major themes:

1. Model driven, as opposed to document driven information management on projects
2. Life cycle thinking and seamless transition of information and processes between life cycle phases
3. Use of past project knowledge (/information) in new developments
4. Dramatic changes in procurement philosophies, as a result of the internet
5. Improved communications at all life cycle phases, through visualization
6. Increased opportunities for simulation and what-if analysis
7. Increased capabilities for change management and process improvement In order to inform future the vision for future ICT in construction was defined as "the construction sector is driven by total product life performance and supported by knowledge-intensive and model based ICT enabling holistic support and decision making throughout the various business processes and the whole lifecycle by all stakeholders". . At MITCOM, it is our constant endeavor to provide the students with the necessary tools and techniques that will enable them to organize their work, as a manager, to meet the defined scope, quality, time and cost constraints. I am confident that the All the course which we have started at Undergraduate as well as Post Graduate level will help the students and the construction industry to shape India into an ever-escalating economy

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CONTENTS

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Establishing Relationship between CBR Value and Physical Properties of Soil

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Abstract:- **Subgrade strength is mostly affected by thickness of pavement, in Highway design. California Bearing Ratio (CBR) is the one of the method to determine the sub grade strength.CBR test is laborious and time consuming, hence a method is proposed for correlating CBR value with the LL, PL, SL, PI, OMC and MDD. In the present study, different soils samples (having 20<LL<70) were collected from different locations. Various laboratory tests including Atterberg limit, Specific Gravity, Gradation Analysis, CBR and compaction were performed on the samples. Various linear relationships between index properties and CBR of the samples were investigated using simple and multiple linear regression analysis and also predictive equation estimating CBR from the experimental index values were developed.**

Keywords: **- Coefficient of correlation (R) ^{2}, MLRA, Regression,SoakedCBR value, SLRA.**

I. INTRODUCTION

All civil engineering works such as the construction of highway, building structure, dam and other structure have a strong relationship with soil. All those structures need a strong layer of soil to make sure the structure are strong and stable. The weakness and failure of soil may capable make the structure which builds above of it become weak and collapse or fail. Therefore, the proper analysis of soil is necessary to ensure that these structures remain safe and free endue settling and collapse. Soil conditions vary from one location to another location. Hence it is difficult to predict the behavior of soil. As a result, soil conditions at every site must be thoroughly investigated for proper design.

Most of the Indian highways system consists of flexible pavement. There are different methods of design of flexible pavement. The California Bearing Ratio (CBR) test is an empirical method of design of flexible pavement. Sub grade soil bearing capacity plays very important role for the design of highway structure. It determines the thickness of the pavement. In other words, sub grade that has lower CBR value will have thicker pavement compared with the sub grade that has higher CBR value. CBR values can be measured directly in the laboratory test in accordance with IS 2720 part-XVI on soil sample obtained from the site.

However, to conduct a CBR test, representative soil sample has to be collected from the location selected, from which a remoulded specimen has to be prepared at predetermined Optimum moisture content and maximum dry density with standard proctor compaction, for the test to be conducted. To obtain soaked CBR value of a soil sample, it takes about a week, making CBR test expensive, time consuming and laborious. As a result, only a limited number of CBR test could be performed per kilometer length of the proposed road to be constructed. Such limited number of CBR test results may not generally reveal the variation in the CBR values over the length of the road to enable rational, economic and safe construction.

This could be avoided only if a large number of soil sample are taken. But such a procedure will increase the project cost and time. . To overcome these difficulties, an attempt has been made in this study to correlate CBR value statistically with the liquid limit (LL), Plastic limit (PL), Plasticity index (PI), maximum dry density (MDD) and optimum moisture content (OMC) of soil, because these tests are simple and can be completed with less period of time.

II. EXPERIMENTAL WORK

Twenty numbers of disturbed soil samples were collected (having different liquid limit) from different locations from in and around the city of Bagalkot district of Karnataka, India. The selected soil samples were tested for CBR value, optimum moisture content, maximum dry density, particle size distribution, liquid limit, plastic limit, shrinkage limit, plasticity index. All these tests were performed according to IS code specification. In this study, regression models, both simple linear regression analysis (SLRA) and multiple linear regression

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INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

analysis (MLRA), were developed for estimating soaked CBR value using physical properties of soils.

Table.1 Results of Laboratory Test for Soil Samples

Sl .No	Fines (%)	S (%)	G (%)	LL (%)	PL (%)	SL (%)	PI (%)	Soil type	Compaction Characteristics		Soaked CBR value (%)
									OMC	MDD	
1	10	87	3	23	NP	8.7	NP	SC	12	1.9	4.84
2	71	28	1	61	26	9.6	35	CH	23.1	1.45	1.06
3	72	25	3	64	39	14.3	25	CH	26	1.45	2.03
4	31	64	5	34	24	14.6	10	SC	12.12	1.98	4.18
5	77	22	1	57	30	22	27	CH	22	1.59	2.79
6	63	37	0	45	25	17.7	20	MI	21.05	1.6	3.2
7	64	35	1	52	28	9	24	CH	23.2	1.6	1.56
8	72	26	2	58	30	23	28	CH	19.8	1.63	2.54
9	71	28	1	66	40	10.8	26	CH	22.1	1.61	2.05
10	42	53	5	39	22.5	10.7	10.7	SC	15.82	1.8	3.45
11	57	26	1	41.5	25.6	14.3	16	CI	17	1.78	3.94
12	60	36	4	35.5	17	11	18.5	CI	16.2	1.89	3.28
13	61	38	1	37	13	8.6	24	CI	17.2	1.74	2.95
14	4	89	7	22	NP	14.7	NP	SW	10.5	2.3	5.25
15	46	45	9	49	27	9.2	22	SC	17.4	2.1	4.92
16	64	35	1	49.4	27	13.2	22.4	CI	18.2	1.74	3.28
17	10	86	4	24	NP	15.1	NP	SM	11	2.12	4.92
18	64	34	2	48	26	14	22	CI	15.7	1.78	3.12
19	74	25	1	66	35	8.4	31	CH	22.3	1.55	1.31
20	68	23	9	52	32	9	20	CH	19	1.69	1.5

III. RESULTS AND DISCUSSION

Table 1 gives the results of various soil properties from the experimental conducted in the laboratory for twenty samples taken for present investigation. The properties include index properties of soils such as liquid limit, plastic limit and specific gravity, compaction characteristics such as maximum dry density and optimum moisture content, grain size distribution analysis such as gravel(G%), sand(S%), silt and clay, California Bearing Ratio test is conducted at optimum moisture content. The range of soil properties studied in this investigation is: Gravel= 0-17%, Sand= 20-90%, Fines (silt & clay) = 4-75%, LL= 20-66%, PL= 20-35%, MDD= 1.45-2.3gm/cc, OMC= 10-23% and soaked CBR= 1-6%. A wide range of soil samples including fine and coarse grained soils are selected to predict soaked CBR value.

3.1 Regression Analysis

The various regression analysis between soaked CBR value with respect to different soil properties are presented in Fig.1, 2, and 3. It shows the linear trend line, which shows the effect of various soil properties with CBR value.

3.1.1 Simple Linear Regression Analysis (SLRA)

Simple Linear Regression Analysis (SLRA) was carried out by considering soaked CBR value as dependent variable and liquid limit, plastic limit, plasticity index, shrinkage limit, maximum dry density and optimum moisture content are considered as independent variables. It has been carried out to develop the correlation between individual soil property and soaked CBR value.

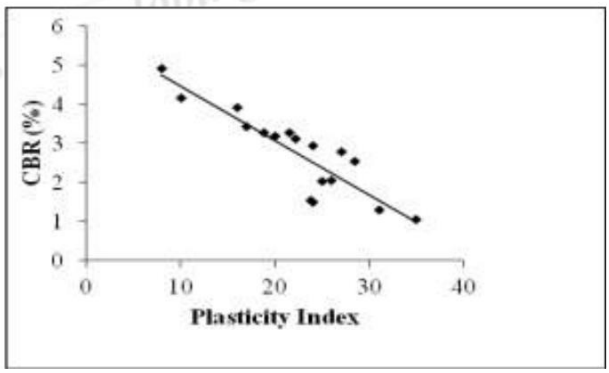

Figure 1 Correlation between plasticity index and CBR

Sample number 1, 14 and 17 are not considered for this regression analysis because these soils are non plastic (NP) in nature therefore using seventeen numbers of samples regression analyses have been made. The coefficient of correlation R^2 was found to be 0.72. Effect of soil properties on CBR value can be explained as liquid limit and plastic limit has less influence on CBR value. But CBR value varies with plasticity index such that as plasticity index increases CBR value decreases. This shows that there

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

is a fair to good relationship exists between CBR values for plastic nature of soils only.

From figure 2 it is observed that there is linear relationship exists between maximum dry density and CBR value. As maximum dry density increases CBR values also increases indicating linear relationship exists between these two parameters. From SLRA the coefficient of correlation R^2 for these two parameters is found to be 0.78, it represents good correlation between them.

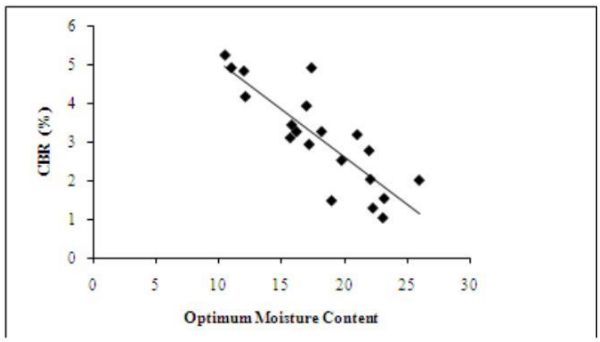

Figure 2 Correlation between plasticity index and CBR

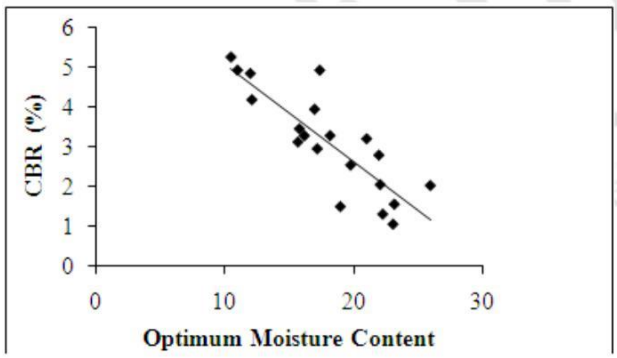

Figure 3 Correlation between plasticity index and CBR

The above figure 3 indicates that as moisture content increases CBR value decreases. The model developed for soaked CBR value has correlation coefficient R^2 =0.70, indicating a reasonable fit to the data and also it indicates that as optimum moisture content increases CBR value increases.

3.1.2 Multiple Linear Regression Analysis (MLRA)

It has been carried out by considering soaked CBR value as the dependent variable and remaining soil properties as independent variable. It can be expressed as given below:

Soaked CBR = (LL, PL, PI, MDD, OMC)

Equations

1. CBR = 5.09477 - 0.09323 (LL) + 0.10939 (SL) + 0.022566 (SI)
2. CBR = 5.813 – 0.007826 (LL) + 0.12097 (PL)
3. CBR = -4.8353 – 1.56856 (OMC) + 4.6351 (MDD)
4. CBR= -3.2353-0.06939 (PI) + 2.8 (MDD)
5. CBR= 6.5452 – 0.07703(OMC) - 0.10395 (PI)

Where, CBR= California Bearing Ratio, LL=Liquid Limit, PL= Plastic Limit, SL= Shrinkage Limit, PI= Plasticity Index, OMC= Optimum Moisture Content, MDD= Maximum Dry Density.

Equation 1,2,3,4 and 5 shows the multiple variable regression analysis. These equations include the correlation of all the parameters with CBR value. The three parameters plasticity index, maximum dry density and optimum moisture content directly affects the CBR value.

Equation 3 shows the correlation between CBR and optimum moisture content and maximum dry density. It is observed from figure 4 that the experimental soaked CBR values are close to predicted values. The model developed for CBR value has correlation coefficient (R^2) =0.82 indicating a reasonable fit to all types of soil.

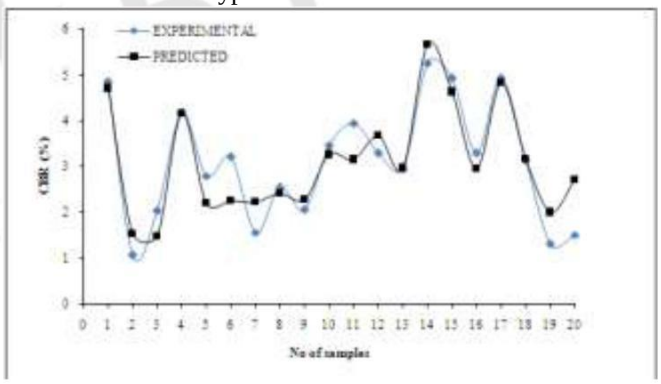

Figure 4.Comparison between experimental and predicted CBR value obtained from equation 3

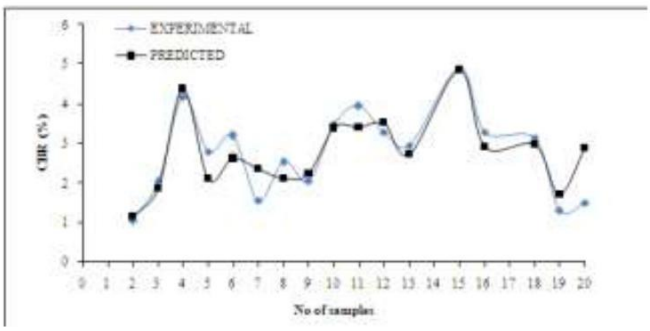

Figure 5 .Comparison between experimental and predicted CBR value obtained from equation 4

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It is known from simple linear regression analysis (SLRA) that CBR value decreases with increase in plasticity index and also increases with increase in maximum dry density. From SLRA coefficient of correlation R^2 for plasticity index and maximum dry density are 0.72 and 0.78 respectively. Hence an attempt is made to correlate CBR from plasticity index and maximum dry density. From the correlation coefficient R^2=0.76, it is concluded from figure 5 that CBR value prediction model based on MLRA are quite near to experimental values.

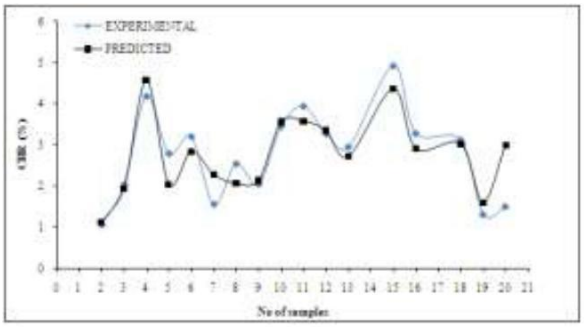

Figure 6 .Comparison between experimental and predicted CBR value obtained from equation 5

The above Figure 6 shows that the effect of moisture content and plasticity index on CBR value of soil samples collected for investigation. It is known from simple linear regression analysis (SLRA) that CBR value decreases with increase in plasticity index and CBR decreases with increase in moisture content. Also coefficient of correlation R^2 for optimum moisture content and plasticity index are 0.71 and 0.72 respectively. An attempt is made to correlate CBR value with these two variables using multiple linear regression analysis as shown in equation-5 and R^2 value found to be 0.75. Therefore it is concluded that MLRA holds good for these two parameters.

IV. CONCLUSION

[1] Based on experimental results and SLRA, there is no significant relation exists to predict CBR value from liquid limit and plastic limit.

[2] Linear relation exists between plasticity index and CBR value with a coefficient of correlation of R^2=0.72.

[3] It is found that good empirical relations y=4.99MDD- 5.711 (R^2=0.78) and y=-0.2443OMC+7.5264 (R^2=0.71) obtained by SLRA to predict CBR value from MDD and OMC.

[4] TheempiricalrelationCBR=-4.8353–1.56856(OMC) +4.6351(MDD) (R^2=0.82) obtained from multiple linear regression analysis (MLRA) shows good relation to predict CBR value from MDD and OMC.

[5] From the correlation analysis it is clear that, large variation can be observed between experimental and predicted CBR value particularly in case of high compressible clays (CH).

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INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Implementation of Automations for Optimisation of Public Operation and Services

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Abstract :- **In recent years, Indiais facing an explosive growth in vehicles ownership and utilization, which has led to traffic congestion and pollution. However Indians prefer to use private vehicles because of many reasons due to lack of cleanliness, lack of technology, smart solutions, their implementationsand bad services.This can be addressed by making smart assistance, using GPS, giving real time updates, updating regular stop and time table, making application which shows availability of public buses and various advanced technologies. In this regard, public transport operators are forced to lay emphasis on the monitoring and improvements of the services provided. This research paper focuses on traveler's satisfaction and preference towards public transport with service quality attributes. The aim is to evaluate the parameters in passenger preference and satisfaction on public transportation network with respect to facilities, comforts and quality of services. The application of this study suggest that the public transport operation especially, buses must improve the quality of their services for the prospective passengers.**

Keywords: **- Traffic congestion, public buses, advanced technologies,smart solutions**

I INTRODUCTION

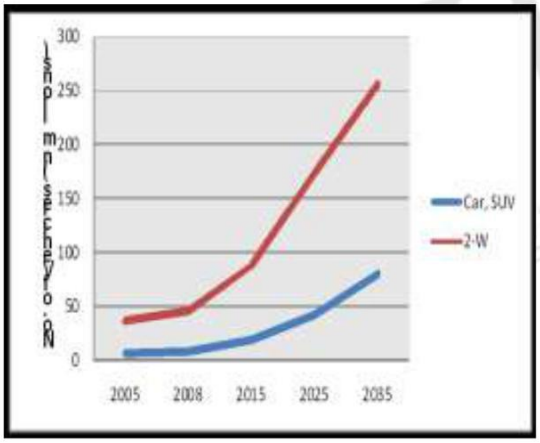

Figure 1: Forecast of Vehicle Populations in India

All the million plus cities in India facing a serious urban transport problems, due to the increases in population in urban areas as a result of both - the natural increase and migration from rural areas and smaller towns. The increase in the number of motorized vehicles and in the commercial and industrial activities has further added to transport demand in urban areas, shown in the above ***Figure 1***. In many cases, this demand has outstripped the existing road capacity. This is becoming more & more evident in the form of greater congestion and delays, which are widespread in Indian cities and indicate the seriousness of transport problems. A high level of pollution is another undesirable feature of these overloaded streets. The transport crisis also takes a human toll. Statistics indicate that traffic accidents are a primary cause of accidental deaths in Indian cities.

The main reasons behind these problems are (i) Prevailing imbalance in modal split, (ii) Inadequate transport infrastructure, and (iii) Sub-optimal use of existing transport infrastructure. The existing public transport systems in the Indian cities have not been able to keep pace with the rapid and substantial increases in demand over the past few decades. Particularly the bus services have much deteriorated, and their relative output is further getting reduced as passengers are continuously switching to personalized modes and intermediate public transport.

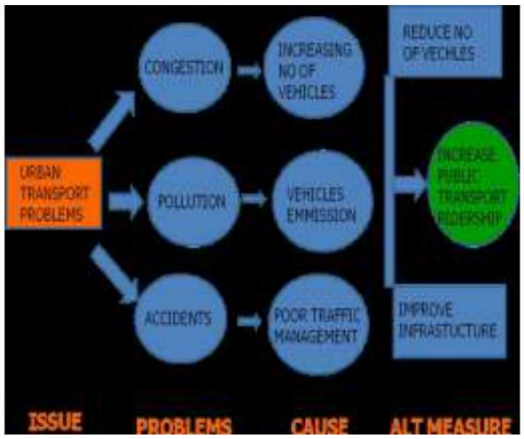

Figure 2

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Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

The above figure 2 mention the major issue, problems cause and best alternative measure related to urban transport and shows that how public transport can reduce urban transport problem in Indian cities. These cities cannot afford to cater only to private cars and two-wheelers. There must be a general recognition that without public transport cities would be even less viable. There is a need to encourage public transport instead of personal vehicles. This requires both an increase in quantity as well as quality of public transport and effective use of demand as well as supply-side management measures.

Hence, it is incumbent on the government to institute appropriate policy initiatives to increase the share of public transport by improving the service quality and comfort. Such interventions should identify & consider factors influencing the demand for public transport and should also quantify the impact of environmental and policy variables. Presently the public transport systems are either undercrowded or overcrowded.

II LITERATURE SURVEY

Herbert S. Levinson and Samuel Zimmerman proposed that the spiraling cost of rail transit, and market realities, a growing number of cities have installed or are planning BRT. This paper presents a synthesis of current experience, drawing upon ongoing research. The paper describes the nature of BRT; where BRT operates; key features such as running ways, stations, vehicles, ITS, and service patterns; performance in terms of ridership, travel times and land development; and the emerging implications for new systems. It is important to match transit markets to rights-of-way; achieve benefits in speed, reliability, and identity, minimize adverse impacts to street traffic, property access, and pedestrians; and obtain community support throughout an open planning process.

The paper by Dario Hidalgo and Pierre Graftieauxsummarizes technical, financial, and performance information regarding bus system improvements in 11 cities in Latin America and Asia. The cities selected in this review improved their transport conditions either through citywide bus reorganizations through improvements in selected corridors and areas of the city. Both citywide reorganizations and corridor improvements included the introduction of bus rapid transit (BRT) elements. The reviewed systems improved the transport conditions for the commuters served and had other benefits, particularly the reduction of pollution and accidents. The BRT corridors implemented show high performance and have generally been well received by the users, with relatively low capital investments and small or no operational subsidies. The systems have faced problems related to planning, implementation, and operations, mostly as a result of institutional and financial constraints. Most problems were solved in the initial months after implementation. The experiences in developing cities show the potential of BRT for a wide range of applications, from medium-demand to very-high-demand corridors. Lessons learned from these applications are useful for the development of similar projects.

III METHODOLOGY

This study provides information on the implementation of public transportation initiatives. The document contains a non-exhaustive list of measures to improve bus service. The approach developed in this guide is flexible and adaptable to local conditions and circumstances, allowing for adjustments and variations.

Section 1 introduces the purpose of the studyby explaining the rationale behind transportation projects aimed at improving bus services, and defining the main attributes of an improved bus system. Furthermore, the guide elaborates on the key motives for improving bus service as well as the potential payoffs that could result from such improvements.

Section 2 provides information on the steps to plan and implement improved bus services.

Section 3 lists a series of potential initiatives and measuresaimed at improving bus service. The first two themes, “network planning and services” and “branding & marketing”, are discussed in a qualitative manner. The last three themes – “right of way & transit priority”, “bus stop and bus station” and “vehicle” – are described in a standardized format, i.e. on index cards including a brief description of the measure, its potential benefits and issues, as well as average costs, examples and additional resources.

Section 4 contains direction on the monitoring and evaluation of improved bus services initiatives.
“The strategy to attract people to transit is always based on increasing convenience, affordability and the promise of performance. The strategy to retain riders is based on reliability and on the many other aspects of a customer’s experience that influence feelings of safety, trust and ease-of-use."

This guide has identified five “categories of action”, each of these containing more specific and

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

detailed measures or initiatives to achieve bus service improvements:

Network Planning and Services

These strategies aim to improve the transportation planning process. Planning for bus service is more effective when it relies on a comprehensive and strategic approach. The primary purpose is to form an integrated and efficient network of transit services, combining bus service with other modes of transportation (both public and private) and urban development policies.

Vehicle

Vehicles should be carefully selected because of their impacts on travel time, service reliability, and operating or maintenance costs.

Bus Stop and Bus Station

Bus stops and stations should be carefully designed because of their impacts on both the convenience and the attractiveness of using a bus service. Various key elements should be considered, such as the visibility of the bus stop/station, its accessibility and available commodities, the linkages to other transportation modes, enhanced traveler information as well as the location of the bus stops/stations (transit-supportive development). Choosing a bus stop location that maximizes surveillance may also contribute to reduce opportunities for crime.

Branding and Marketing

Branding and marketing strategies have become a critical component of transit improvement projects. These strategies are intended to build a distinct brand identity for a bus service by emphasizing its distinctive features and benefits, and presenting it as a "premium" transportation alternative. Branding, market research activities and social marketing are among the list of possibilities.

Right-of-Way and Transit Priority

A bus service can significantly benefit from the introduction of right-of-way and other measures that reallocate road space by giving priority to transit vehicles and increase the competitiveness of buses. By allowing buses to bypass traffic congestion, the service gains in speed and reliability. There exists a variety of transit priority measures and right-of-ways along which the bus can operate, such as dedicated right-of-ways, bus lanes and transit priority systems.

Smart Application for Public Convenience

Present bus transportation system is not well organized, so people avoid the use of public bus transport. Therefore there is a need of a smoother bus transport system. This application will keep the users updated.

This application will have following specifications:-

1. Bus timings
2. Bus routes
3. Alternative Bus which can be use
4. Booking facility available
5. Synced with GPS
6. Rapid Transit facility

Rapid Transit System

BRT (BRTS, busway, transitway) is a bus-based public transport system designed to improve capacity and reliability relative to a conventional bus system. Typically, a BRT system includes roadway that is dedicated to buses, and gives priority to buses at intersections where buses may interact with other traffic; alongside design features to reduce delays caused by passengers boarding or leaving buses, or purchasing fares. BRT aims to combine the capacity and speed of a metro with the flexibility, lower cost and simplicity of a bus system.

BRT systems normally include most of the following features:

Dedicated lane

Bus-only lanes make for faster travel and ensure that buses are not delayed by mixed traffic congestion. Separate rights of way may be elevated, in a cutting, or in a tunnel, possibly using former rail routes. Transit malls or 'bus streets' may also be created in city centers.

Busway alignment

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Centre of roadway or bus-only corridor keeps buses away from the busy curb-side, where cars and trucks are parking, standing and turning.

Off-board fare collection

Fare prepayment at the station, instead of on board the bus, eliminates the delay caused by passengers paying on board.

Intersection treatment

Prohibiting turns for traffic across the bus lane significantly reduces delays to the buses. Bus priority will often be provided at signalized intersections to reduce delays by extending the green phase or reducing the red phase in the required direction compared to the normal sequence. Prohibiting turns may be the most important measure for moving buses through intersections.

Platform-level boarding

Station platforms should be level with the bus floor for quick and easy boarding, making it fully accessible for wheelchairs, disabled passengers and baby strollers, with minimal delays.

High-level platforms for high-floored buses makes it difficult to have stops outside dedicated platforms, or to have conventional buses stop at high-level platforms, so these BRT stops are distinct from street-level bus stops. Similar to rail vehicles, there is a risk of a dangerous gap between bus and platform, and is even greater due to the nature of bus operations. Kassel curbs or other methods may be used to ease quick and safe alignment of the BRT vehicle with a platform.A popular compromise is low-floor buses with a low step at the door, which can allow easy boarding at low-platform stops compatible with other buses. This intermediate design may be used with some low- or medium-capacity BRT systems.

High capacity vehicles

High-capacity vehicles such bi-articulated buses may be used, typically with multiple doors for fast entry and exit. Double-decker buses or guided buses may also be used. Advanced Power train control may be used for a smoother ride.

Quality stations

BRT systems typically feature significant investment in enclosed stations which may incorporate attractive sliding glass doors, staffed ticket booths, information booths, and other more standard features listed above. They will often include level boarding, using either low-floor buses or higher boarding platforms level, and multiple doors to speed passenger boarding and enhance accessibility to disabled passengers. Fare validation upon entry to the station in a similar manner to that used on entry to a subway system is also common, particularly at busy stations.

Prominent brand or identity

A unique and distinctive identity can contribute to BRT's attractiveness as an alternative to driving cars, marking stops and stations as well as the buses.

Large cities usually have big bus networks. A map showing all bus lines might be incomprehensible, and cause people to wait for low-frequency buses that may not even be running at the time they are needed. By identifying the main bus lines having high-frequency service, with a special brand and separate maps, it is easier to understand the entire network.

IV CONCLUSION

There is a growing number of bus rapid transit systems throughout the world. A review of these experiences indicates that BRT can reduce saving times, attract new riders, and induce transit-oriented development. It can be more cost effective and provide greater operating flexibility than rail transit. BRT can also be a cost extension of rail transit lines. And it generally can provide sufficient capacities to meet peak-hour travel demands in most U.S. corridors.

There is, however, a need for improvements in vehicle design and system identity. There remain missing elements in many BRT systems, often a result of cost-cutting measures made during the development process. Other considerations include maintaining high average trip speeds. High speeds can be best achieved when a large portion of the service operates on separate rights-of-way. In addition, major BRT investments should be reinforced by transit supportive land development and parking policies.

More cities can be expected to implement BRT systems in the future. There will be a growing number of fully integrated systems, and even more applications of selected elements. These efforts will lead to substantial improvements in transit access and mobility.

This paper also suggests the use of smart application which will help in the smooth functioning of the BRT.

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

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Advance Way to Upgrade Pavement Subgrade Layer by Chemical Stabilization

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Abstract :- There are numerous soil stabilization techniques for improving the strength of the in-situ soil especially in road construction, and one of the techniques is using chemical additive. Chemical improvement is a time saving method that enables subgrade or sub-base layer and otherwise unsatisfactory materials in-situ to obtain higher density and strength, obviating the need for costly excavation and replacement with borrow material. This paper presents some results of the preliminary stages of research program carried out to explicate the mechanism and behavior between the liquid chemical and the engineering properties of three natural residual soils at laboratory scale. Liquid-formed chemical was selected in this research due to scarcity of such findings instead of the prevalent solid chemical additive such as lime, cement or fly ash. The focus on this research is on the improvement of engineering properties of two natural residual soils and mixed with different proportions of liquid chemical. Series of laboratory test on engineering properties, such as Modified Proctor Test, Consistency limits, moisture-density relationship (compaction) and California Bearing Ratio was undertaken to evaluate the effectiveness and performances of this chemical as soil stabilizing agent.

Keywords: **- Atterberg limit, CBR, Chemical Stabilization, Terrasil, Modified proctor test**

I. INTRODUCTION

Over the past few decades several factors have led to an increase in the number of people migrating to large cities. Consequently these large cities are getting over populated and quite expectedly necessity of business, residential construction has increased the civil engineering projects located in areas with unsuitable soil is one of the most common problems in many parts of the world. The unsuitable soil (Black cotton Soil) can be stabilized by performing soil stabilization. In India black soil is the most problematic soil when it comes to construction. In rainy season black cotton soil swells and become sticky. Whereas in summers the moisture present in the soil evaporates and soil shrinks resulting in the crack of approximate 10 to 15 cm wide and up to 1 meter deep. The percentage covered by black cotton soil in geotechnical areas of India is 16.6%, which says huge amount of soil in India needs stabilization. Mechanical, chemical, electrical, thermal and other methods are in practice to improve the engineering properties of soil.

In developing countries like India the biggest handicap to provide a complete network of road system is the limited finances available to build road by the conventional methods. Therefore there is a need for low cost road construction to meet the growing needs of the road traffic. The construction cost can be considerably decreased by selecting local materials including local soils for the construction of the lower layers of the pavement such as the embankment and sub-base course. If the stability of the local soil is not adequate for supporting wheel loads, the properties are improved by soil stabilization techniques. Thus the principle of soil stabilized road construction involves the effective utilization of local soils and other suitable stabilizing agents.

II. MATERIAL AND METHODOLOGY Types of Soil

- **Black cotton soil**

In this study, the soil under scrutiny was gathered from the vicinity of Flora Institute Of Technology, Khopi, Pune. At first, so as to distinguish the wide soil sorts in the field with no research facility testing, a visual characterization is done, which demonstrates that soil under scrutiny is brown in shading, further examination is completed with water to make a paste and rubbed in middle of fingers leaves a stain which is not watched for residues. When it is wet it doesn't get to be dry soon. In like way, display swelling and shrinkage and are described by a typical shrinkage pattern. The soil has an expansive surface zone because of level and lengthened molecule shapes that stick together when wet, avoiding typical waste procedures. When it is wet it doesn't get to be dry soon. In like way,

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

when completely dry, it is not soon wetted and shrinks causing breaks.

- **Red soil**

Red soil is derived from weathering of ancient metamorphic rock of the Deccan plateau. Red soil is any of a group of soil that grow in a humid temperature, moist climate under deciduous and mix forests and that have raw mineral. Thin organic layers overlying a yellowish brown leached deposit resting on an alluvial. Their colour is mostly ferric oxides occurring a slight coatings on the soil particle through the iron oxide arise as hematite as hydrous ferric oxide, the colour is red and when it happen in the hydrate system as limonite the soil become to be yellow colour. Generally the surface soils are red while the horizon under gets yellowish colour.

- **River sand**

Sand is natural occurring granular material composed of finely divided rock & mineral particles. It is defined by size, being finer than gravel & coarser than silt. Sand can also refer toward textural class of soil or soil type that is a soil containing more than 85% sand size particles (by mass).

The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or SiO2), usually in the form of quartz. The second most common type of sand is calcium carbonate, for example aragonite, which has mostly been created, over the past half billion years, by various forms of life, like coral and shellfish. It is, for example, the primary form of sand apparent in areas where reefs have dominated the ecosystem for millions of years like the Caribbean.

Tests on Soil

Test to know the engineering properties of soil can be carried out on site as well laboratory. On-site test are as follows:

1. Standard Penetration Test.
2. Cone Penetration Test, etc.

Laboratory test are as follows:

1. Atterberg Limits Test.
2. California Bearing Ratio.
3. Direct Shear Test.
4. Expansion Index Test.
5. Soil Compaction Test.
6. Unconfined Compression Test etc.

Type of Chemical

- **Terrasil**

Terrasil is nanotechnology based 100 percent organo silane, water dissolvable, bright and warmth steady, receptive soil modifier to waterproof soil subgrade. The Characteristics of Terrasil is such that it wipes out narrow ascent and water entrance from top, decreases water penetrability of soil bases (10-5 cm/s to 10-7 cm/s) while keeping up 100% vapor porousness, diminishes expansively and free swell, keeps up dry CBR under wet conditions, holds quality of road bases and expands imperviousness to deformation by keeping up frictional values between residue and controls disintegration of soils . TERRASIL is anything but difficult to utilize and safe to handle item that renders treated soils very water repellant. Terrasil conveys demonstrated results with a wide range of soils and doesn't modify their appearance. Terrasil is a think that blends with water. Once connected, it attempts to bond with the soil's silica and oxygen atoms. This implanted synthetic response makes the treated soil 98% water safe. The holding procedure starts inside of 3 hours of the beginning application till the procedure is finished (72 hrs.), Terrasil turns into a changeless piece of every soil particle and won't separate or filter into groundwater .

Table 1 Chemical composition of terrasil.

Chemical Compound	Value in Range(%)
Hydroxyalkyl-alkoxy-alkylsilyl	65-70%
Benzyl Alcohol	25-27%
Ethylene Glycol	3-5%

III. LABORATORY WORK AND RESULT

Performed various laboratory test on soil i.e Red and Black cotton soil to find out their basic properties such as liquid limit, plastic limit, specific gravity, modified proctor & CBR tests. And soil stabilization by using conventional stabilization for both red and black cotton soil by using natural river sand(10%) & chemical stabilization for both red & black cotton soil by using Terrasil(0.041%) from Zydex Industries.

A. Conventional Method Engineering Properties

In conventional method 10% of natural river sand is used as an additives to the soil i.e. both red and black cotton soil by weight of soil. All the test such as liquid limit, plastic limit, specific gravity, modified proctor & C.B.R test were performed on respective soils.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Red soil
Liquid limit

Table 2 LL of Red soil with 10% sand.

No	I	II	III
No. Of blows	24	25.5	28
Container no	1	2	3
Mass of container + wet soil(g)	25	33	27
Mass of container + dry soil(g)	22.5	28.5	24
Mass of water (g)	2.5	4.5	3
Mass of container (g)(W_1)	16	16	16
Mass of oven dry soil (g)(W_2)	6.5	12.5	8
Water content (%)	38.46	36	37.5

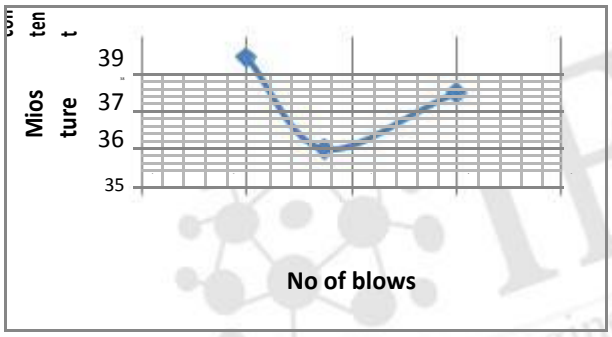

Fig. 1 Flow curve for Red Soil with 10% sand.

Liquid Limit:- 38.5
Plastic limit

Table 3 PL of Red soil with 10% sand.

No	I	II	III
CONTAINER NO	1	2	3
Wt of container	16.5	16.5	16.5
Wt of cont+ wet of soil	23.5	22	22.6
Wt of cont. + dry soil	21	20.5	20
Wt of water	2.5	1.5	2.6
Wt of dry soil	7	6	6.5
Water content	35	25	40

Plastic Limit:-33.33
Specific gravity [IS: 2720 (Part-III/SEC-I)]

Table 4 Specific Gravity Test for Red soil with 10% sand.

Determination	I	II	III
Density bottle no	1 (250gm)	2 (350 gm)	3 (300 gm)
Mass of density bottle	681	681	681
Mass of density bottle + dry soil	932	1032	982
Mass of density bottle + soil + water	1653	1684	1668
Mass of bottle +water	1506	1506	1506
Specific gravity	2.41	2.02	2

Average Specific Gravity=2.14
Modified proctor test (Heavy Compaction)

Table 5 Proctor Test for Red soil with 10% sand.

Determination no	I	II	III	IV	V
Wt of mould + compacted soil	5136	9096	10560	10120	9560
Wt of mould	5546	5546	5546	5546	5546
Volume of mould	2250	2250	2250	2250	2250
Wt of compacted soil	2567	3550	5014	4574	4014
bulk density	1.4	1.57	1.80	2.032	1.784
Dry density	1.29	1.42	1.56	1.722	1.48
Percentage of water use	6	10	15	18	20

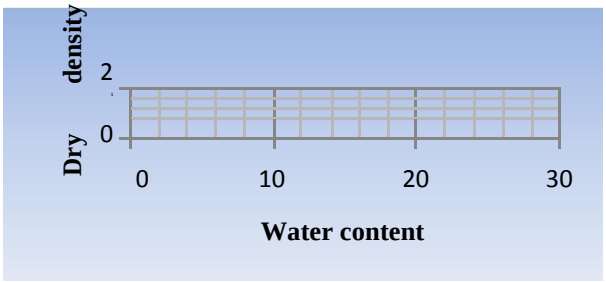

Fig. 2 Compaction Curve for Red soil with 10% sand.

OMC: - 15% and MDD:- 1.7125 g/cm^3
CBR

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Table 6 Standard load used in C.B.R test.

Penetration	Unit std. Load (kgf/cm2)	Total std. Load (kgf)
2.5mm	70	1370
5mm	105	2055
7.5mm	134	2630
10mm	162	3180
12.5mm	183	3600

Table 7 C.B.R test of red soil with 10% sand.

Soil type	Penetration	CBR	
		Native	10% sand
Red soil	@ 2.5 mm	6.5	8.37
	@ 5.0 mm	7.99	9.47

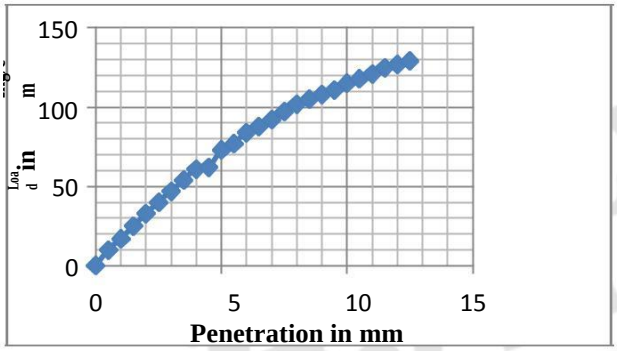

Fig. 3 Load Penetration Curve for C.B.R test of Red soil with 10% Sand

Black cotton soil

Liquid limit

Table 9 LL B.C soil with 10% sand.

N0	I	II	III
No. Of blows	21	26	31
Container no	1	2	3
Mass of container + wet soil(g)	26	27.5	27
Mass of container + dry soil(g)	22.5	23.5	23
Mass of water (g)	3.5	4	4
Mass of container (g)(W_1)	16.5	16.5	16.5
Mass of oven dry soil (g)(W_2)	6	6	6.5
Water content (%)	58.3	61.63	66.66

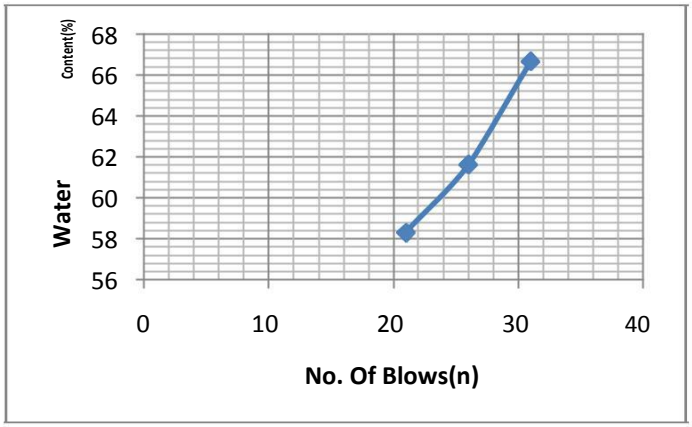

Fig. 4 Flow curve for B.C soil with 10% sand.

Liquid Limit:-60.9

Plastic limit

Table 8 PL for B.C soil with 10% sand.

NO	I	II	III
CONTAINER NO	1	2	3
Wt of container	16.5	16.5	16.5
Wt of cont+ wet of soil	24.5	23.5	23
Wt of cont. + dry soil	23	22	21.5
Wt of water	1.5	1.5	1.5
Wt of dry soil	8	7	7.5
Water content	18.75	21.14	20

Plastic Limit:- 19.96

Specific gravity [IS: 2720 (Part-III/SEC-I)]

Table 9 Specific gravity test for B.C soil with 10% sand.

Determination	I	II	III
Density bottle no	1	2	3
Mass of density bottle	681	681	681
Mass of density bottle + dry soil	932	1033	980
Mass of density bottle + soil + water	1640	1714	1677
Mass of bottle +water	1506	1506	1506
Specific gravity	2.14	2.44	2.33

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Average Specific Gravity:-2.30

Modified proctor test(Heavy Compaction)

Table 10 Proctor Test for B.C soil with 10% of Sand.

Determination no	I	II	III	IV
Wt of mould + compacted soil	8966	9331	9790	9565
Wt of mould	5546	5546	5546	5546
Volume of mould	2250	2250	2250	2250
Wt of compacted soil	3420	3785	4244	5546
bulk density	1.52	1.68	1.88	1.78
Dry density	1.43	1.55	1.70	1.56
Percentage of water use	6	8	10	13

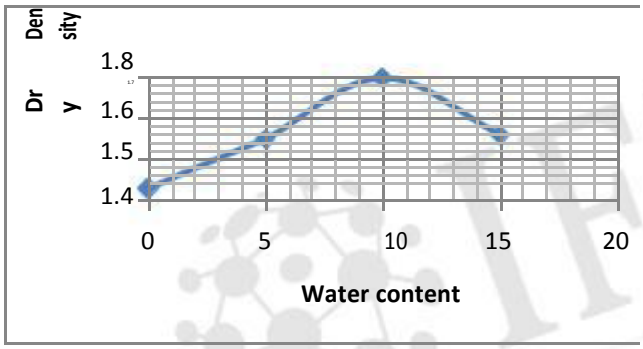

Fig. 5 Compaction Curve for B.C soil with 10% Sand.

OMC:- 10.125% and MDD:- 1.7 g/cm^3 CBR

Table11 Standard load used in C.B.R test.

Penetration	Unit std. Load (kgf/cm2)	Total std. Load (kgf)
2.5mm	70	1370
5mm	105	2055
7.5mm	134	2630
10mm	162	3180
12.5mm	183	3600

Table 12 C.B.R Test for B.C Soil with 10% sand.

Soil type	Penetration	CBR	
		Native	10% Sand
Black cotton soil	@ 2.5 mm	1.64	2.05
	@ 5.0 mm	1.42	1.8

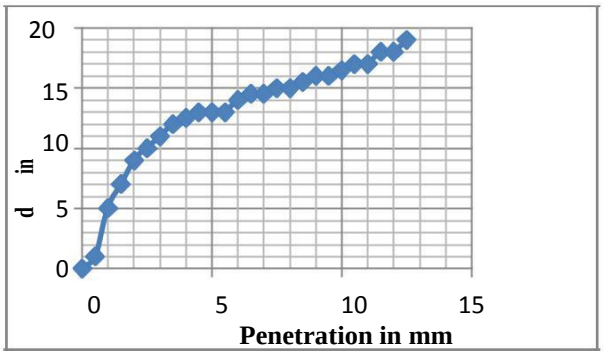

Fig. 6 Load Penetration Curve for C.B.R Test of B.C soil with 10% sand.

B. Chemical Method Engineering Properties

In chemical method 0.041% of Terrasil is used as an additive to the red & black cotton soil by weight of soil. All the test such as liquid limit, plastic limit, specific gravity, modified proctor & C.B.R test were performed on respective soils.

Red soil

Liquid limit

Table 13 LL Red soil With 0.041% Terrasil.

N0	I	II	III
No. Of blows	25	28	23
Container no	1	2	3
Mass of container + wet soil(g)	26	28	30
Mass of container + dry soil(g)	25	26.5	29
Mass of water (g)	1	1.5	1
Mass of container (g)(W_1)	16.5	16.5	16.5
Mass of oven dry soil (g)(W_2)	8.5	10	12.5
Water content (%)	11.76	15	8

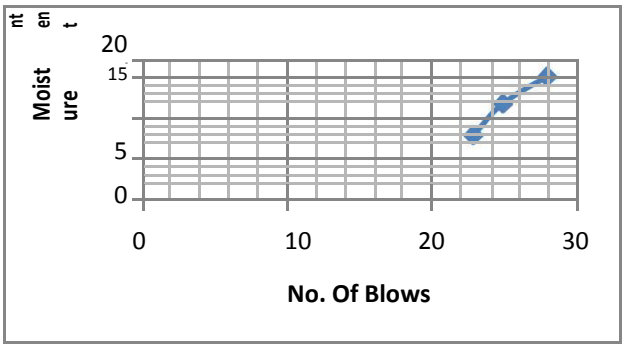

Fig. 7 Flow curve for Red Soil with 0.041% Terrasil.

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Liquid Limit:-11.7

Plastic limit

Table 14 Plastic Limit of Red Soil with 0.041% Terrasil.

NO	I	II	III
CONTAINER NO	1	2	3
Wt of container	16.5	16.5	16.5
Wt of cont+ wet of soil	33.5	32.5	31.2
Wt of cont. + dry soil	30	29.5	28
Wt of water	3.5	3	3.2
Wt of dry soil	13.5	13	11.5
Water content	25.9	23.07	27.8

Plastic Limit:-25.59

Modified proctor test (Heavy Compaction)

Table 15 Proctor Test Compaction Test of Red soil with 0.041% Terrasil

Determination no	I	II	III	IV	V
Wt of mould + compacted soil	7707	8446	9458	8458	5671
Wt of mould	5546	5546	5546	5546	5546
Volume of mould	2250	2250	2250	2250	2250
Wt of compacted soil	2161	2900	3912	3125	2912
bulk density	0.96	1.28	1.73	1.38	1.29
Dry density	0.91	1.16	1.50	1.16	1.075
Percentage of water use	6	10	15	18	20

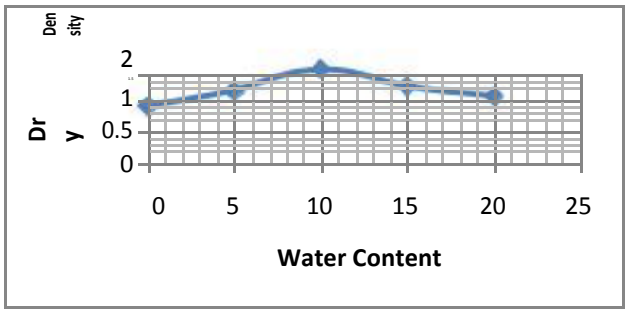

Fig. 8 Compaction Curve for Red Soil with 0.041% Terrasil.

OMC:-10.18% and MDD:-1.91g/cm^3

CBR

Table 16 Standard Load used in C.B.R Test.

Penetration	Unit std. Load (kgf/cm2)	Total std. Load (kgf)
2.5mm	70	1370
5mm	105	2055
7.5mm	134	2630
10mm	162	3180
12.5mm	183	3600

Table 17 C.B.R test of Red soil with 0.041% Terrasil.

Soil Type	Penetration	C.B.R	
		Native	0.041% Terrasil
Red Soil	@2.5 mm	1.64	2.79
	@5 mm	1.42	2.46

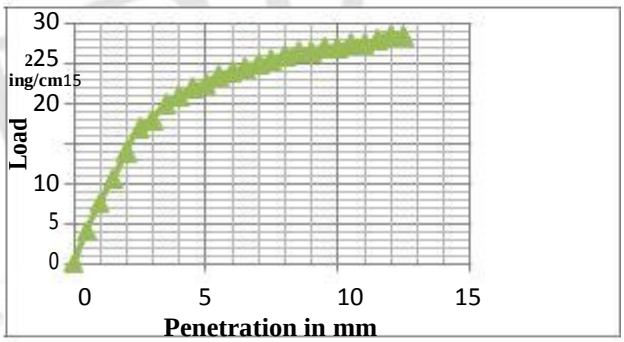

Fig. 9 Load Penetration Curve for C.B.R Test of Red soil with 0.041% Terrasil.

Black cotton soil

Liquid limit

Table 18 LL B.C Soil with 0.041% Terrasil.

N0	I	II	III
No. Of blows	25	22	28
Container no	1	2	3
Mass of container + wet soil(g)	29	32	26
Mass of container + dry soil(g)	25	26.5	23
Mass of water (g)	4	5.5	3
Mass of container (g)(W_1)	16.5	16.5	16.5
Mass of oven dry soil (g)(W_2)	8.5	10	6.5
Water content (%)	47	55	46

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Special Issue

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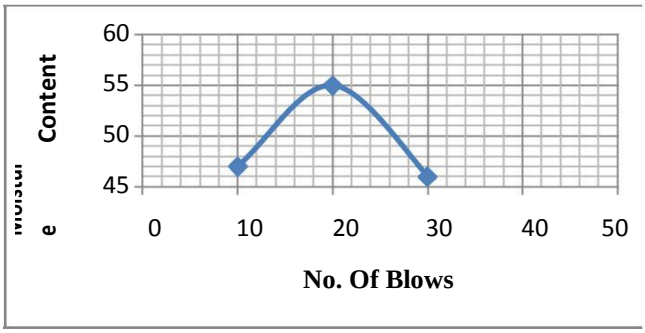

Fig. 10 Flow Curve for B.C soil with 0.041% Terrasil.

Liquid Limit:- 51.14

Plastic limit

Table 19 PL B.C soil with 0.041% Terrasil.

NO	I	II	III
CONTAINER NO	1	2	3
Wt of container	16.5	16.5	16.5
Wt of cont+ wet of soil	25	26	26.5
Wt of cont. + dry soil	23.5	24.5	24.3
Wt of water	1.5	1.5	1.5
Wt of dry soil	7	8	6.3
Water content	21.42	`18.75	23.80

Plastic Limit:-21.32

Modified proctor test(Heavy Compaction)

Table 20 Compaction Test of B.C soil with 0.041% Terrasil.

Determination no	I	II	III	IV
Wt of mould + compacted soil	9543	9728	9941	9812
Wt of mould	5546	5546	5546	5546
Volume of mould	2250	2250	2250	2250
Wt of compacted soil	3997	4182	4395	4266
bulk density	1.77	1.85	1.95	1.89
Dry density	1.63	1.68	1.69	1.61
Percentage of water use	8	10	15	17

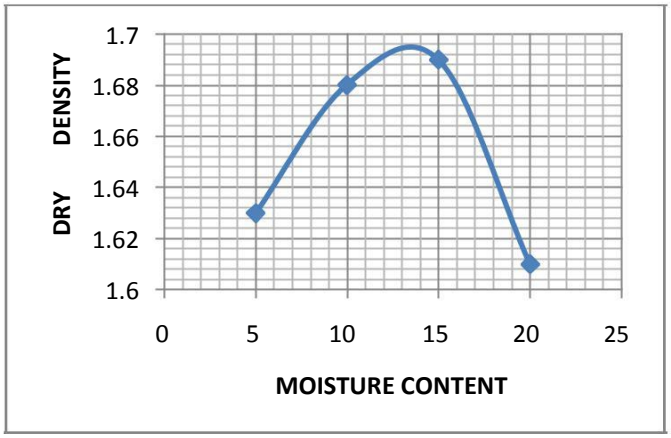

Fig. 11 Compaction Curve of B.C soil with 0.041% of Terrasil.

OMC:- 14.5 and MDD:-1.692

CBR

Table 21 Standard Load Used in C.B.R Test.

Penetration	Unit std. Load (kgf/cm2)	Total std. Load (kgf)
2.5mm	70	1370
5mm	105	2055
7.5mm	134	2630
10mm	162	3180
12.5mm	183	3600

Table 22 C.B.R test of B.C soil with 0.041% Terrasil.

Soil Type	Penetration	C.B.R	
		Native	0.041% Terrasil
Black Cotton Soil	@2.5 mm	1.64	10.641
	@5 mm	1.42	20.175

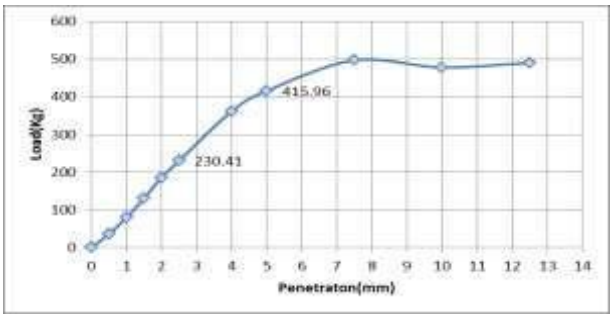

Fig. 12 Compaction Curve of B.C soil with 0.041% of Terrasil

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

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IV. CONCLUSIONS

1. It is concluded that for Black cotton soil and Red soil the Terrasil is an effective stabilizer to improve the density and to reduce water content.
2. The Liquid limit and Plastic limit found better after adding Terrasil for native soils.
3. It clearly shows that from compaction test results there is significant change in MDD and OMC for blended soil with Terrasil compared to native soil, as we are blending Terrasil to the native soil it densifies the soil and reduces the water content to achieve maximum dry density.
4. From test results for MDD and OMC we can make out the increase in density and reduction in moisture content.
5. From test results it is concluded that Terrasil is an effective stabilizer for Black cotton soil and for Red soil.
6. From result it is clear that by adding Terrasil to the selected soils the CBR values has increased significantly.
7. From test results for CBR, it can be concluded that Terrasil is a significant stabilizer for Black cotton soil and for Red soil, if it is available in economic haulage then it proves to be effective in economic considerations.

V. ACKNOWLEDGMENT

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Application of Intelligent Transportation System for Prevention of Traffic Congestion

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Abstract :- **The number of vehicles has increased exponentially, but the road width and transportation systems have not developed in an equivalent way to efficiently cope with the number of vehicles traveling on them. Due to this, road jamming and traffic correlated pollution have increased with the associated adverse societal and financial effect on different markets worldwide. WSNs have gained increasing attention in the traffic detection and avoiding road congestion. Many Wireless Sensor Network are being used such as Bluetooth, ZigBee, ultra wideband, and Wi-Fi. Due to its high power consumption, Wi-Fi has many limitations inspite having high data rate and long range distances. Implementation of ZigBee technology, consuming less power and other better prospects help to reduce overall cost, making it economically feasible in the developing countries like India. Sensors and networks are growing in technology faster. Wireless Sensor Network (WSN) is set to form a significant part of the new pervasive Internet. This research paper highlights on its applications as an emerging trend in future transportation management system.**

Keywords: **- Wireless Sensor Network, ZigBee, traffic detection**

I. INTRODUCTION

Traffic congestion is a major problem in cities of developing countries like India. Growth in urban population and the middle-class segment consuming vehicles significantly to the rising number of vehicles in the cities. Congestion on roads eventually results in slow moving traffic, which increases the time of travel, thus stands-out as one of the major issues in metropolitan cities. So, there is loss of life due to the delay in the arrival of ambulance to the hospital in the golden hour. The main reason is that traffic signals are used to manage conflicting requirements for the use of road space often at road junctions by allocating the right side of a way to different sets of mutually compatible traffic movements during distinct time intervals.

Traffic congestion management was recognized as one of the major problems in Pune, which has caused much frustration and loss of man hours. The operation of standard traffic lights which are currently deployed in many junctions, are based on predetermined timing schemes, which are fixed during the installation and remain until further resetting. Municipal governments are shifting away from their analog traffic management systems and are looking for better ways to control and manage the hundreds of busy intersections in their jurisdiction. In order to solve the problem an intelligent ZigBee traffic control has been developed. ZigBee technology with appropriate algorithm will be applied to a multi vehicle, multi lane and multi road junction area to provide an efficient time management scheme.

Most of the accidents these days are caused because of drivers not knowing the upcoming traffic hurdles like curves, traffic signals, railway lines and etc. If drivers come to know about the upcoming signals, curves, and railways lines etc the accidents can be avoided. The aim is to provide drivers with intelligent roads so that they can receive the information about the curves and the traffic signals ahead. After receiving the information about the signals ahead, drivers will be careful; this will help to avoid the road accidents.

Similarly in mountainous areas where there is lots of rain and snow throughout the year, driving is a tough job. In order to make driving on roads easy, an efficient system is required which informs drivers about upcoming traffic hurdle before a safe distance so that drivers becomes alert. There are many researches going on in the field of ITS (Intelligent Transportation Systems) and already many systems are available but these systems are very expensive which make these systems very difficult to install. ZigBee is inexpensive which reduces the total cost of the system. Similarly its low power consumption makes it useable in areas where there is no power available. This research brings an idea of using short range wireless technology "ZigBee" in Intelligent Transportation Systems.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

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II LITERATURE SURVEY

Geetha.E, V.Viswanadha, Kavitha.G proposed an intelligent auto traffic signal control system. Traffic congestion is one of the major issues to be considered. Generally Vehicular traffic intersects at the junctions of the road and is controlled by the traffic signals. Traffic signals need a good coordination and control to ensure the smooth and safe flow of the vehicular traffic. During the rush hours, the traffic on the roads is at its peak. Also, there is a possibility for the emergency vehicles to stick in the traffic jam. Therefore; there is a need for the dynamic control of the traffic during rush hours. Hence, they propose a smart traffic signal controller. The proposed system tries to minimize the possibilities of traffic jams, caused by the traffic lights, to some extent by clearing the road with higher density of vehicles and also provides the clearance for the emergency vehicle if any. The system is based on the PIC 16F877A micro controller, IR sensors and Radio Frequency Identification (RFID) technology. The code for this project is compiled in high tech C compiler and the simulated with Proteus software.

Ayush Kr. Mittal and Deepika Bhandari proposed a green wave system. It is used to provide clearance to any emergency vehicle by turning all the red lights to green on the path of the emergency vehicle, for this reason providing a complete green wave to the desired vehicle. A "green wave" is the synchronization of the green phase of traffic signals. With a "green wave" setup, a vehicle passing through a green signal will continue to receive green signals as it travels down the road. Advantage of the system is that GPS inside the vehicle does not require additional power. The biggest disadvantage of green waves is that, when the wave is disturbed then the disturbance can cause traffic problems that can be exacerbated by the synchronization. In such cases, the line of vehicles in a green wave grows in size until it becomes too large and some of the vehicles cannot reach the green lights in time and vehicles must stop. This is called over-saturation.

Suresh Sharma, A.Pithora, G.Guptha, M.Goel, and M. Sinha proposed a RFID system. The use of RFID traffic control to avoid problems that usually arise with standard traffic control systems, particularly those related to image processing and beam interruption techniques are discussed. This RFID system [2] deals with multivehicle, multilane, multi road junction areas. It provides an efficient time management scheme, in which a active time schedule is worked out in real time for the road of each traffic column. The real-time operation of the system gives the judgment of a traffic policeman on duty. Number of vehicles in each column and the routing are proprieties which upon the calculations and the judgments are done. The disadvantage of this work is that it does not discuss what methods are used for communication between the emergency vehicle and the traffic signal controller.

III METHODOLOGY

Intelligent Transportation Systems using short range wireless technologies as a communication medium is an effort to make driving easy. This research is based on a concept that drivers get to know about the upcoming traffic hurdles like traffic signals, curves, railway lines etc before actually reaching at them. This will avoid accidents on road which are caused by sudden confrontation with traffic hurdles. Similarly this system can be very helpful in mountainous areas where there is snow and fog and drivers are actually unaware of upcoming traffic hurdles. ZigBee is a short range wireless technology used in this research because it's very inexpensive and consumes very low power as compared to its other peer short ranger wireless technologies like Bluetooth and Wi-Fi. Since this system is more important for mountainous areas where there is no power in some cases, ZigBee will help with its low power consuming attribute. Although ZigBee is a short range wireless technology but it provides enough range to transfer data from car to traffic hurdles and vice versa. Because of its low cost, this system can be used in developing countries as well. Various research papers say that ZigBee with its low power, low cost and enough data transfer rate is a good choice for Intelligent Transportation Systems of this class.

A. Requirements

Every vehicle should have a ZigBee Host. Along with the ZigBee Host vehicle must be provided with Radio Frequency Indication (RFID) tag that stores a vehicle identification number (VIN). Every vehicle has its unique VIN number that provides the information regarding the priority of vehicle and type of vehicle. With the help of VIN we can uniquely identify the vehicle and its owner.

Vehicle Identification Number: - In the proposed work RFID tag will store vehicle identification number. These numbers is divided in three parts. First part represents the priority of the vehicles. Next part represents the type of vehicle and next digit represents the vehicle number. In the proposed work, different types of vehicles have different type of priorities.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Vehicles are divided into 4 categories:-

1. Ambulance, Fire brigade vehicles and VIP vehicles: These vehicles have a highest priority.
2. Local buses, school and colleges buses: These buses need to reach their destination on time so these vehicles also need a fast service.
3. Private cars, motorcycles and scooters.
4. Heavy vehicle.

Day time priority of 3rd category is high as compare to 4th category but during night hours the priority of heavy vehicles is high.

B. System Description for Traffic Hurdles:

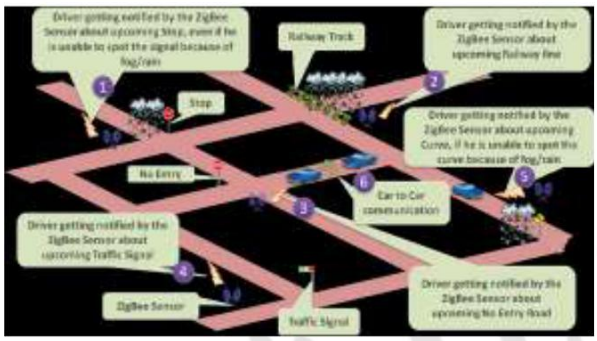

Figure 1

Figure No.1 given above illustrates the concept of this study. Because of the weather conditions most of the times, traffic hurdles become very dangerous and cause road accidents e.g. slippery at curve or invisibility of traffic signals due to fog or heavy snow. In such conditions drivers get aware of these traffic hurdles when they are at it and won't be able to stop the car which results in accidents. This study will emphasize on warning (informing) drivers of upcoming traffic hurdles before actually reaching them.

On each traffic hurdle a ZigBee Sensor is installed and each car is equipped with a ZigBee Host. Whenever car reaches the range of the ZigBee Sensor (for this study we considered this range to be 100 m), the communication between the ZigBee Sensor and Host starts, the ZigBee Sensor sends the signal (in the form of bits) to the ZigBee Host informing about the type of hurdle ahead along with the distance to the hurdle. The ZigBee host after receiving this information will display this information on a screen to driver. Driver then can take appropriate action after getting informed.

C. Flow of Information:

In this system a ZigBee sensor is installed at each traffic hurdle that contains all the information about that hurdle e.g. Hurdle ID, Distance from ZigBee Host etc. Each car in this system is equipped with ZigBee Host. As soon as car enters the communication range of the traffic hurdle, ZigBee Host in the car starts communicating with ZigBee Sensor at the traffic hurdle.

The information flow between the car and the traffic hurdle, in this case the Traffic Signal. The numbers 1~5 are described below;

1) Car (ZigBee Host in the Car) sends its ID to the Sensor at Traffic Signal.
2) Sensor acknowledges the ID.
3) Car asks for the information about the upcoming traffic hurdle.
4) Sensor sends the information about the traffic hurdle.
5) Acknowledges the information received from traffic hurdle.

Intelligent Transportation Systems can not only be used for traffic congestion control but also can be used for Ambulance clearance and stolen vehicles detects.

1. First part contains automatic signal control system. Each vehicle equipped with an RFID tag. When it comes in the range of RFID reader, it will send the signal to the RFID reader. The RFID reader will track the how many vehicles have passed through for a specific period and determine the congestion volume. Accordingly, it sets the green light duration for the path.

2. Second part for is the emergency vehicle clearance. Here each vehicles contain Zigbee transmitter and Zigbee receiver will be implemented at the at the traffic junction. The buzzer will be switched ON when the vehicle used for emergency purpose.

3. If a match is found, it sends SMS to the police control room and changes the traffic light to red, so that the vehicle is made to stop in the traffic junction and local police can take appropriate action

D. PROPOSED MODEL for these three parts:-

From the current problem section, existing technologies are congestion controller, emergency vehicle clearance, stolen vehicle detection, etc. To solve these difficulties, we propose to implement our

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Special Issue

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Intelligent Traffic Control System. It largely covers of three parts.

- First part contains automatic signal control organization. Here, each vehicle is equipped with an RFID tag. When it originates in the range of RFID reader, it will send the signal to the RFID reader. The RFID reader will track how countless vehicles consume passed through for a specific period besides determines the congestion capacity. Accordingly, it sets the green light period for that track.
- Second part is for the emergency vehicle clearance. Here, each alternative vehicle contains ZigBee transmitter module besides the ZigBee receiver will remain implemented by the traffic junction. The buzzer will be switched ON once the vehicle is rummage-sale aimed at emergency resolution. This will send the signal through the ZigBee transmitter to the ZigBee receiver. It will make the traffic light to change to green. Once the ambulance passes through, the receiver no longer receives the ZigBee signal and the traffic light is turned to red.
- The third part is responsible for stolen vehicle detection. Here, when the RFID reader reads the RFID tag, it compares it to the list of stolen RFIDs. If a match is found, it sends SMS to the police control room and changes the traffic light to red, so that the vehicle is made to stop in the traffic junction and local police can take appropriate action.

IV CONCLUSION

This research study highlights that with the help of ZigBee technology drivers come to know about the upcoming signals, curves, and railways lines etc and hence the accidents can be avoided. With automatic traffic signal control based on the traffic density in the route, the manual effort on the part of the traffic policeman is saved. The design and implementation of this technique is directly targeted for traffic management so that emergency vehicle on road gets clear way to reach their destination in less time and without any human interruption. As the entire system is automated, it requires very less human intervention. The stolen vehicle can be detected by the signal automatically, which turns red, so that the police officer can take appropriate action, if he/she is present at the junction. Also SMS will be sent regarding the location obtained using GPS, so that they can prepare to catch the stolen vehicle at the next possible junctions.

Emergency vehicles like ambulance, fire trucks, need to reach their destinations at the earliest. If they spend a lot of time in traffic jams, precious lives of many people may be in danger. With emergency vehicle clearance, the traffic signal turns to green as long as the emergency vehicle is waiting in the traffic junction. The signal turns to red, only after the emergency vehicle passes through. This system was proved to be effectual to control not only ambulance but also authoritative vehicles. Thus the proposed system if implemented in countries with large population like INDIA can produce better results. The system is more accurate with minimum possible duration. This system will definitely help the traffic police to give the way to the ambulance when there is heavy traffic on the road. It is very smart to find the location of stolen vehicle and help police to take necessary actions.

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Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Review on "Box Girder Culvert Analysis Using Ansys"

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Abstract :- **Thedesign of a highway and railway bridges depends critically upon standards and criterias. Naturally, theimportance of highway bridges in a modern transportation system would imply a set of rigorous design specifications to ensure the safety, quality and overall cost of the project. The nature of complexity of box girder bridges makes it difficult to accurately predict the structural response of box girder under loading. However, this complexity and difficulty in thedesign and analysis of box girder bridges can be handled by the use of the digital computer software in the design. Now a days box girder iswidely used for the construction of the bridge. Box girder cross section smay take theform of single cell (one box), multi-spline (separate boxes) or multi-cell with a common bottom flange. The objective of this analysis is to modelling the box girder in an ANSYS FEM design. This task involves examining the stresspatterns obtained using static three-dimensional finite element modelling. ANSYS is developed by th eworld's largest ANSYS finite element analysis software company from United States. Itcan interface with most CAD software, sharing and exchange of data.**

Box girders provides better resistance to torsion, which is of benefit if he bridge deck is curved in plan. In thiscurrentstudy, non composite straight steel boxes are analyzed with beam and Shell elements using the three dimensional finite element analysis and their behaviour is investigated. Box girder bridge can be analyzed by usingn onlinear finite elemen tprogram ANSYS. In this research, a steel box girder is analyzed by ANSYS program. The objective of this analysis is to model the box girder in an ANSYS FEM design. This task involves examining the stress patterns obtained using static three-dimensional finite element modelling.

Keywords: **- Box Girder, Finite Element Method, ANSYS, Stress patterns**

I. INTRODUCTION

A culvert is a structure that allows water to flow under a road, railroad, trail, or similar obstruction from one side to the other side. Typically embedded so as to be surrounded by soil, a culvert may be made from a pipe, reinforced concrete or other material. It is well known that roads are generally constructed in embankments which come in the way of natural flow of storm water (from existing drainage channels). As such flow cannot be obstructed and some kind of cross drainage works are required to be provided to allow water to pass across the embankment.

Box culvert has many advantages compared to slab culvert or arch culvert. The box is structurally strong, stable and safe and easy to construct. The main advantage is, it can be placed at any elevation within the embankment with varying cushion which is not possible for other type of culverts. A multi cell box can cater for large discharge and can be accommodated within smaller height of embankment. It does not require separate elaborate foundation and can be placed on soft soil by providing suitable base slab projection to reduce base pressure within the safe bearing capacity of foundation soil.

The size of box and the invert level depend on the hydraulic requirements governed by hydraulic designs. The height of cushion is governed by the road profile at the location of the culvert.

The benefits of steel box culverts include Structural Capacity, Lightweight Construction, Easy Installation, Aesthetically pleasing, Maintenance free, Long service life and Design flexibility.

Ongoing culvert function without failure depends on proper design and engineering considerations being given to load and water capacities, surrounding soil analysis, backfill and bedding compaction, and erosion protection. Improperly designed backfill support around aluminium or plastic culverts can result in material collapse or failure from inadequate load support.

The study includes the study of effect of soil pressure on box girder and to analyse the performance of the steel box girder using finite element analysis.

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Special Issue

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2. LITERATUREREVIEW

1. **Sandeep Kumar Ahirwar, Mohd. Afaque Khan, Abhishek Kumar (April-2016)** were tried to explain the various methods to understand the behavior of Box Girder Bridges. The study states that, the main beam of Box Girder Bridge is comprises of girders in the shape of hollow box which is economical and long lasting solution as well. These are widely constructed for medium and short spans. They are built to carry load in Shear and Flexural bending. Design and analysis of box-girder bridges are very complex because of its three dimensional behaviors which consists of torsion, distortion and bending in transverse and longitudinal directions. The need of this study is to understand the behavior of box girder bridges with the help of various analytical methods to understand the behavioral aspect.

2. **Ms. Patil M.B. 1, C.M. Deshmukh2 , Dr.C.P.Pise3 , Y .P . Pawar2 , S .S .Kadam , D .D .Mohite2, S.V. Lale2 (March-2016)** explained in their study that the behavior of the composite structure is heavily influenced by the properties of its component materials. The use of a concrete slab on a steel girder uses the strength of concrete in compression and the high tensile strength of steel. Stronger, stiffer materials like steel attract proportionally more load than materials such as concrete. If there is no connection then the materials will behave independently, omitting the positive effects, but if adequately connected the materials act as one whole structure. In this study they determined three girders which can be effective to the composite bridges and their analysis is made using software.

3. **P.Sachithanantham, D.Ebenezar Anburaj (June-2015)** addressed examination utilizing shell and pillar component models of the straight and bended box brace span. This undertaking includes analyzing the anxiety examples which acquired utilization of static three-dimensional limited component demonstrating. Examinations are made between the straight and bended box brace spans, from the shell component model and pillar component model for each. At the end, the parametric examinations are performed on the bended steel box model to assess the impacts of a few critical parameters on the conduct of the support. This paper states that the longitudinal bending stress distribution in wide flange girders is distributed non-uniformly throughout the width. It remains maximum at the edge and reduces towards the centre, and usually it cannot be obtained accurately from elementary beam theory.

4. **Zhang Kai Yuan (June-2015)** In this research, a steel box girder was analyzed in ANSYS program with the Monte Carlo simulation direct sampling probabilistic method. The objective of this analysis is to make a model of the box girder in an ANSYS FEM design, check the frame structure of box girder in moments and force, bending + axial and stress and strain graph and to compare the result based on difference graph. In this research, Finite Element Methods (FEM) models were used to stimulate the characteristic behavior of the concrete, steel and reinforcement steel structure using ANSYS+CIVILFEM 12.0 program. In order to validate the requirements to meet the alignment, driving comfort, people's aesthetic and other requirements, this study test have been taken on the box girder by load through ANSYS+CIVILFEM software. This research is applied on different size and type of box girder, which generated different result by application of different loading on box girder.

5. **Muthanna Abbu, Talha Ekmekyapar, Mustafa Özakça (May-2013)** proved that although three dimensional Finite Element (FE) modelling is probably the most critical and time consuming, it is still the most comprehensive and effective technique for static as well as dynamic analyses, which captures all aspects affecting the structural response. The other methods proved their adequacy but are limited in scope and applicability. In this study, three-dimensional solid FE model was created using ANSYS for the study of thermal loadings. By taking into consideration, longitudinal strains, modal analysis, and deformations, this model simulated a three span, 220-meter concrete bridge which is built to replace an existing six span concrete bridge across the Kealakaha Stream. A major interest in this paper is to perform three-dimensional FE analyses of composite box girder bridge to replicate the actual bridge behaviour. In this, attention is focused on development of representative numerical models for a composite box girder bridge. To achieve this purpose several FE models of a laboratory specimen are developed using different approaches available within ANSYS software.

6. **Zakia Begum, MS, (2010)** explained that the box girders offer better resistance to torsion, which is particularly of benefit if the bridge deck is curved

in plan. Due to the high torsional stiffness of the box girders as the cross section is closed, it often ranges from 100 to 1000 times larger than the torsional stiffness of comparable I-shaped sections, the torsional moment induced by the curvature of the girder can be resisted by the I-shaped girders with much more transverse bracing than that of the box girder. The fabrication of the I-shaped girder is more economical as compared to the Box shaped girder, but this additional cost in box girder is usually balanced by the reduction in substructure that need to construct. This study is to develop the three-dimensional finite element beam and shell models of curved and straight box girders using the commercially available finite element computer program "ANSYS".

7. **Kritee Chhetri1, Rajendra.S and Kavitha.N** made a study which showed the 3D analysis and dynamic vehicular analysis result is compared to a simplified static analysis by analysing span to height ratio of the culvert. A parametric study is made on the behaviour of a multi cell box culvert when subjected to dead loads and IRC wheel loadings. The effective width method is used to model the box culverts using SAP 2000 software. For the analysis and design of culvertsIRC 70R loading is used. The results of the study revealed that their issignificant influence on the result of the dynamic analysis and it is necessarily and carefully considered for analysis and design. The alteration in the relative stiffness of various members in a culvert is observed by changing in span to height and hence affects the internal forces in the members. Also, considerable variations in the results of bending moments can be seen with varying span to height ratio of culverts. Analysis of Vehicular dynamics revealed that the maximum bending moment occurs for the dynamic vehicular load case.

8. **PatilYashavant S.1, Prof. ShindeSangita B.:-** The comparative analysis of two standards namely AASHTO and IRC followed in construction of superstructure of bridge accounting load of heavy vehicles is presented in this paper.The aim of this study is to find the optimized Design, to apply the variety of checks and exercising them. As a result, it is found that results of stresses and bending moment due to self-weight and superimposed loads remains same, but varies under moving load considerations.This is due to the fact that IRC codes accounts for the design for the heavy loading conditions as compared to the AASHTO codes. The results revealed that the IRC codes are costly i.e. less economic because of the number of reinforcement bars in the pile cap and piles is more, than those with AASHTO code with the same dimensions. With the help of ANSYS Software of finite elements base modeling,displacement analysis is carried out. It shows that the chances of settlement increases with the increasing displacement intensity.

9. **C. Lande, S. K. Kamane, S. A. Mahadik.:-** In the present study, analysis of a RCC box culvert is presented using finite element method. 3D configuration of the space is considered and computer code is developed to find the bending moments, support reactions and member forces due tolateral soil pressuresand equivalent traffic load. With the help of excel programming, member forces Equivalent moments and support reactions are calculated. It concludes that Culvert Box full with water and live load surcharge on top of slab then there is increase in bending moments at centre and end of the top. On the contrary, Empty Box Culvert, live load surcharge on top slab, vertical wall bending moment at centre and end is increased.

10. **SurabhiTiwari, A.M.Gharad and P.D.Pachpor**:- In the present study, one RCC Underpass railway bridge carrying fly ash flow and consisting of piping system is considered. Using finite element analysis software package ANSYS 12, Two models; box-bridge hinged at base and subjected to static live load and soil pressure and same is surrounded by soil springs on faces of two vertical walls and one bottom face of it and top face with live load were analysed and compared. to study the effect of soilstructure interaction on RCC Underpass box-bridge the parametric study has been carried out. As the stiffness of adjoining soil increases the shear force and bending moment values also increases, whereas, for the other two vertical faces of the box culvert theshear force and bending moment values were in fair agreement. It can be stated thatsoil structure interaction analysis is essential for accurate results for2D analysis of RCC Underpass box culvert whencomes under different loading conditions i.e.from the adjoining soil, bottom strata and various live loads

3. RESULTS AND DISCUSSIONS

The above literature studied about design and analysis of RCC box culvert under different loading conditions. It can be noted that, the effect of Depth of

cushion, coefficient of earth pressure for lateral pressures on walls, width or angle of dispersion for live loads on box without cushion and with cushion for structural deformations are important. Box culvert full with water, live load surcharge on top slab of box condition then the bending moments at centre and end of the top and bottom slab are increased. The code IRC:6, Standard specifications and Code of practice Road Bridges can be referred for different loading conditions and specifications. The Indian Roads Congress and Directorate of bridges & structures (2004), "Code of practice for the design of substructures and foundations of bridges" Indian Railway Standard can also be used during design and analysis of box culvert. The structural design involves consideration of load cases and factors like live load, effective width, braking force, dispersal of load through fill, impact factor, co-efficient of earth pressure etc. Vehicular dynamic analysis has revealed that the maximum bending moment occurs for the dynamic vehicular load case.

IV. CONCLUSION

From the study of above literature, it can be concluded that the performance of box culvert is considerably dependent upon the Live load, effective width, impact factor coefficient of earth pressure, depth of cushion and flow of water through it. All the above literature shows the study of RCC box culvert, Hence the interest arises to design and analyse the box culvert by changing the material. Steel box culvert may be the next choice for further studies. A number of different specific elements will appear for each general category. Each element has its own set of DOFs, which are the degrees of freedom for which ANSYS will find a solution.

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Collation between Underground and Elevated Metro System

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Abstract :- **Pune, the cultural capital of Maharashtra and Oxford of the east, has now emerged as an important industrial and commercial center. Due to rapid development in economic, industrial and commercial activities, there is an enormous increase in traffic which causes traffic congestion and pollution problems. There are arterial roads passing through Pune city. National highway No. 4, 9, and 50 are some of the important state highway across pune city. From geographical point view, this city is divided by MulaMutha and Pavna rivers. As this city is divided by railway lines of Central and South Central Railways, there are number of crossings. Due to this there is tremendous traffic congestion on important roads in the city.**

As there is a poor and slow public transport connectivity, one loses time to reach from one destination to the other increasing usage of personal vehicles to travel within the city causing the traffic congestions. Aunderground metronetwork will minimize the transport time and also reduce the road traffic in the heart of the city.

This paper proposes that an underground metro connectivity will be more beneficial rather than an elevated metro as in Delhi, Mumbai and Bangalore and highlights various parameters of its onsite implementation

Keywords: **- Oxford of the east, traffic congestion, arterial roads, underground metro network**

I. INTRODUCTION

A metro or a metropolitan railway system is a passenger transport system neededin an urban area having a higher frequency of traffic. Rapid transit systems are typically located either underground or elevated viaducts above the street level. Elevated metro system is a rapid transit railway with tracks above the street level via ducts or other elevated structures. On the other hand underground metro , as the name suggests the tracks are below the ground surface.

We definitely need a very good public transport system which can solve the traffic congestion problems which are increasing due to the increase in the number of vehicles on roadand elevated metro would also add more to the problem, hencethis paper has been proposed to enlighten the advantages of underground metro over elevated metro systems.

II. LITERATURE SURVEY

William Cartwright suggested that the results of an evaluation of this proposal for a new map for the Melbourne metropolitan rail system. It begins by providing a brief history of metropolitan rail maps in Melbourne, to provide a background to what now exists. Then it looks at this recent proposal and outlines Raghavendra V1, Stanley Jose, G.H Arjun Shounakand Dr. T.G system subjected to gravity, hydrostatic pressure conditions combined with blast induced pressures. The intention is to study the blast effects of a terror-attack on the tunnel system, by simulating a pressure wave and study the effects on neighbouring tunnels for various time instances. This geotechnical and structural modelling along with its analysis are carried out using ANSYS. The validation of the results with Kirsch and Bray's solutions is the back bone of this numerical model. Further, plane-strain analysis is done to study the effects of various shapes of tunnels under such loads, by comparing the responses of single and twin, with and without support systems.

ITA Working group Number 13 answers the question about how the decision is made as to whether to place Urban Mass Transit Systems above ground (either at surface or elevated) or underground. Following collection of a substantial amount of data from 30 cities in 19 countries, representing the situation from 1995 to 1998 (with some later updates), analysis of that data and deliberations on the issues raise d has led to the findings and recommendations contained in this report. For many developing

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Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

countries, the investment cost of a fixed guideway urban mass transit the basis for evaluation, which is built around the design principles of Beck‘s London map. Finally, it provides the results from the evaluation, reports on conclusions from this evaluation and makes recommendations about how the proposed map might be improved.

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III. METHODOLOGY

There are two types of metro -

- Underground metro
- Elevated metro

I) Undergroundtunneling by using TBM

A **tunnelboringmachine(TBM)** also known as a —**mole**—, is a machine used to excavate tunnels with a circular cross section through a variety of soil and rock strata. They can bore through hard rock, sand, and almost anything in between. Tunnel diameters can range from a metre (done with micro-TBMs) to almost 16 metres to date. Tunnels of less than a metre or so in diameter are typically done using trenchless construction methods or horizontal directional drilling rather than TBMs.

Tunnel boring machines are used as an alternative to drilling and blasting (D&B) methods in rock and conventional _hand mining‘ in soil. TBMs have the advantages of limiting the disturbance to the surrounding ground and producing a smooth tunnel wall. This significantly reduces the cost of lining the tunnel, and makes them suitable to use in heavily urbanized areas. The major disadvantage is the upfront cost. TBMs are expensive to construct, and can be difficult to transport.

However, as modern tunnels become longer, the cost of tunnel boring machines versus drill and blast is actually less—this is because tunnelling with TBMs is much more efficient and results in a shorter project.

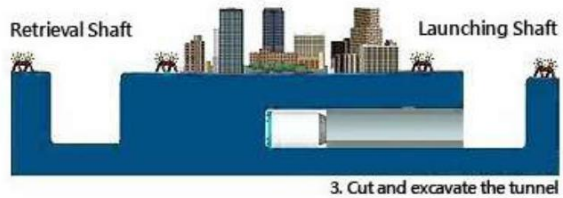
Urban tunnelling and near surface tunnelling Urban tunnelling has the special challenge of requiring that the ground surface be undisturbed. This means that ground subsidence must be avoided. The normal method of doing this in soft ground is to maintain the soil pressures during and after the tunnel construction. There is some difficulty in doing this, particularly in varied strata (e.g., boring through a región where the upper portion of the tunnel face is wet sand and the lower portion is hard rock).

TBMs with positive face control, such as EPB and SS, are used in such situations. Both types (EPB and SS) are capable of reducing the risk of surface subsidence and voids if operated properly and if the ground conditions are well documented.

When tunnelling in urban environments, other tunnels, existing utility lines and deep foundations need to be addressed in the early planning stages. The project must accommodate measures to mitigate any detrimental effects to other infrastructure.

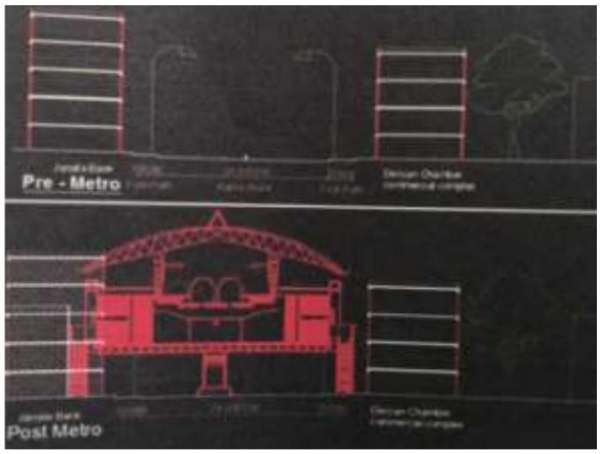
1. Excavate launching shaft and retrieval shaft

2. Assemble the TBM at the launching shaft



3. Cut and excavate the tunnel

4. TBM arrives in the retrieval shaft to be dismantled for transportation



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Elevated metro

Most of viaduct structures are being constructed using pre-cast segments installed using the underslung girder technique. The advantage of this technique is that it enables the viaduct deck spans to be erected very rapidly on site with minimal disruption to traffic below.

Viaducts are essentially multi-spanned bridges crossing over roads or rivers or valleys. On the Gautrain project, viaducts typically span in the order of 40 to 50m between piers.

Over the past months erection of viaduct decks has been ongoing at many locations along the route. Three girders are being used simultaneously and together they will erect approximately 10.5 kilometers of viaduct deck structure.

IV. ADUCT CONSTRUCTION

Designed in Singapore and fabricated in China, each set of launching girders weighs about 400 tonnes. These massive 118 metre long, hydraulically powered, steel structures are fitted onto the sides of the pier heads using temporary brackets.

The Launching Girders span between two of the bridge piers at any one time. The pre-cast segments of the viaduct (each weighing between 45 and 60 tonnes and wide enough to carry two railway tracks) are placed by crane onto the girders and, using of a system of trolleys, are slid along the top of the girders into their final position.

High strength epoxy glue is then applied to the segment joints before post-tensioning takes place. The epoxy also seals the joint against water ingress from the outside. Once all the segments for a given span are in position on the girders, steel cables are threaded through ducts cast into the segments and which run the length of the span. These cables are then tensioned (—stressed‖) such that all the pre-cast segments are compressed together to form a continuous beam – one bridge span.

Figure 1 : File photo of viaduct showing launching girders resting on brackets attached to piers

ISSUES RELATED TO ELEVATED METRO-

- Elevated metro has to run on the road at a height of about 10mtr. There will be a flyover like structure called via duct with pillars on road. Reduction in total road carriageway width by about 3mtr.
- 9mtr of central road portion will be barricaded during construction causing a traffic chaos as no suitable alternative roads are available. (examplekarve road, jm road, sasoon road, railway station area etc.)

- 35-40mtr wide, 140mtr long and 23mtr high metro stations will be constructed at a distance of 1km increasing traffic congestion.
- Parking space will not be available at metro stations due to the location in congested city areas. Alignment of the metro-

- It cannot be at the centre of the road because in case of an obstruction the metro cannot take any sharp turns.

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

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- Existing paudphata flyover will shift the metro to Paudphata – SNDT road further reducing the road width, demolition of road side buildings, land acquisition etc.
  Railway crossings at pune railway station also pose a big problem as it is a very important rail route. Risks and trauma-
- Because of the construction of elevated metro system there will be a risk to the existing buildings.
  Mental trauma to citizens due to continuous disturbance, disruption of utility services, mobility problems, changes n daily life pattern, rehabilitation due to demolitions, land azquisitions etc.
  Violation of fire safety norms and DC rules in metro construction-
- Insufficient space for metro stations and alignment.
- Part or full demolition of existing buildings.
- The construction will encroach on the footpaths and side margins of road side buildings.
- It could be very close to existing buildings without sufficient circulation of space between them.
- Natural light, ventilation for buildings will be affected.
- All portions and floors of buildings will not be easily accessible for fire engines and in case of any emergencies, the rescue will be severely hampered.

Visual impact and quality of life-

- Hundreds of trees on the roads will be cut down.
- Building side margins and road side open spaces, beautification will vanish.
- Huge metro stations across the entire road will also create problems in traffic congestion.
- The overall aesthetical view of a particular road will change due to this elevated metro.
- The view of all the historical monuments across pune will be distorted.

This visual pollution on prime roads will reduce the quality of life for the citizens. shifting of surface and underground utilities required

- serious problems in physical shifting
- poor co-ordination between different agencies
- availability of suitable space for re location will be a problem
- citizens will suffer due to disruption of services during shifting, relocating and replacement traffic management during construction a big problem
- suitable roads for traffic diversion are not available
- there are severe traffic congestion and unsafe road conditions
- insufficient traffic police strength for traffic management

Advantages of underground metro-

- Underground metro electrification system has less number of components and a very simple design as compared to overhead or elevatedelectrification system.
- These projects are usually funded by the World bank with very low interest rates at free of custom duty because they reduce large amount of co2 emission done by the vehicles.
- Expected life of elevated metro is much less than underground metro- due to the above ground steel and concrete structures.
- Interconnectivity of elevate d metro route with other routes cannot be done but it is possible in the case of underground metro.
- Operation and maintenance cost of underground metro is very less because it is unaffected by external weather conditions.
- Additional traffic capacities were provided for individual transport.

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- Relief from traffic congestion can be achieved due to underground metro.
- Architectural quality and the aesthetical view of a particular city can be maintained by underground metro

V. CONCLUSION

Thus this paper concludes that underground metro system is much more preferable than elevated metro system. In a metropolitan city like Pune, to avoid traffic congestion which may be caused due to piers and metro stations of elevated metro system can be avoided by implementing this proposed idea.
The data we collected enables us to take better decision and provide more efficient, environment friendly and equitable service and thus not affecting the pace of development of the city. This study examines the cost and benefits of underground metro projects for achieving the twin goals of inclusive and sustainable development.

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Economical Road Divider and Natural Fence

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Abstract :- **Being the Second Largest Road Network of over 54,72,144 Kilometres, India has perfectly set to be on the verge of becoming Developed Nation. Road Transport has always remained as first choice by the transporters. Yet in terms of Road Safety India is missing its rank as it is also a destination for Maximum Road Accidents. Statistics says in India Road Accidents leads to sad demise of one person in every four Minutes due to negligence.**

The Road Safety issue becomes more sensitive during Night driving because of high beam-perils. During night time every vehicle has its headlights on, and we have high beams on highways. The plants planted on divider acts as barrier in order to avoid glare from the vehicle coming in the opposite direction and hence reduce accidents because many times glare from head lights blinds the vision for some seconds which is enough time for accidents to happen. Tulsi plant can be implanted as natural barrier which can achieve maximum economy and gives zero maintenance cost of divider. This natural barrier gives numerous advantages than artificial divider.

Has anyone wondered about pollution condition of today's dividers in India? Road safety divider are used to prevent vehicle from colliding. They are made up of concrete. However, it leads to higher expenses and also causes emission of hazardous gases such as Carbon Dioxide, Methane, Nitrous oxide, Precursor gases (NOx, CO, NMVOCs, SO2, HFCs, PHCs and SF6) etc. To avoid such emissions, an attempt is being made to develop Road Safety Divider Materials for ensuring environment friendly and economical substitute. Using some suitable substitute material we can reduce the economical cost of divider by 51%. Hence this paper attempts in development of economical road dividers and natural fence diminishing blur vision and reducing road accidents.

Keywords: **- Road accidents, blind vision, concrete divider, tulsi, oxygen emission, greenhouse gases.**

I. INTRODUCTION

Road transportation provides benefits both to nations and to individuals by facilitating the movements of goods and people. It enables increased access to jobs, economic market, education, recreation and health care, which in turn have direct and indirect positive impacts on the health of the population. However, the increase in road transportation has also placed a considerable burden on people's health in the form of road traffic injuries, respiratory illness and the health consequences that ensure from a reduction in physical activity. There are additional negative economic, social and environmental consequences that arise from movement of people and goods on the roads- such as air pollution, greenhouse gas emissions, consumption of finite resources, community severance, and noise.

Road traffic death rates in many high income countries have stabilized or declined in recent decades, data suggests that in most of the regions of the world the global epidemic of the traffic injuries is still increasing. It has been estimated that, unless immediate action is taken, road deaths will rise to the fifth leading cause of death by 2030, resulting in an estimated 2.4 million fatalities per yearRoad accidents have been emerged as a new health challenges in the world which not only leads to injuries, disabilities and loss of precious human lives but also imparts substantial economical burden on the family concerned and nation as a whole. A number of factors contributing to the risk of collision including vehicle design, speed of operation, road design, road environment etc .

After Ms Marry Ward, who was first documented victim of automobile accident that took place on August 31 1869, the global status report on road safety 2015, reflecting information about 180 countries, indicates that worldwide the total number of road traffic deaths has plateaued at 1.25 million per year, with the highest road traffic fatality rates in low income countries. Statistics says that in India road accidents leads to demise of one person every four minutes due to negligence.The problem is much more in the country where close to 5,00,000 road accidents caused nearly 1,46,000 deaths and left more than thrice that number injured.

In order to implement preventive measures a detailed green data is inevitably required. This study aims to provide a base line data to avoid increasing road accidents.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

II. OBJECTIVES

- To study the road divider mechanisms practiced in India and to give economical cum environment friendly substitute.
- To give an substitute which will help to reduce the road accidents causing due to intense beam of headlight causing blur vision.

III. SCOPE

In this paper there is an attempt to use environmental friendly, recycled and cost effective products which gives us economy up to 39% as road divider material. Also we have to provide a tulsi shrub which acts as barrier and will act as translucent green material. These tulsi plants are to be planted outskirts of cities i.e. on national highway, state highway etc. Where as in city area we can plant beautification plants like chafa, bougainvillea etc. Tulsi plant not only sustain the pollution on the divider but also reduces the pollution by emitting oxygen for 20hrs, ozone for 4 hrs, and nascent oxygen which helps to reduce the pollution on the road. Also it helps in keeping environment fresh along highway which can boost the brain activity of the drivers and eventually they will remain fresh whole journey. Planting tulsi plant can also provide huge labor pool as there are many herbal medicinal factories emerging in this era. As there is fast growth of tulsi shrub hence germination process is also very fast, so there is densification, which will totally act as translucent material. We can use tulsi leaves, stem, flowers bark etc. as ingredients for herbal products like tulsi water, tulsi capsules etc. hence maximum economy will be achieved, hence one cause of road accidents can be minimized.

IV. LIMITATIONS

- Lack of available/reliable data.
- Lack of prior research study on the topic.
- Lack of exact mathematical interpretation. Self-reported data.

V. DATA ANALYSIS

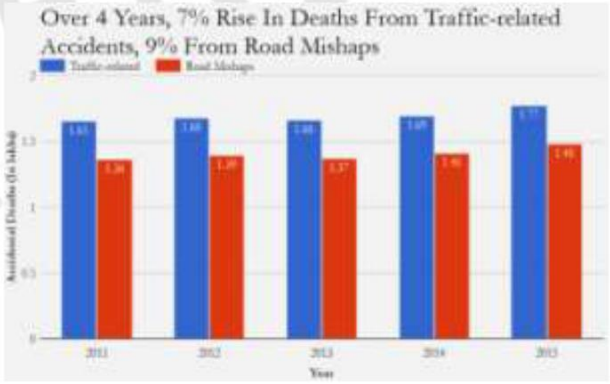
Estimation of cost:

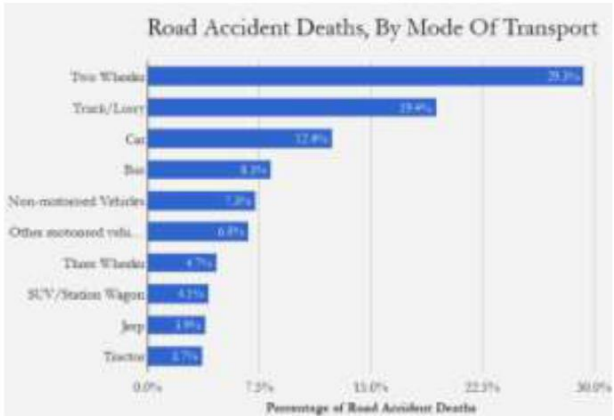
For current concrete road divider:

Ingredients	Material required	Cost (Rs)
Cement	156kg	842.4/-
Sand	156kg	103.35/-
Aggregate	312kg	144.67/-
		Total-1090.42/-

For the eco-friendly road divider:

Ingredients	Material required	Cost(Rs)
Fly ash+cement	156kg	475.8/-
Surkhi	156kg	51.67/-
Broken brick bats	312kg	137.77/-
		Total-665.24/-





ISSN (Online) 2456-1290

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Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

VI. FINDING

- The report estimates that the cement production by plants is set to increase at the rate of 8.2 per cent per year to 237 million metric tons in 2012. This also contributes to increased carbon emissions. This paper aims to provide suitable economical, eco-friendly material to reduce carbon emission. Here 38.99 % of economy is achieved.
- During night time every vehicle has its headlights on, and we have high beams on highways. The plants planted on divider acts as barrier in order to avoid glare from the vehicle coming in the opposite direction and hence reduce accidents because many times glare from head lights blinds the vision for some seconds which is enough time for accidents to happen.

VII. CONCLUSION

Road accidents is increasing every year and is dangerous to all people. In this situation all people must realize and give more attention to decrease the rate of road accident. At the same time, all people must co-operate with authorities to settle these problems. The causes are road condition from poor, climate and vehicle factors. The rate of road accidents can be reduced by the various accidents including from education, comfortable road condition, campaign and enforced the law. If all people give support and cooperation, this problem could be settled easily and our country also can decrease the number of death that results from road accidents.

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ISSN (Online) 2456-1290

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Special Issue

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Emerging Trends of Harnessing Solar Energy from Road Pavement: A Green Road Concept

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Abstract :- **Renewable resources are an integral part of nature which can be harvested with no limitation. Harnessing energy has become a necessity in present conditions of global crisis and innovative ideas need to be implemented to prevent the depletion of natural resources.**

The upcoming technologies and demands globally have made the road network facilities as a basic backbone for communication services. As per the emerging trends, the maintenance and the operation of the roads require the illumination facilities, GIS, GPS and various sensors where the demand for the electricity consumption has increased.

The present research paper puts forth some promising techniques to utilise solar energy from road infrastructure. It is a new research territory that encompasses technologies to capture the wasted energy in pavements, accumulate and store it to satisfy some of the daily needs. Implementation of such methodology can prove viability and prominence of the same.

Keywords: **- renewable, roads, solar energy, sensors, electricity, global crisis.**

I. INTRODUCTION

The energy received from the sun which is approx 174000 TW which exceeds the current energy demands around the world (18 TW). This is the very reason why using solar energy becomes a concrete, reliable, renewable, environment friendly alternative for overcoming the current energy crisis.

In India a major problem seen on road transport is the lack of electrical facilities such as street lights, neon billboards and hotels on the highways. Even though the electrical street lamps are being substituted by solar lamps, the electricity thus generated is utilized only for lighting of lamps and not the other elements in the vicinity of it.

Lack of functioning of lamps on highways and especially hilly regions have been causing tremendous amount of accidents. Methods need to be adopted so as to reduce the inefficiency of lamps and focus on providing electricity using renewable sources. One of the methods that can be implemented is use of photovoltaic cells along the lining of the road. Photovoltaic cells are those semiconductors which convert visible sunlight into direct current. Such cells can be lined along the length of the highways or roads. The photovoltaic cells could also be embedded in the roadway between the Jersey barrier and the adjacent rumble strip. The electricity thus generated could be utilized to power the street lamps neon flash boards as well as direction and danger signs especially in the hilly ghat regions

Another practical approach that can be adopted is to install water filled pipes below the asphalt pavement and let the solar energy heat the water. The hot water can be thus channelled to nearby hotels or restaurants on the highways to fulfil their hot water needs.

Use of thermo-electric effect to generate electricity can also be adopted to harness the energy coming from the sun. Two semiconductors where one is placed in the shady areas on the side of roads and another inside the pavement, the theory says that the temperature difference might be enough to create current flow. Though the electricity generate might be very small but it can be usable.

Above methods suggest few of the alternative ways to harness the solar energy from the road and convert it into useful amount of energy.

It is necessary that these methods be adopted because there have been cases in India where the drivers have to rely on their driving skills to get past the section of road owing to the lack of electrical supply or no availability of street lamps

II. LITERATURE SURVEY

"We have mile after mile of asphalt pavement around the country, and in the summer it absorbs a great deal of heat, warming the roads up to 140 degrees

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Fahrenheit or more," said K. Wayne Lee, a professor of civil and environmental engineering at the University of Rhode Island (URI) and the leader of the joint project. "If we can harvest that heat, we can use it for our daily use, save on fossil fuels, and reduce global warming."

France has been the first country in the world to develop a solar powered road and is testing whether more of these roads are worth pursuing. The road is 1km long and made of 2,880 solar panels. It is estimated that there will be enough energy produced from the road to provide street lighting for the small village of Tourouvre-au-Perche. If this project is successful, France will continue to roll out 1000km more of these roads.

Regarding photovoltaic cell Lee comments that, "Since the new generation of solar cells is so flexible, they can be installed so that regardless of the angle of the sun, it will be shining on the cells and generating electricity."

Andrew Correia, a Graduate student has built a prototype system demonstrating the working of water filled pipes under the asphalt pavement he says that "One property of asphalt is that it retains heat really well," he said, "so even after the sun goes down the asphalt and the water in the pipes stays warm. My tests showed that during some circumstances, the water even gets hotter than the asphalt."

URI chemistry professor Size Yang believes that thermo-electric materials could be embedded in the roadway at different depths or some could be in sunny areas and others in shade and the difference in temperature between the materials would generate an electric current.

III. METHODOLOGY

The following methods to harness the solar energy from pavements are discussed in details herewith.

A. Method 1: Solar cell-lined highways or photovoltaic applications in pavements

Solar voltaic power generation is the direct conversion of solar energy into electricity. Sunlight comes in many colours, combining low-energy (1.1eV) infrared photons with high-energy (3.5eV) ultraviolet photons and all the rainbow of visible-light photons in between. Solar cells, also called photovoltaic or PV cells, are semiconductor devices designed to capture these photons and convert their energy directly into electrical energy.

The basic principle on which the PV cells work on can be summed up as: When a photon with sufficient energy impinges upon a semiconductor it can transfer enough energy to a electron to free it from the bonds of the semiconductor's valence band so that it is free to move and thus carry an electric current. The junction in a semiconductor diode provides the necessary electric field to cause the current to flow in an external circuit. The typical output voltage of a PV cell is between 0.5 and 0.6 Volts and the energy conversion efficiency ranges from less than 10% to over 20%. A DC-to-AC converter is required to convert the energy into electrical output.

The amount of power produced depends entirely upon the amount of sunshine available. The location, the degree of shading, season/time of the year, time of day, and other local climatic factors are the variables on which the output of these solar panels installed will depend. A situation with a long roadway and smaller needs will have a much better chance of energy independence

One of the simplest ideas to harness the heat out of asphaltic or concrete pavements is to wrap flexible photovoltaic, or solar cells around the top of barriers or dividers, dividing highways to produce enough electricity for streetlights and light up road signs. The photovoltaic cells could also be embedded in the roadway between the adjacent rumble strips.

The rural areas or the ghat regions in India, where sufficient lighting is not available can be illuminated by the energy generated by this process by putting up the solar panels on dividers or borders of the road surface, without interrupting the heavy road traffic. These panels can sufficiently light up the streetlights and illumination boards in the same area without much loss of energy.

The method of placing photovoltaic cells could be successfully implemented on Pune-Bangalore Highway (NH 4) where the dividers can satisfy the criteria which are needed for the implementation of above methodology. Also the above method could be used in the hilly ghat regions of Konkan area where there is deficiency of proper electrical network.

If the storage of energy is required, a virtual grid system can be used with a specialized meter. These meters spin backward when extra energy is produced.

ISSN (Online) 2456-1290

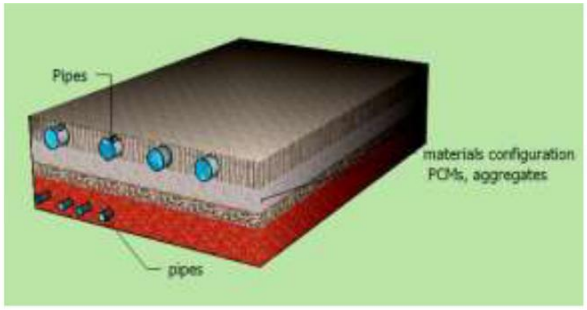
International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

In turn, energy can be pulled back from the grid and it can be used to power the lights and heating elements in storm conditions when the panels may not produce sufficient energy due to lack of enough sunshine

B. Method 2: Subterranean pipes

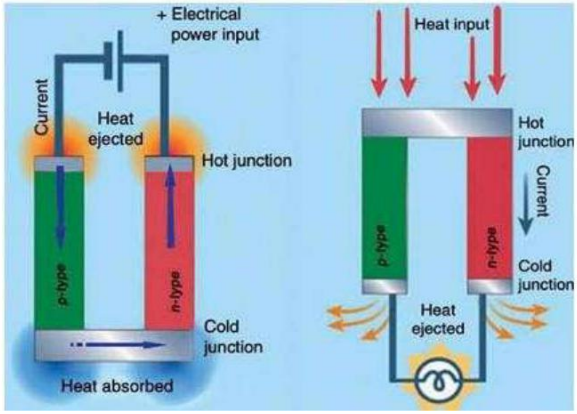


Another practical approach to harvest solar energy from pavements is to embed water-filled pipes beneath the asphaltic segment of the road and allow the sun to warm the water.

The method proposes embedding pipes and pumps in particular arrangements to harvest the extracted solar energy and convert it to thermal or electric energy. The arrangement used for this purpose is called asphalt solar collector (ASC) and it circulates water through a series of pipes below the pavement surface. The principle is that the radiation from the sun and atmosphere is absorbed in the pavement through an increase in warmth which is captured by water piping system and stored in the ground or other storage reservoirs.

The heated water could then be piped beneath the road surface and channelled into to nearby hotels or restaurants adjacent to the highways to satisfy heating or hot water needs, similar to geothermal heat pumps. It could even be converted to steam to turn a turbine in a small, traditional power plant.

C. Method 3: Generation of Energy using Thermo-electric effect



A third alternative uses thermo-electric effect to generate a small but usable amount of electricity using the thermal gradient of the pavement infrastructure which can satisfy the lighting needs on the road.

The thermo- electric effect is described when two types of semiconductors are connected to form a circuit linking a hot and a cold spot, there is a small amount of electricity generated in the circuit.

The semi-conductor devices exploit the temperature difference between the pavement sub-grade and the pavement surface that provides a potential source for electricity generation using the thermo-electrical principles.

The alternative technique that could be used is to embed the thermo-electric materials in sunny areas and others in shade along the road, and the difference in temperature between the materials would generate an electric current.

With many of these systems installed in parallel, enough electricity could be generated to light the streetlights and neon flashboards or for other purposes.

Instead of the traditional semiconductors, he proposes to use a family of organic polymeric semiconductors developed at his laboratory that can be fabricated inexpensively as plastic sheets or painted on a flexible plastic sheet.

IV. CONCLUSION:

The first method i.e the method of lining the highways with photovoltaic cells has an advantage of being cost efficient as well as generating maximum amount of energy thus utilising its purpose to its fullest The third method of using the thermo-electric effect generates a small but usable amount of energy compared to the first method. However research is still being conducted in this field of utilising the solar energy using the thermo-electric effect.

The implementation of subterranean pipes in the road network along with photovoltaic cells can be an efficient way to form an ideal green road. Whereas, the subterranean pipes can also be combined with thermo-electric generates but it would not yield the equally satisfactory results as the photovoltaic cells

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Smart Highways – An Innovation Towards Mobility

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Abstract :- **Nowadays, our chosen mode of transport not only takes us from A to B, but they make our lives easier and journeys more pleasant. Therefore, our infrastructure needs to facilitate us. There is always room for improvement in usage, interaction and safety of traffic flow. Smart highways and smart roads are terms for a number of different proposals to incorporate technologies into roads for the operation of autonomous cars, for lighting and for monitoring the condition of the road. This innovative concept creates an entirely new mobility experience for drivers, cyclists and pedestrians. Ideas from this testing ground are increasingly becoming part of our everyday landscape. Intelligent transportation systems usually refers to the use of information and communication technologies in the fields of road transport, including infrastructure, vehicles, users, traffic management and mobility management as well as interfaces with other modes of transport. This clearly shows that mobility can be smarter, more interactive and more sustainable without having to widen roads or lay more rail connections. It is simply a case of putting demand first. This paper describes the necessity of smart highways, its advantages over conventional highways, the latest and advanced technologies used in smart highways and how this leads to a sustainable and eco-friendly environment. It starts with the disadvantages of conventional highways and how smart highways provide a solution to every problem. Issues like need for smart highways and how highways in India can be smart are also given due attention. Finally, the paper concludes with future scope of Smart Highways.**

Keywords: **- Autonomous Cars, Mobility, Sustainable Environment, Traffic Management**

I. INTRODUCTION

We live in cities of endless grey concrete roads, surrounded by steel lamps and they have a huge visual impact on our cities. But why do the roads remain so rough and without imagination? Why not turn them into a vision of mobility, a symbol for future? - Daan Roosegaarde

In the last 25 years, the number of kilometers travelled per person has increased to approximately 40%. However, this growth is beginning to level off. There seemed to be a limit to our need for mobility, especially when it comes to using cars. Thus, the issue of mobility is all about offering sustainable transport solutions. For a long time, we have had super intelligent cars, but really dump roads. In the past decades, large investments have been going into developing smart cars but a very little have been given to the development of smart roads. Smart Highway is an interactive and sustainable road that includes a five-step plan for modernizing European roadways. It proposes embedding highways with technology that can visually communicate when the road is slippery, charge your electric car as you drive, and generate electricity for its own lights. The goal is to make roads more sustainable and interactive by using light, energy and road signs that automatically adapt to the traffic situations. The Smart Highway is not a completely new road, but rather a kit of parts that can be applied to existing roads as needed. Smart Highway is a tactile, high tech environment in which the viewer and space become one. This connection, established between ideology and technology results in what Roosegaarde calls as „Techno-poetry". With his unique approach, Daan Roosegaarde is offering the world an entirely new approach to roads, which is not only beautiful and alluring but also a sustainable and cost-effective solution, thus offering a unique design to both developing and developed countries.

Why Smart Highways?

1) Safety: Protecting our dear loved ones, regardless if they are travelling by car, bike or on foot, making sure they arrive safely at their destination is the top priority of all our traffic solutions. Reliable high quality products, excellent optical performance signalization and powerful monitoring systems combined with quick service provides safe and reliable solutions for year to come.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

2) Information: By presenting the right information at the right time to public transport passengers and accessibility and safety can be improved. Research shows that up to 30% of motorists change route when they receive information about travel tome or obstacles, which means the road network will be used in a more effective way. A good flow of information also provides a more comfortable ride and reduces stresses for both public transport and public health.
3) Motion: Along with requirements of improved accessibility, environmental improvements and traffic safety, follows the need for smarter transportation systems, where several types of transportation shares the road space.
4) Environment: Creating a sustainable traffic solution is challenge for all modern times. By investing in smart and adaptive traffic solutions, traffic flow will be improved.

All the above-mentioned criteria can be satisfied by implementing ideas like:

i) Glow in the dark lines
ii) Electric Priority Lane
iii) Wind Lights
iv) Dynamic Paints
v) Interactive Lights.

Glow in the dark lines

These glowing lines use luminescent paints. Luminous paint or luminescent paint is paint that exhibits luminescence. In other words, it gives off visible light through fluorescence, phosphorescence, or radio luminescence. Fluorescent paints offer a wide range of pigments and chroma which also 'glow' when exposed to the long-wave "ultraviolet" frequencies (UV). These UV frequencies are found in sunlight and some artificial lights, but they and their glowing-paint applications are popularly known as Black Light and 'black-light effects', respectively. Phosphorescent paint is made from phosphors such as silver-activated zinc sulfide or doped strontium aluminate, and typically glows a pale green to greenish-blue color. The mechanism for producing light is similar to that of fluorescent paint, but the emission of visible light persists long after it has been exposed to light. Phosphorescent paints have a sustained glow which lasts for up to 12 hours after exposure to light, fading over time. Radio luminescent paint contains a radioactive isotope (radionuclide) combined with a radio luminescent substance. The isotopes selected are typically strong emitters of fast electrons (beta radiation), preferred since this radiation will not penetrate an enclosure. Radio luminescent paints will glow without exposure to light until the radioactive isotope has decayed (or the phosphor degrades), which may be many years. They are therefore sometimes referred to as "self-luminous". Therefore, these glowing roads on the smart highways get charged by solar energy during the day and then glows up to 10 to 12 hours when it gets dark. They provide more visible road markings as compared to conventional paints. They also add beauty to the roads.

Electric Priority Lane

The main problem faced in environment today are the emissions from the vehicles. So the best solutions to these problems are Electric Cars. An electric car is an automobile that is propelled by one or more electric motors, using electrical energy stored in rechargeable batteries or another energy storage device. There are many hurdles that are related to the introduction of full electric vehicles – first of all the limited range which is due to the limited energy density of the existing battery chemistries inferior to gasoline or diesel powered vehicles. By introduction of wireless charging, substantial benefits can be achieved with respect to user interaction, availability and automation compared to wired charging. For this electromagnet are used. The road side electromagnet is called primary coil and the vehicle side electromagnet is called secondary coil. If current is flowing through the primary coil, a magnetic induction field is created which will cause a flow of current in the secondary coil by Faraday"s law of Induction. The efficiency of induction based energy transfer is going down quickly with the increasing distance between the coils. But the efficiency can be substantially increased if the frequencies of the electromagnetic fields of the primary and secondary coils are brought to resonance. We distinguish the charging categories as follows.

1) Stationary – In stationary the electric energy is transferred to a parked vehicle.
2) Quasi dynamic – The electric energy is transferred from the road side primary coil system of limited length to a secondary coil of a slowly moving vehicle.
3) Dynamic – With dynamic wireless charging, the energy is transferred via a special driving lane equipped with a primary coil system at a high power level to a secondary coil of a vehicle moving with high velocity

Wind Lights

Air flow can produce significant mechanical power. Windmills are used for their mechanical power, wind pumps for water pumping, and sails to propel ships, but the most frequent current use is to turn a generator for electrical power. Wind power, as an alternative to burning fossil fuels, is plentiful,

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

renewable, widely distributed, clean, produces no greenhouse gas emissions during operation, and uses little land. The net effects on the environment are far less problematic than those of nonrenewable power sources. As of 2015, Denmark generates 40% of its electricity from wind and at least 83 other countries around the world are using wind power to supply their electricity grids. Wind power capacity has expanded to 369,553 MW by December 2014, and total wind energy production is growing rapidly and has reached around 4% of worldwide electricity usage.

In Wind Lights, pinwheel generators are placed on the verge of the highways. These pinwheels are attached with street bulbs. So, when a car or any other vehicle passes by, the draft of the vehicle rotates the pinwheel which in turn switches on the lights.

Dynamic Paints

Dynamic Paints are temperature sensitive paints. Under normal conditions they remain transparent, but when the temperature drop enough to create hazards like black ice, it becomes visible to the road and reveals warning on the road.

High resolution non-intrusive measurements of temperature using temperature sensitive paints (TSP) have been demonstrated by several researchers. These measurements include boundary layer transition in a cryogenic wind tunnel and heat transfer measurements on the impingement surface of compressible impinging jets. A typical TSP consists of the luminescent molecule and an oxygen impermeable binder. The basis of the temperature sensitive paint method is the sensitivity of the luminescent molecules to their thermal environment. The luminescent molecule is placed in an exited state by absorption of a photon. The exited molecule deactivates through the emission of photon. A rise in temperature of the luminescent molecule will increase the probability that the molecule will return to its ground state by a radiation less process known as thermal quenching. The temperature of the painted surface can be determined by monitoring the fluorescent intensity of the painted surface.

Interactive Light

Lighting that emits too much light or shines when it is not needed is wasteful. Wasting energy has huge economic and environmental consequences. In an average year in the U.S. alone, outdoor lighting uses 120 terawatt-hours of energy, mostly to illuminate streets and parking lots. That is enough energy to meet New York‟s total electricity needs for two years. IDA estimates that at least 30% of all outdoor lighting in the U.S. alone is wasted mostly by lights that aren‟t shielded. That adds up to $3.3 billion and the release of 21 million tons of carbon dioxide per year. To offset all that carbon dioxide, we will have to plant 875 trees yearly. So, smart highways have a good solution for this. They have Interactive Lights. This uses sensors to detect an approaching car, at which it switches on. The light grows brighter as the car comes near and then dims as it passes. In this way, the road is only lit when needed rather than pouring light on empty streets.

II. FUTURE SCOPE OF SMART HIGHWAYS IN INDIA

Roads now no longer remain as a medium to travel from one place to another, we can now use it to charge electric cars and harness solar energy due to its large exposed surface area. There is also technology to keep portions of the roads well-lit with more energy efficient and environment friendly technology and methods. Hopefully there will be more upcoming technology to make our roads smarter and safer to travel on. A smart highway is the need of present time because a lot of energy is saved as we can use Green energy and other supportive technologies like cloud computing for faster data communication and rapid action taking as and when demanded. Altogether there is a lot of scope on highways specially to be converted into a smart highway.

III. CONCLUSION

Mankind started his journey to cover long distances by foot. Slowly they invented wheel and that gives mankind the speed and power to shorten the long distances. The travel time was cut down to days and month from months and year. After inventing the wheel, the second idea was to develop roads on which the vehicle can travel easily. We now have fast moving vehicles all over the world and world class highways to ride on it. Now there is a need to make the highways smart. A smart highway is the need of the present time. Indian highways specially need to be converted into smart highways as it is well placed geographically. It has abundant sunlight and other green resources.
So, let us all take one step forward in making our roads more smarter, safer and beautiful.

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Innovative System of Zero Visibility Navigation for Railway Networks

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Abstract :- **Indian Railway is most economical and fastest transportation system for long distance. It gives a good support to our country economy, but due to fog trains get delayed or cancelled and it do hamper our railway budget. Indian Railways has huge losses due to cancellation, delay and accident of trains. Also many people have heavy losses in personal life due to delay of trains or accident. In December and January, locomotive pilots grapple with zero visibility on the tracks and government policy of delay or cancelling has worsen the crisis. Therefore this research deals with smooth functioning of Indian Railway even in dense fog, by introducing concept of zero visibility navigation and overcome such constraints.**

This concept of "Zero Visibility Navigation" uses technology and software skills. This uses laser signaling systems, RF signaling systems, Embedded Systems, Digital Communication system, etc. with some visual graphics and animation systems. The application of this system can be made practically possible, as the driver can locate the tracks and signals by using laser light during the fog without physically sighting outside the window. A speedy and safer transportation can reduce the accidents, overcome the delays, and thus change the face of Indian lot of adversity in the operations of the railways. It's because of the dense fog and railways making it very efficient and feasible.

Keywords: **- zero visibility, Indian railway, safer transportation, laser signal, dense fog.**

I. INTRODUCTION

A Scenario of Indian Railways

Indian Railways is the lifeline of the nation. About 60% of its population use Railways as the primary means of transport. It's a huge national asset. It's also one of the oldest networks and the only organization working under a single system. In an earlier era, the Indian Railways have been described as "imperium in imperia", an empire within an empire. The size and scale is gigantic. The United States, China and Russia are the only countries that have longer railway lengths, measured in kilometers. With the advancement in technology, the countries like Japan, Germany, China, France, etc. have achieved high speeds of transportation thus setting benchmarks for the Indian Railways to accompany them. This has led to the demand of having speedy transportation within the country, but at a cheaper rate. For a country like India, which has all the seasons' up to their peak, it would be tough to manage a speedy network to a precision. Amongst the seasons, the winter season brings a cold winds that the drivers find it difficult to have a peek outside the window

The Dense Fog causes the following problems: -

1. Due to extremely low visibility many serious rail accidents occur causing severe loss to life and property.

2. The trains get late by hours together causing difficulties to passengers and losses to the railways. The train accidents reportedly took place due to dense fog, low clarity and manual error. The accidents have raised serious concerns on railway safety. As per the norms of Indian Railways, during fog conditions trains must stick to the speed limit of 30 km per hour and in the dense fog International 8 km per hour. Railway officials say most accidents are due to the failure of their own staff. But of the 177 accidents that occurred in 2008 to 2010, less than half were due to manual error. The truth is the railways are still using outdated techniques like detonators to warn the train drivers during fog. When the train passes over them the driver gets a warning to slow down. Another technique is the LED signaling system. But it is also incapable of penetrating the fog. This has led to the development of an innovative concept of "Zero Visibility Navigation System".

II. LITERATURE SURVEY

Navigation basically is a field of study that focuses on the process of monitoring and controlling the movement of a craft or vehicle from one place to another.

Zero Visibility Navigation System is an innovative concept that allows the loco pilot to look at the tracks without actually peeking outside the window even during the dense fog condition where visibility is

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

very low. Hence, the speed of the train remains constant without any mishap or delays.

A Significance in Indian Railways

In the Northern cities like Delhi, Amritsar, Ghaziabad, Meerut, etc. where the network of railways is quite dense and as it is the main route for connectivity with the rest of the country, the operations of the railways should be speedy in order to tackle the heavy traffic and avoid the delays.

But, the dense fog creates the problems of cancellation and delays of many long bound and prestigious trains, thus creating chaos between the passengers and the railway management.

So, considering all these aspects the recent technology of Indian Railways can't fulfill the voids in the system. Hence, introducing this "Zero Visibility Navigation System" will help in building a full fledge operating system that can work efficiently in all the critical conditions.

III METHODOLOGY

A. Working Principle

Firstly, a detailed survey has to be done of rails so get relative positioning of points of important landmarks which is to be fed into a software. It should contain all the intermediate stations, warning signs, important signs, symbol boards, speed limit boards and bridges, tunnels, etc.

After feeding this into software a locomotive will have display which will allow driver to see the tracks without looking outside. Also, all signals will be using laser light which can easily pierce fog. Hence the driver will be looking at the virtual animation video of the happenings outside and he does not need to look outside while running the locomotive and hence the problem of visibility is solved. In short, the driver merely follows an animated video like one plays a computer game. In the games like Road rash, the speed taken into account is the instantaneous speed, but calculating the instantaneous speed of the model toy train is not possible, so we assume the speed of the remote-controlled train as constant. Hence, the position of the landmarks can be fixed as per the time required to reach them.

We already fed the complete database of the route (say an example from Agra to New Delhi). From Agra to New Delhi the relative positions of all the expected and important landmarks will be surveyed in detail. Such landmarks will be numerous such landmarks present on this railway route. But our database system will be efficient to hold all this data. The data will comprise of all necessary landmarks to be considered along with their relative distances of occurring e.g.

All the intermediate signals

- All the intermediate stations
- Warning Signs.
- Important signs, symbol boards
- Speed limit boards

Information about forthcoming bridges, tunnel, trench, elevation, angle-turning, level-crossing etc.

B. Structure

Expected Time of appearance Landmark
1(Signal) ---- (To be filled by
Landmark 2(Blow Horn symbol) ----- user as per
the Landmark 3(Signal) ----- requirement)

Fig 1 Visibility During Dense Fog Conditions.

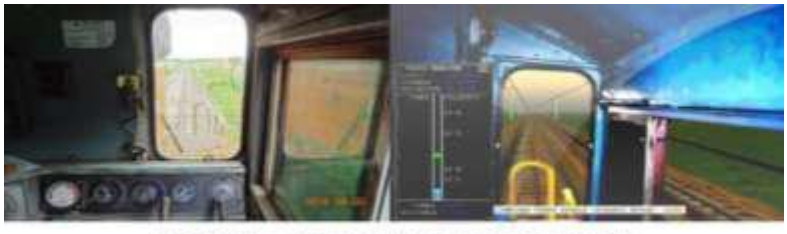


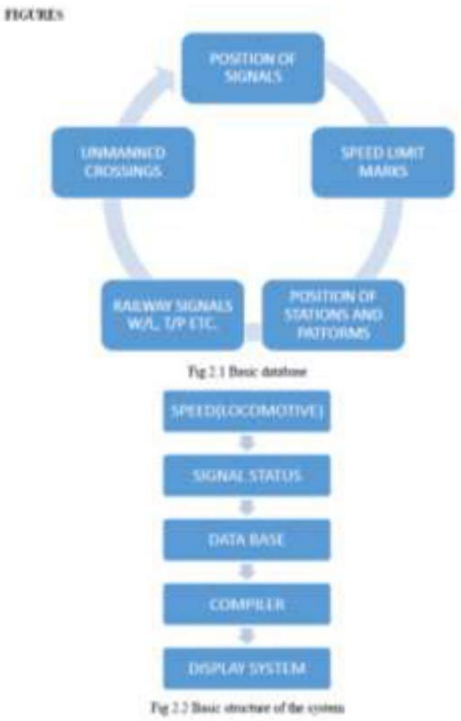
Fig 3 Conversion of actual view to virtual view

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India



III. CONCLUSION

This technology of "Zero Visibility Navigation System" is very innovative as it deals with the safety of the passengers as well as the railways. This system is very efficient as it saves the time and money required for the journey. It will help in easy transportation during not only the dense fog but also in the other critical conditions like heavy rains, storms, smog, etc.

While making this system to be implemented precisely, the priority should be given to those areas which are worst hit during the dense fog conditions. As the railway network is dense in these areas of dense fog i.e. North India, this system must be put into practice on urgent basis. But as this system requires large number of databases, so it will take a considerable time to get the system fully functioning. All the other routes can be advanced step by step.

In the practical implementation, we can use the technology of graphical image processing, just as we see in the simulators i.e. virtual imaging. Hence, instead of just displaying the name of the landmark, we can have a digital image of the landmark. Also, the use of computer screens in the locomotives will help in proper view of the scenario ahead without looking outside.

As this system is computer driven, the data from other modern devices like the Anti-Collision Device (ACD) and the Vigilance Control Device (VCD) should also be correlated to make the system more accurate and intact.

This has proved to be an aid for the loco pilots while driving the train. This technology can change the face of Indian Railways as it is more feasible and cost-effective.

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Introduction of a New Road Barrier System for Safety Management and Efficiency on the Mumbai-Pune Expressway

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Abstract :- **The transportation sector in India, has expanded rapidly especially after the onset of the new century. The Government of India is investing huge amounts of revenue in the infrastructure and transportation sector in order to link various cities and towns. The Mumbai-Pune expressway, connecting the commercial capital of the country, Mumbai, and the cultural and educational capital, Pune, is one such example of the progressive transportation sector. Though the expressway has proven to be a pioneer of infrastructure development, large number of accidents occurring is becoming a major concern for national highway authority of India. On the backdrop of such mishaps, improving the efficiency and competence of the expressway is the need of the hour. In view of this, this research paper emphasises on the optimisation and utilization of safety barriers as one of the most common methods for immunisation of road sides. This paper highlights on the need for cost effective road safety investments using 'rolling barrier' systems which can redirect the deviated automobiles onto the right pathand also prevent the overturning of vehicles.**

Keywords: **- accidents, expressway, infrastructure, transportation, optimisation, safety barriers.**

I. INTRODUCTION

In India, the transportation sector has grown leaps and bounds since the beginning of the 21st century. The expressway has witnessed 14,500 accidents leading to 1,400 deaths since its inception.The Mumbai-Pune Expressway, inaugurated in the year 2002, is an epitome of technological and infrastructural advancement of the country. Albeit it has paved the way for a faster and a comfortable journey, it has also witnessed thousands of fatal accidents. These accidents impose a huge socio-economic cost in terms of untimely deaths, injuries and loss of potential income. Moreover, accidents lead to traffic jams resulting in an overall delayed journey, contradicting the basic purpose of construction of such expressways. Therefore, road safety and management of the expressway has consequently become an issue of national concern.

II. LITERATURE SURVEY

G.Udayakumar et al.,has come up with a research paper which suggests and devises flexible median divider using suitable polymer material, so as to reduce the risk level during median divider accidents.In view of this, he has examined and analyzed the existing barrier systems and has also suggested a new flexible barrier system to overcome the drawbacks of the existing system. He has also analyzed the suggested flexible barrier with the help of ANSYS, which is an engineering simulation software and helps to put a virtual product through a rigorous testing procedure. He has suggested the use of PVC barrier in place of the conventional RCC barrier, citing its flexibility, collision impact reduction and cost effectiveness.

NCHRP report 711, suggests the use of cable barrier system to redirect errant vehicles that deviate from the actual path. The report also compares the low tension cable barriers and the high tension cable barriers on the basis of their performance. It emphasizes on the need for using high tension cable barriers considering its cost effectiveness and swift maintenance.

The report made use of vehicle dynamic programs like HVE (Human Vehicle Environment, by the Engineering Dynamics Corporation) and CarSim (by MechanicalSimulation Corporation). The programs were developed for benefit of engineers and safety researchers, to analyze the interactions among humans, vehicles, and their environment. They arehigh-level simulation tools aimed at creating three-dimensional models of vehicles and environmentsand allow the study of their dynamic interaction under selected conditions.

But, maintenance concerns for cable barriers included weak soil, foundation breaks, repair delayscaused by wet or icy medians, anchor creep, post lean, unreported nuisance hits, and costs. Although the

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

newer technologies for cable barriers date back to the1990s, many agencies may have been cautious about applying the technology due to the lack of experience and limited guidance in doing it effectively.

Guido Bonin et al., has suggested the use of road safety barriers with short elements of light weight concrete. They also suggest the replacement of the conventional concrete barriers by the short elements of light weight concrete citing the chances of higher dissipation of energy, thus reducing the overall dynamicity and helping in maintaining a good containment capability. They have made use of the finite element models of the vehicles used and that of the actual portable concrete barrier to help them in the process of simulation and also emphasize on solving the barrier problem using computational mechanics

with finite element models, which try to reproduce real time situations on the computer.

However, due to the rigidity of a material like concrete can have repercussions like severity of impact leading to harsher consequences. Also, during the use of the dummy model, though the analysis validity is good, the behavior with a different model can be different. Such uncertainty during the virtual phase can prove catastrophic in the real world.

Also, as we can see from the Table no.1below that instead of preventing accidents, the concrete barriers, guard rails and the likes have fuelled it.

Objects of Impact of vehicles	Total Percentage
1. Concrete Barriers	23%
2. Guard Rails	19%
3. Flowerpots and Curb Stones	15%
4. Bridge Wall	13%
5. Overhead Bridge Pillar / Tunnel Wall	13%
6. Trees	5%

Table no.1 Percentage of Impact of Vehicles on Various Objects

`The solutions mentioned above, however effective they propose to be, seem satisfactory only in the lab scale operations. India of the 21st century needs pragmatic solutions which can be effective on the field itself. The rolling barrier system, which can prevent,and also bring down the severity of accidents, can be the solution for the present problem. Sighting the aptness of the system, the Malaysian government has already installed it oncertain roads around the town of Subang as part of a two-year pilot project.

III.PURPOSE OF THE RESEARCH

As we can see from Table no.2, we can easily analyze that most of the accidents on the expressway are caused by the vehicles deviating from their path and running off road to either of the sides. Due to lack of infrastructural facilities at the median and the sides, the deviating vehicles meet with fatal accidents. In order to avoid such mishaps and maintain the efficiency of the expressway, there is a dire need of technological and infrastructural solutions for the same. The rolling barrier system is one such solution to maintain and regulate the competence of the expressway.

Type of Accident	Total Percentage
1. Run off road to left	32%
2. Run off road to right	23%
3. Collision with another vehicle moving ahead or waiting	21%
4. Collision with another vehicle which starts, stops or stationary	10%
5. Collision with another vehicle moving laterally in same direction.	5%
6. Collision with another oncoming vehicle	2%

Table no.2 Percentage of Type of Accident

IV. WORKING PRINCIPLE

The conventional barrier system which includes the likes of concrete barriers as well as the steel guardrails try to absorb as much shock energy from the impact of collision as possible and thus potentially break the momentum of the colliding vehicle. However, as we can see from the number of fatal accidents on the expressway, this prevailing customary system has proven to be substandard. Whereas, the rolling barriers not only absorb the impact energy but also convert it into rotational energy, assisting the vehicle to stay on track and prevent overturning. As we can see from Fig.2that as soon as an automobile swerves from the actual path and hits the barriers laterally at any angle, the rollers convert the impact energy into rotational energy by rotating with the impact. The rotational energy not only helps to cut down the impact of the collision but also helps to propel the vehicle forward rather than potentially breaking through an immovable barrier. Upper and lower frames adjust tires of large and small

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

vehicles to prevent the steering system from a functional loss.

Following Fig.1 shows the precise working principle of the rolling barrier system.

Fig.1

Fig.2

Props at an interval of 0.7 m increase bearing power to prevent vehicles from further derailing. As the props used in the system are independent, only damaged parts need to be replaced. This keeps maintenance costs pretty low and the efficiency of the system intact. Fig.3 shows the easy removal of components from the assembly.

Fig.3

V. ASSEMBLY OF THE SYSTEM

1) Firstly, the supporting post and safety rails, bolts and middle post are assembled.
2) Secondly, the stopper board which decreases the speed through friction is assembled.
3) Then the shock absorbing rollers with strong cushions are installed.
4) The upper part of the assembly includes the same components as used in the lower part viz. the stopper board and safety rails.
5) Lastly, the LED caps, post cover and the round rails are assembled.

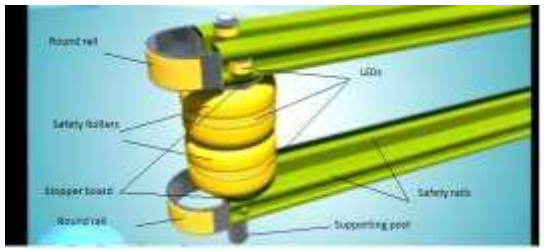

Fig.4 shows the assembly

The rotating barrels are made from Ethylene Vinyl Acetate (EVA), which is a copolymer of ethylene and vinyl acetate. It is an extremely elastic and transparent material. It is produced under high temperature and high pressure. It offers good gloss, low-temperature toughness, good chemical resistance, high friction coefficient, and resistance to UV radiation. Moreover, EVA has the advantage of being 100 % recyclable of all production waste which means that no waste is achieved producing from the material. This helps to exploit the resources using EVA in all productions. EVA is free of chlorides, heavy metals, phenols, latex and all toxics.Use of EVA barrels will make the entire rolling barrier system cost effective and environment friendly which is the need of the hour.

Fig.5 Rolling Barriers during Night and Day Time

VI. ADVANTAGES OF ROLLING BARRIER SYSTEM

- Highly effective shock absorber.
- Impact severity reduction due to its conversion into rotational energy.
- Keep the vehicle on track and avoid deviation.
- Self luminescence to help drivers control vehicles during night time
- Easy maintenance.

- Cost effective due to reduction in costs of repairing and maintenance due to roller's resilience.
- Easy height adjustment of barriers for passenger cars and lorry.
- Eco-friendly due to the use of Ethylene Vinyl Acetate (EVA).

VII. CONCLUSION

India, being on the verge of becoming a developed country needs to channel its efforts that sustain its development process. Inefficient infrastructural systems leading to loss of citizenry and hence a huge human resource deficit can prove disastrous. The use of modern technological innovations like the rolling barrier system on the Mumbai-Pune expressway can help reduce accidents, diminish fatalities and also stimulate national growth. It will not only reduce the impact of collision but also help in redirecting to the actual path, by converting the impact energy into rotational energy. Considering the diverse terrain of the expressway, there can be several solutions to address the problem. But the rolling barrier system can prove to the panacea for most of the road transport ills, if correctly designed, properly installed and regularly supervised during the normal service. Moreover, the eco-friendliness of EVA being conducive to sustainable development makes the employment of the rolling barrier system a win-win situation.

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Optimisation of a Smart Road Junction

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Abstract :- **21st century India needs planned, technologically sound and sustainable development. A crucial aspect of this development is road transportation. The infrastructure facilities play major role in developing any zone of a country in the modern era and globalization. A smart and efficient road network enhances the progress of that region. A fresh outlook is needed if these road networks and new developing ones are to be truly a part of the modern world. This project highlights on optimising the construction and execution aspect of a road network. It also focuses on analysing the current and future demand for designing a very efficient and smart road junction with aim to have a free and speedy movement for all categories of traffic. For our project, we have chosen a 3-km stretch and an intersection in PCMC. This project will assist in redefining the design parameters for any infrastructure project.**

Keywords: **- Design, Materials, Optimisation, Road Transportation Network, Time.**

I. INTRODUCTION

We started by conducting various standard tests on materials to determine the type and grade of the materials to be used, and to design the cross-section of the 3-km stretch. Then, we moved on to optimisation in terms of the next parameter, time, by listing out the various construction activities, and compressing the same to get an optimum schedule. Having collected data and experience about abroad construction process, we expanded our project to design a road intersection (Bhakti Shakti Chowk, Nigdi, PCMC, Maharashtra). For this purpose, we carried out traffic surveys to study the existing traffic situation at the intersection. We intend to design a grade-separated, cyclist and pedestrian friendly, preferably signal-free intersection. This will result into easing congestion at the junction, reducing accident and casualties, making it more accessible for pedestrians and cyclists. Our ultimate aim is to design the complete intersection such that all the aids applied together will induce discipline with minimum effort on part of the users.

II. LITERATURE REVIEW

The many literature reviews highlight the various parameters associated with road network design and construction. The paper by Ibrahim Mahamid, et al. investigates the time performance of road construction projects in the West Bank in Palestine to identify the causes of delay and their severity according to contractors and consultants. The main causes of delay were found to be: Segmentation of the West Bank and limited movement between areas; Award project to lowest bid price; Political situation; Progress payments delay by owner; and Shortage of equipment.

Several research papers focus on road transportation and traffic in a developing country like India and are prepared after conducting studies in the cities of Vijayawada, New Delhi, and Ettumanoor. The study by Consulting Engineering Services (India) Private Limited on Comprehensive Traffic and Transportation Study for Vijayawada City (2006) discusses various traffic surveys in major road networks, zones and intersection of Vijayawada City. The study by CSIR – Central Road Research Institute on Traffic and Transportation Planning (Annual Report) (2011-12) concludes that learner drivers should be compulsorily tested for the basic psychophysical traits or capacities and they should get passing marks before appearing for the learner license. The research study by Geethu Lal et. Al, (2016) on Sustainable Traffic Improvement for Urban Road Intersections of Developing Countries examines the traffic problems and sustainable improvement of road intersection at Ettumanoor, India. Analysis of the collected data revealed that the improper planning of the junctions, lack of traffic signals and unauthorized parking are the major factors contributing to the traffic congestions. Various remedial measures are also proposed, focusing on junction improvement, alternative operation plan and junction signalization.

Finally, paper by Romi Satria and María Castro (2016) on road safety recommends various tools and techniques to prevent road accidents. Several GIS tools used to model accidents have been examined. The understanding of these tools will help the analyst to

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

make a better decision about which tool could be applied in each particular condition and context. next study by Qiang Guo et. Al,(2016) particularly focuses on the role of different road network patterns on the occurrence of crashes involving pedestrians. The results indicated that higher global integration was associated with more pedestrian-vehicle crashes; the irregular pattern network was proved to be safest in terms of pedestrian crash occurrences, whereas the grid pattern was the least safe.

Gap Analysis

The above literature reviews helped us understand dynamics of road transportation design, construction and maintenance, that we would later encounter in our project. We learned about causes of delay in road construction; study of various Indian cities and their road junctions and intersections; prediction and mitigation of road accidents involving vehicles and pedestrians; and use of modern applications like GIS to road design. The information from these literature reviews will surely assist us in carrying out our objectives of studying an ongoing road project, testing of materials and design of intersection.

Methodology

This research paper starts by studying an under construction 3 km road stretch in PCMC. This study consists of survey, material testing, cross-section design, scheduling and cost analysis. We then move onto studying an intersection (Bhakti Shakti Chowk, PCMC, Maharashtra). We intend to design a grade-separated, cyclist and pedestrian friendly, preferably signal-free intersection. Also, we intend to introduce ―smart-aids‖ to make this intersection truly smart. This can be done using various traffic controlling devices, using in-built GPS in vehicles and connecting them to the intersection network. The aim is to completely optimise the intersection in terms of materials, process, time cost. This will result into easing congestion at the junction, reducing accident and casualties, making it more accessible for pedestrians and cyclists. Our ultimate aim is to design the complete intersection such that all the aids applied together will induce discipline with minimum effort on part of the users.

Experimental Work

Road Construction Project

We started by working on the Development and Construction of 45m wide road from Mumbai Pune Express Highway to Bhakti Shakti Chowk (Up to ROB Railway Line) Package – I: Ch. 0/000 to 2/850 Km under the guidance of Ajwani Infrastructure Private Limited. The project package includes design and construction of 45m 6-lane road along with 2 lanes of BRTS, water supply network, sewage network and electrification. Work on the project commenced on 11.09.2014.

Testing of materials

Various tests were conducted on aggregates and bitumen for the finalisation of cross-section. The results of the same are tabulated as follows:

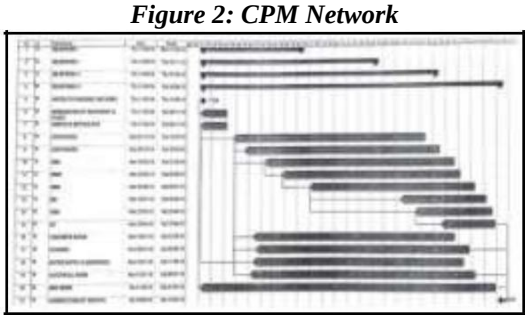
Table 1: Test Results

Test	Date of Sampling	Date of Testing	Result
Compaction Test	15/07/2016	16/07/2016	MDD – 2.049 gm/cc OMC – 12.10%
CBR Test	16/07/2016	18/07/2016	2.5 mm penetration, 7 N/mm^2
Ductility Test	22/07/2016	22/07/2016	> 70 cm
Softening Point Test	22/07/2016	22/07/2016	47°C
Penetration Test	22/07/2016	22/07/2016	60/70 Bitumen

CPM Network Analysis - Further the quantities and corresponding costs of materials were calculated and the activities involved in the project listed down.

Notice to Proceed the Work -- Mobilization of Machinery and Plant -- Survey and Setting Out – Excavation – Earthwork – GSB -- WMM — BBM – BM – DBM – BC -- Concrete M15/M20 -- CD Work -- Water Supply and Sewerage -- Electric Work -- Miscellaneous Work -- Handing Over of Site

Figure 2: CPM Network



Intersection Project

We then extended our project to the Design, Development and Construction of Bhakti Shakti Chowk Intersection (Which includes Bhakti Shakti Junction and Transport Nagar Junction).

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

The Bhakti Shakti Chowk Intersection is located at the crossing of Pune-Mumbai Highway and Nashik Road (Spine Road) which are two major roads in the city. Vehicles coming from Dehu Road and other areas along the Mumbai-Pune Highway enter PCMC limits at Nigdi through this Chowk to go ahead to Pune or different parts of Pimpri-Chinchwad.

Figure 3: Location Map

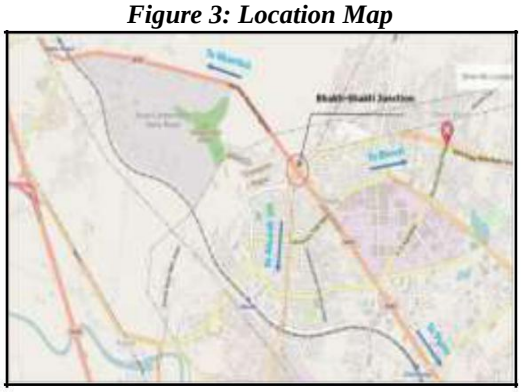
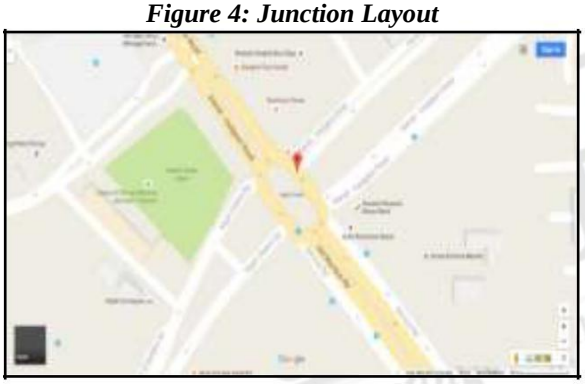
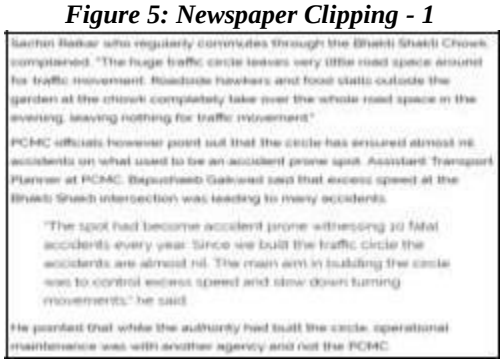


Figure 4: Junction Layout



The junction has signals but heavy vehicle movement from all directions still leads to congestion. The highway has already been widened to 61m (as many as 10 lanes). The civic body has started construction of the Bhakti Shakti Chowk – Mukai Chowk BRTS which will further increase the traffic passing through the junction.

Figure 5: Newspaper Clipping - 1



Sachin Ratkar who regularly commutes through the Bhakti Shakti Chowk, complained, "The huge traffic circle leaves very little road space around for traffic movement. Roadside hawkers and food stalls outside the garden at the chowk completely take over the whole road space in the evening, leaving nothing for traffic movement."

PCMC officials however point out that the circle has ensured almost nil accidents on what used to be an accident prone spot. Assistant Transport Planner at PCMC, Bapusaheb Gaikwad said that excess speed at the Bhakti Shakti intersection was leading to many accidents.

"The spot had become accident prone witnessing 10 fatal accidents every year. Since we built the traffic circle the accidents are almost nil. The main aim in building the circle was to control excess speed and slow down turning movements," he said.

He pointed that while the authority had built the circle, operational maintenance was with another agency and not the PCMC.

Traffic Surveys

Traffic surveys were conducted on the intersection to find out the peak hours (Morning and Evening), turning movement count, traffic characteristics at both the junctions, traffic projections for 20 years. After the surveys, short term and long term traffic solutions at both the junctions were proposed.

Intersection Turning Movement Count Survey

The purpose of the survey is to summarize the counts of vehicle movements through an intersection during certain time periods. This type of volume summary is used in making decisions regarding the geometric design of the roadway, sign and signal installation, signal timing, pavement marking, traffic circulation patterns, capacity analysis, parking and loading zones, and vehicle classification. This data is used in making decisions at a planning-level (e.g., traffic impact analyses), as well as operational analyses-level (e.g., signal installation and timing). Pedestrian and bicycle movements may be included during the intersection volume studies.

Traffic Volume Count Survey

These studies are conducted to determine the number, movements, and classifications of roadway vehicles at a given location. These data can help identify critical flow time periods, determine the influence of large vehicles or pedestrians on vehicular traffic flow, or document traffic volume trends. The length of the sampling period depends on the type of count being taken and the intended use of the data recorded. For example, an intersection count may be conducted during the peak flow period. If so, manual count with 15-minute intervals could be used to obtain the traffic volume data.

Table 3: Traffic Surveys and Schedule

Survey	Location	Duration	Date(s)
Turning Movement Count (TMC)	Bhakti - Shakti Junction	8 AM – 2PM and 4 PM – 9PM	4th – 5th Dec 2016
Turning Movement Count (TMC)	Transport Nagar Junction		
Traffic Volume Count	Service Road		

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

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Bhakti Shakti Junction					
Approach	Direction	Peak Hour Traffic		% of total PCUs	Type
		Vehicles	PCUs		
Pune	**Pune to Mumbai**	**1,628**	**2,046**	**16%**	**Through**
	Pune to Bhosri	**1,679**	**1,687**	**13%**	**Right**
	Pune to Akurdi	531	446	3%	Left
Mumbai	Mumbai to Pune	859	957	7%	**Through**
	Mumbai to Bhosri	869	752	6%	Left
	Mumbai to Akurdi	710	729	6%	**Right**
Bhosri	Bhosri to Pune	581	726	6%	Left
	Bhosri to Mumbai	**1,055**	**1,810**	**14%**	**Right**
	Bhosri to Akurdi	**1,484**	**1,403**	**11%**	**Through**
Akurdi	Akurdi to Pune	337	258	2%	Right
	Akurdi to Mumbai	263	208	2%	Free
	Akurdi to Bhosri	**1,530**	**1,850**	**14%**	**Through**
	Total	11,522	12,871	100%	

Table 4: Traffic Survey Analysis and Results at Bhakti Shakti Junction

Transport Nagar Junction				
Approach	Direction	Peak Hour Traffic		% of total PCUs
		Vehicles	PCUs	
Pune	Pune to Transport Nagar	680	795	11%
	Pune to Mumbai	**2,615**	**3,269**	**44%**
Mumbai	Mumbai to Transport Nagar	75	104	1%
	Mumbai to Pune	**2,139**	**2,396**	**32%**
Transport Nagar	Transport Nagar to Pune	32	42	1%
	Transport Nagar to Mumbai	833	827	11%
	Total	6,374	7,433	100%

Table 5: Traffic Survey Analysis and Results at Transport Nagar Junction

- Morning Peak Hours: 9:00AM to 10:00AM, Vehicles 8,856 (9,480 PCUs)
- Evening Peak Hours: 6:00PM to 7:00PM, Vehicles 11,572 (12,876 PCUs)
- Major movement at this junction is in Pune-Mumbai direction which is 76 per cent of the total movement.
- Free left movement (Pune to Transport Nagar and Transport Nagar to Mumbai) are 22 per cent of the total.
- Peak hour traffic at Transport Nagar junction is 6,374 vehicles (7,433 PCUs)

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

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Figure 7: Turning Movement Diagram

In ferences

After studying the intersection and conducting various traffic surveys several problems were observed. Low turning visibility due to existing traffic rotary, which leads to accidents; Deficient Junction Geometry; Delay due to shape of rotary, due to right turning larger trucks from Bhosri needing more time in weaving; Increased signal time as traffic from Mumbai to Pune direction has to stoptwice at Bhakti Shakti Junction and Transport Nagar Junction. To aid in solving these problems, we have decided to design an alternative efficient, pedestrian-friendly, preferably signal-free intersection.

CONCLUSION

The infrastructure facilities play major role in developing any zone of a country in the modern era and globalization. With the advent of the concept of smart city, it has become crucial to study all aspects of a smart city, particularly road transportation network. Focused with this aim, we studied in detail an ongoing project and decided to design and efficient intersection. Furthermore, a fresh outlook is needed if these road networks and new developing ones are to be truly a part of the modern world. To achieve this, computer-aided systems or ―smart aids‖ to the intersection (using GIS, GPS) can be applied. To truly realize the results of this efficient design, multiple intersections in the vicinity will have to be designed and then the combined effect observed. This analysis can assist the current and future demand for designing a very efficient and smart road junction with aim to have a free and speedy movement for all categories of traffic.This project highlights on optimising the construction and execution aspect of a road network, thus redefining the design parameters for large scale infrastructure projects.

Acknowledgments

We would like to thank various people who encouraged and guided us throughout the project. It was nigh impossible for us to finish this project without their valuable support. We fail to fully express our gratitude to our guide, Prof Shantini Bokil Ma‘am. She made this project an easier task to complete. She was a huge help as without her supply of the books, ideas and the matter needed, we would not have been able to gather the information needed. We also extend our gratitude to Ajwani Infrastructure Pvt. Ltd. And PCMC for giving us this glorious opportunity to study and be a part of their ongoing projects, and assisting us along the way. We would surely not have done this if not for them. And last but never the least; we would like to thank our HOD Sir and teachers who have been with us all throughout this enjoyable and educational project.

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Predictive analysis and Design of Simulation Model for Effective Traffic Management for Two major junctions of Pune City

[1]Kalyani Kulkarni, [2]Sneha Khedekar, [3]Ninad Pande

Abstract :- **This paper deals with traffic volume studies to determine the volume of traffic moving on the roads and classification of roadway vehicles at a particular section during particular time. Volumes of a day or an hour can vary greatly depending on the different day of the week or different time period of a day. Traffic volume survey is determination of number, movement and classification of roadway vehicles at a given location.**

Traffic volume is the most delicate information to implement transportation planning, design and to start new transportation modes. The data collection and collector both should be good and sound. Traffic volume counting should be accurate. Choose vantage point; if don't have then select a reference station. In case of manually counting try to keep a hand counting machine. In this paper we have chosen simulation model as the problem of uncontrolled traffic is rising in the city. The management of traffic has become a necessity. The model and its analysis are helpful for prediction of the traffic volume at the end of five years at selected junctions in Pune city facing maximum traffic congestion.

Keywords: **- traffic volume, simulation model, major junctions, prediction, five years**

I. INTRODUCTION

Effective traffic management is the need of the hour as the vehicular population and the problem caused by traffic congestion are ever increasing. There is no system adopted for traffic management in our city; however no mechanism has been implemented for co-operation and co-ordination.

Several studies related to traffic density, volume, congestion problems were conducted. This covered traffic systems like bus rapid transit, non motorised transport and public transport.

Due to scarcity of resources and desire to streamline the arrangement, a simulation model has been put to use. We plan to design a simulation model that will help us predict the traffic situation as well as the traffic volume at a particular junction for future.
Through this simulation model we can apply the remedial measures such as changes in road dimension, alternative routes to avoid traffic congestion, construction of flyovers or subways.

Traffic volume studies are conducted to determine the volume of traffic moving on the roads and classifications of roadway vehicles at a particular section during a particular time. Volumes of a day or an hour can vary greatly, depending on the different day of the week or different time period of a day. Traffic Volume survey is the determination of the number, movement and classifications of roadway vehicles at a given location.

II. AIM & OBJECTIVES

The aim of the study is to design the simulation model for forecasting and solving issues related to traffic congestion by predicting the traffic volume in the future from the analysis of the current traffic volume.
To achieve this aim following objectives were set:

1. Identification of the traffic problem in a certain area (nal stop and mundhwa-keshavnagar junction).
2. Study of traffic volume and data collection.
3. Design of simulation model.
4. Recommendation of remedial measures.

III. METHODOLOGY

1. Problem identification based on current traffic congestion problems.
2. Selection of junctions, time periods, vehicle type.
3. Data collection by manual/counter method.
4. Analysis based on Monte Carlo Simulation method.
5. Prediction of increase in traffic volume for next 5 years based on results obtained.
6. Remedial measures suggested tackling traffic problem.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

IV. DATA COLLECTION

For the predictive analysis we needed the current traffic volume. Out of the many methods available for finding the current traffic volume we selected the manual method. Considering the generalized traffic scenario at both the junctions, for collection of this traffic volume we selected the time slots of one hour in the peak hours in the morning and evening and one hour in the slack hours in the afternoon. We recorded the traffic by taking video recording.

a) NAL STOP

This junction connects prime commercial areas such as Deccan and Shivajinagar. It also connects prime residential areas like Kothrud, Karvenagar and Warje. These areas have large number of schools and colleges and are considered the heart of the city. Thus we observe crowded roads having mixed traffic conditions.

Table 1
Nal stop readings – 9-10am

Road direction	Sr. No.	2 wheeler	3 wheeler	4 wheeler	heavy	
Towards Deccan	1	2172	280	756	72	
Towards Kothrud	2	1028	340	456	132	
Towards Mhatre bridge	3	2316	186	588	36	
		5516	**806**	**1800**	**240**	**8362**

Table 2
Nal stop readings – 2-3 pm

Road direction	Sr. No	2 wheeler	3 wheeler	4 wheeler	heavy	
Towards Deccan	1	1184	288	536	100	
Towards Kothrud	2	1624	356	672	108	
Towards Mhatre bridge	3	1902	240	534	66	
		4710	**884**	**1742**	**274**	**7610**

Table 3
Nal stop readings – 7-8 pm

Road direction	Sr.no	2 wheeler	3 wheeler	4 wheeler	heavy	
Towards Deccan	1	1920	432	858	120	
Towards Kothrud	2	2234	376	875	112	
Towards Mhatre bridge	3	1452	225	658	62	
		5606	**1033**	**2391**	**294**	**9324**

From the above data we get to know about the current overall traffic scenario at Nal Stop. From the analysis of this data we can clearly see that the two wheeler traffic is the maximum compared to the other three vehicle types.

b) KESHAVNAGAR – MUNDHWA JUNCTION

The area connected by this junction has largely developed over the past few years due to many corporate companies having their large campuses and also development of residential and commercial places like Magarpatta City, Amanora Park Town, Seasons Mall and many other famous hotel chains

Table 4
Mundhwa readings – 9-10am

ROAD DIRECTION	Sr no.	2 wheeler	3 wheeler	4 wheeler	heavy	
towards nagar road	1	1052	210	845	108	
towards seasons	2	1952	198	863	114	
towards keshavnagar	3	757	157	923	49	
towards passport off.	4	1423	212	821	98	
		5184	**777**	**3452**	**369**	**9782**

TABLE 5
Mundhwa readings – 2-3pm

Road direction	sr no.	2 wheeler	3 wheeler	4 wheeler	heavy	
Towards nagar road	1	639	103	430	53	
Towards seasons	2	986	91	523	49	
Towards keshawnagar	3	452	67	578	43	
Towards passport off.	4	782	107	334	19	
		2859	**468**	**1865**	**164**	**5356**

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Table 6
Mundhwa readings – 7-8 pm

Road direction	sr. no.	2 wheeler	3 wheeler	4 wheeler	Heavy	
towards nagar road	1	1120	202	861	111	
towards seasons	2	2051	201	884	117	
towards keshawnagar	3	921	221	924	101	
towards passport off.	4	1578	163	817	54	
		5670	**787**	**3486**	**483**	**10426**

This suggests that the two wheeler based traffic is the maximum. But as compared to the other areas of the city, the 4 wheeler based traffic is greater as the connecting areas have large commercial and corporate zones.

V. ANALYSIS

Analysis of data collected was divided in 2 cases:

1. Case A: **Keeping direction and time constant (vehicular type analysis)** NAL STOP JUNCTION

Time : 9-10am

Vehicle type: Two wheeler

Direction	Sr. No.	2 wheeler	cum. Freq	range
Deccan	1	2172	2172	0-2171
Kothrud	2	1028	3200	2172-3199
mhatre bridge	3	2316	5516	3200-5516
			5516	

year	random nos	freq
1	451	2172
2	1156	2172
3	2791	1028
4	4672	2316
5	5353	2316
		10004

Vehicle type: Three wheeler traffic

Direction	3 wheeler	cum. Freq	range
Deccan	280	280	0-279
kothrud	340	620	280-619
mhatre bridge	186	806	620-806
		806	

Year	random nos	freq
1	101	280
2	304	340
3	413	340
4	599	340
5	734	186
		1486

Vehicle type: Four wheeler traffic

Direction	4 wheeler	CF	range
Deccan	756	756	0-755
Kothrud	456	1212	756-1211
mhatre bridge	588	1800	1212-1800
	1800		

Year	RN	freq
1	356	756
2	609	756
3	904	456
4	1270	588
5	1696	588
		3144

Vehicle type: Heavy Vehicles

Direction	heavy	CF	range
Deccan	72	72	0-71
Kothrud	132	204	72-203
mhatre bridge	36	240	204-240
	240		

year	RN	freq
1	29	72
2	45	72
3	97	132
4	169	132
5	235	36
		444

2. Case B : Vehicle and duration constant: NAL STOP JUNCTION

Towards deccan

Time: 9-10am

vehicle type	towards deccan	CF	range
2 wheeler	2172	2172	0-2171
3 wheeler	280	2452	2172-2451
4 wheeler	756	3208	2452-3207
Heavy	72	3280	3208-3280
	3280		

year	RN	freq
1	1014	2172
2	1736	2172
3	2463	756
4	2902	756
5	3127	756
		6612

Time: 2-3pm

vehicle type	towards deccan	CF	range
2 wheeler	1184	1184	0-1183
3 wheeler	288	1472	1184-1471
4 wheeler	536	2008	1472-2007
Heavy	100	2108	2008-2108
	2108		

year	RN	freq
1	966	1184
2	1270	288
3	1542	536
4	1754	536
5	2008	100
		2644

Time: 7-8pm

Similar calculations were done for case A and B for other junctions and time periods.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

VI. RESULTS & OUTCOME

1. **Case A : Keeping direction and time constant OUTCOME: Which type of vehicle is causing max. traffic.**

	2 wheeler		3 wheeler		4 wheeler		heavy	
Road	2015-16	2020-21	2015-16	2020-21	2015-16	2020-21	2015-16	2020-21
Nal stop								
time 9-10	5516	10004	806	1486	1800	3144	240	444
time2-3	4710	8954	884	1596	1742	3086	274	524
time 7-8	5606	9292	1055	1992	2391	4124	294	518
Mundhwa-keshavnagar								
time 9-10	5184	7136	777	989	3452	4351	369	467
time2-3	2859	3988	468	487	1865	2498	164	213
time 7-8	5670	7522	787	950	3486	4326	483	500

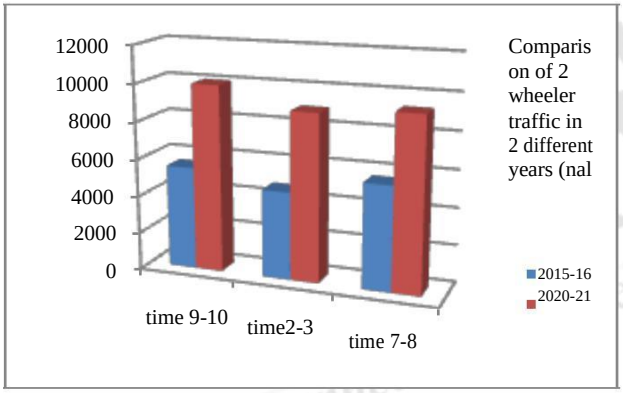


Fig.1 Comparison of 2 wheeler vehicle traffic based on time:

vehicle type	towards deccan	CF	range
2 wheeler	1920	1920	0-1919
3 wheeler	432	2352	1920-2351
4 wheeler	858	3210	2352-3209
Heavy	120	3330	3210-3330
	3330		

year	RN	freq
1	1014	1920
2	1432	1920
3	2008	432
4	2556	858
5	3073	858
		5988

Location: Nal Stop

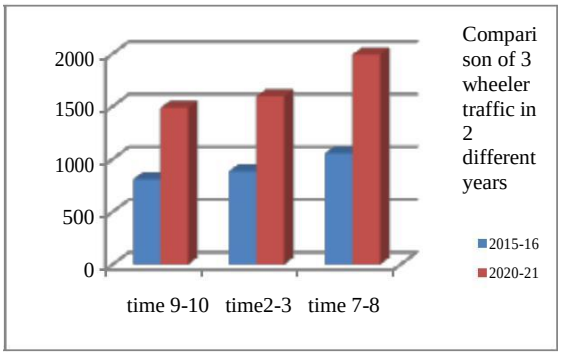


Fig .2 Comparison of 3 wheeler vehicle traffic based on time:

Location: Nal Stop

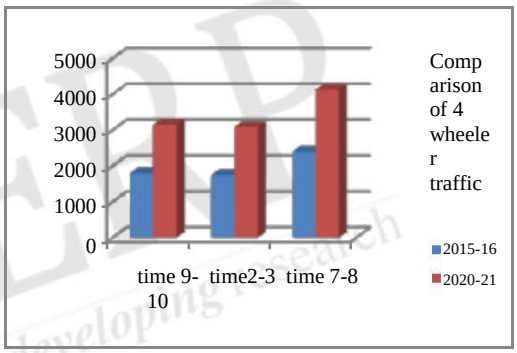


Fig.3Comparison of 4 wheeler vehicle traffic based on time:

Location: Nal Stop

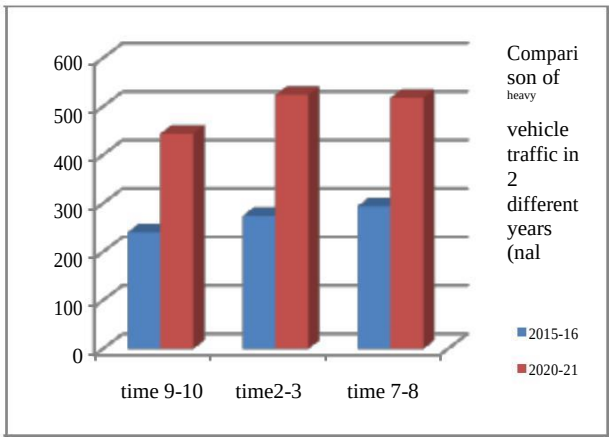


Fig.4Comparison of heavy vehicle traffic based on time:

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Location: Nalstop

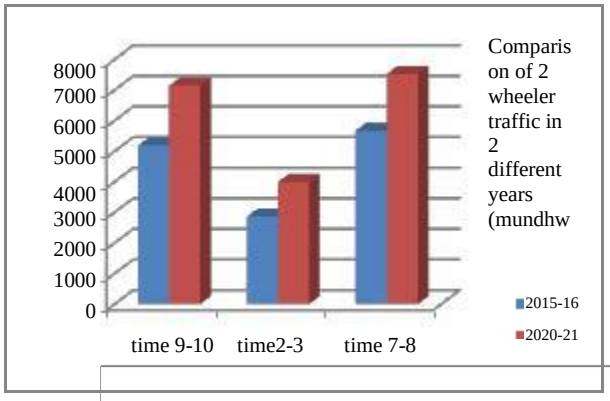


Fig.5Comparison of 2 wheeler vehicle traffic based on time:

Location: Mundhwa-Keshavnagar

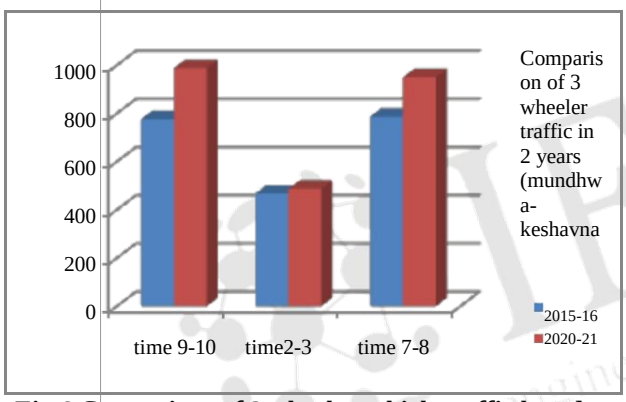


Fig.6 Comparison of 3 wheeler vehicle traffic based on time:

Location: Mundhwa-Keshavnagar

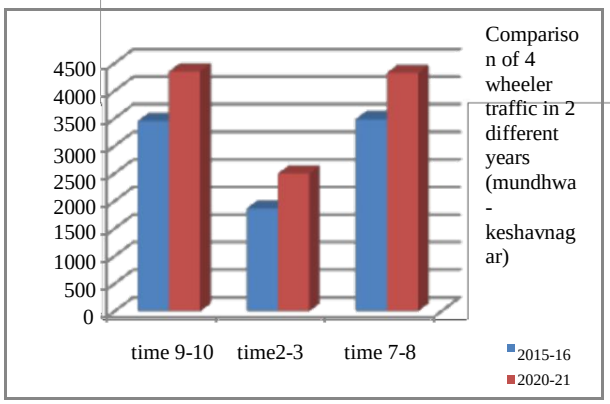


Fig.7 Comparison of 4 wheeler vehicle traffic based on time:Location: Mundhwa-Keshavnagar

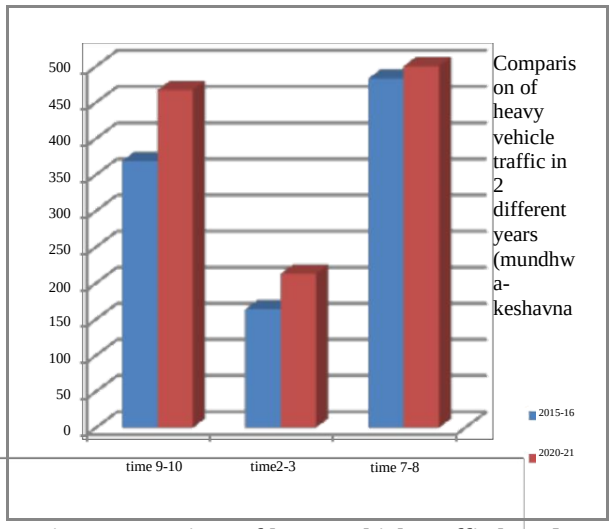


***Fig.8 Comparison of heavy vehicle traffic based on time*:**

Location: Mundhwa-Keshavnagar

2. **CASE B: Keeping vehicle type and duration and direction constant**

	time: 9-10am	
Road	2015-16	2020-21
nal stop		
Towards deccan	3280	6612
towards kothrud	1956	3996
Towards mhatre bridge	3126	5994
	8362	**16602**
mundhwa-keshavnagar		
Towards nagar road	2215	4432
Towards seasons	3127	5079
Towards keshavnagar	1886	3517
Towards passport off.	2554	4700
	9782	**17728**

	time: 2-3pm	
Road	2015-16	2015-16
nal stop		
Towards deccan	2108	2108
towards kothrud	2760	2760
Towards mhatre bridge	2742	2742
	7610	**7610**
mundhwa-keshavnagar		
Towards nagar road	1225	1225
Towards seasons	1649	1649
Towards keshavnagar	1140	1140
Towards passport off.	1242	1242
	9782	**17728**

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

	time: 7-8pm	
Road	2015-16	2015-16
nal stop		
Towards deccan	3330	3330
towards kothrud	3597	3597
Towards mhatre bridge	2397	2397
	9324	**9324**
mundhwa-keshavnagar		
Towards nagar road	2294	2294
Towards seasons	3253	3253
Towards keshavnagar	2167	2167
Towards passport off.	2612	2612
	10326	**10326**

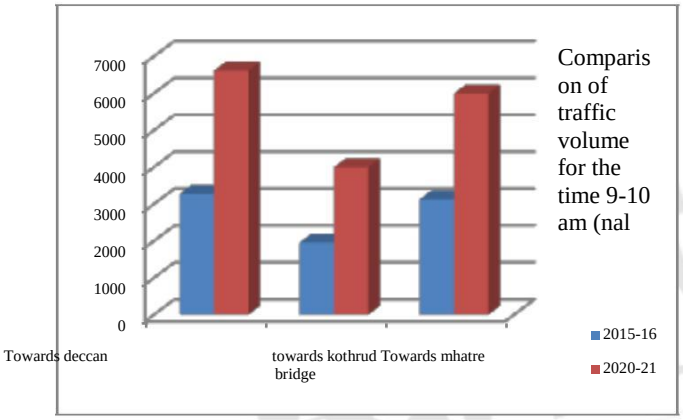


Fig.9 Comparison of traffic based on direction of traffic:

Location: Nal Stop
Time: 9am-10am

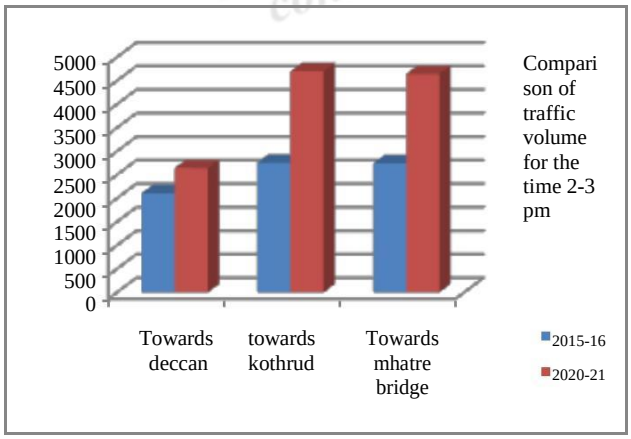


Fig.10 Comparison of traffic based on direction of traffic:

Location: Nal Stop
Time: 2pm-3pm

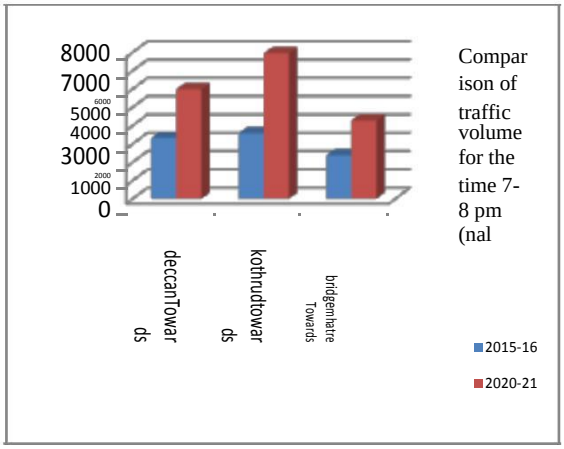


Fig.11 Comparison of traffic based on direction of traffic:

Location: Nalstop
Time: 7pm-8pm

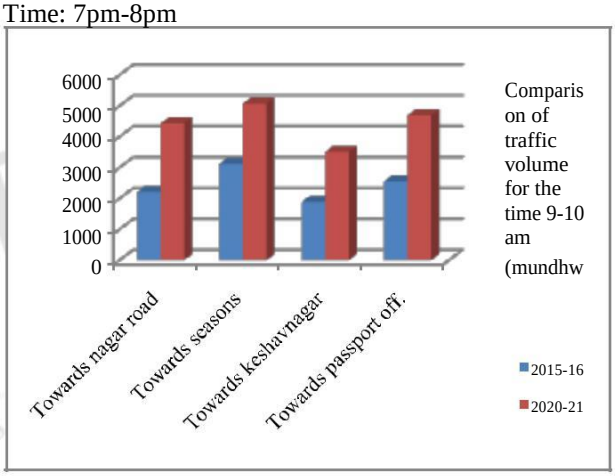


Fig.12Comparison of traffic based on direction of traffic:

Location: Mundhwa-Keshavnagar
Time: 9am-10am

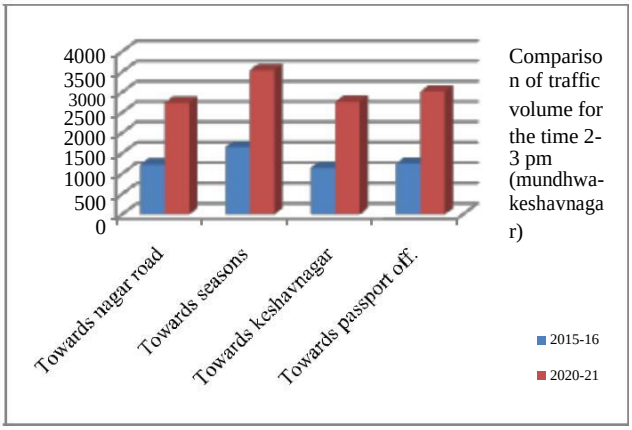


Fig.13 Comparison of traffic based on direction of traffic:

Location: Mundhwa-Keshavnagar
Time: 2 pm - 3 pm

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

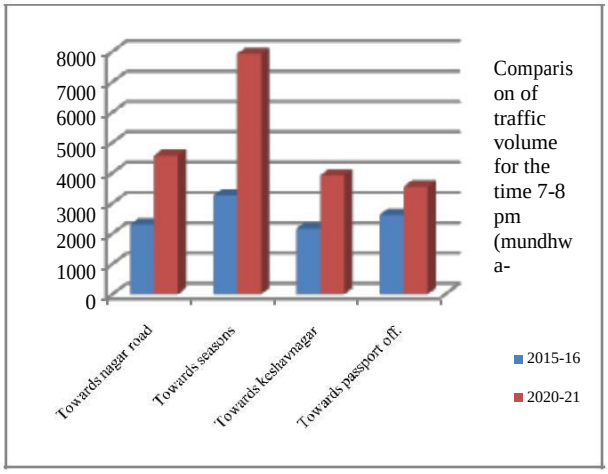
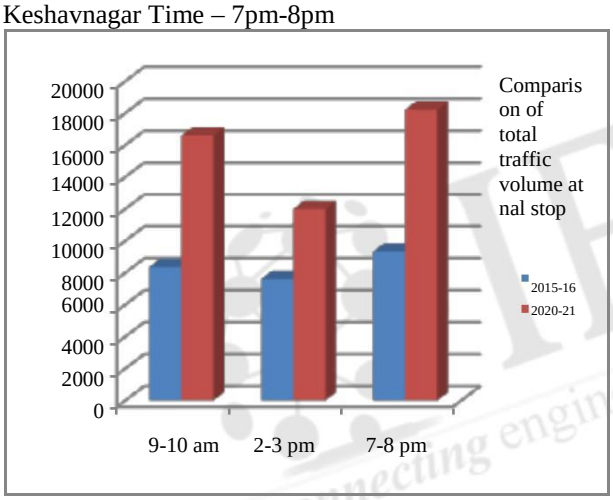
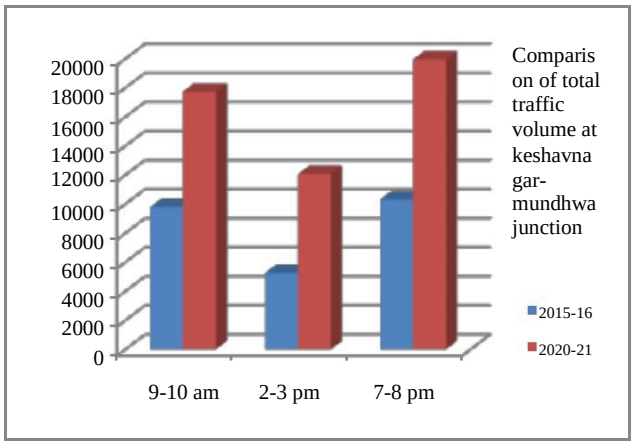


Fig.14. Comparison of traffic based on direction of traffic:

Location: Mundhwa-
Keshavnagar Time – 7pm-8pm



Comparison of total traffic at various time slots Location: Nalstop



Comparison of total traffic at various time slots Location: Mundhwa-Keshavnagar

VII. CONCLUSION

From the analysis of the current traffic condition, and depending on the data we predicted the traffic volume data after a five year period. The irrational rise in the traffic volume data is studied and depending on the data remedial measures are suggested. The irregular rise in vehicular traffic is shown with the help of bar graphs. From the simulation data we can see that the traffic volume has almost doubled in the predicted time period (5 years). The same simulation model can be used to predict the traffic volume for even 10 or greater number of years. But, as there is so much traffic rise in just five years recommendations are made on the predictive analysis of five years. The remedial measures suggested can be included in the development plans by the Municipal Corporation or local governing authorities to avoid the traffic congestion problems in future.

Remedial measures that can be implemented are:

1. Road widening can be done where there is enough space available.
2. Delhi pattern can be followed i.e. vehicles having odd number in the unit place of the number plate are allowed on odd days and vehicles having even number on even days. It is more of complicated remedy having much criticism but if followed perfectly it is a good solution.
3. Reductions of existing elements, for e.g. bus stops on critical turns can be shifted to some other location and can be avoided near to junctions.
4. Provision of grade separation and flyovers.
5. Diversion of traffic can be done wherever parallel road options are available.
6. Change of pattern of vehicular flow, provision of one ways.
7. Use of smart traffic control and signalling systems by use of traffic volume sensor.

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ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Recycling Methodology of Plastic in Laying Roads and Pavements

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[1][2] [3] [4] Research Professors, Department of Civil Engineering, MITCOE, Pune

Abstract :- **Significant environmental and economic problem are created because all forms of plastic like carry bags, wrappers, chocolates, chips, hand bags, cold drink bottles andlids of all bottles. Utilization of waste plastic bags in bituminous mixes has proved that these enhance the properties of mix in addition to solving disposal problems.**

The processed waste plastic, when added to hot aggregate will form a fine coat of plastic over the aggregate and such aggregate, when mixed with the binder is found to give higher strength, higher resistance to water and better performance over a period of time. Therefore, Plastic roads, is a simple way to make eco-friendly constructions. The innovative technology not only strengthened the road construction but also increased the road life as well as will help to improve the environment. The main objective of this paper is to discuss the significance of plastic in terms of innovative methodology for treatment and disposing and to provide solution to reduce,recycle,reuse by applying it for pavement and road construction

Keywords: **- waste plastic bags, innovative, aggregate, pavement, reduce, recycle, reuse.**

I. INTRODUCTION

The objective of the current research is to analyze practices followed by plasticrecovery and recycling units in, India. Disposal of waste plastic is a major problem Plastic is everywhere in today's lifestyle and its disposal is a great problem.It is non-biodegradable and it mainly consists of low-density polyethylene. Burning of these waste plastic bags causes environmental pollution. To find its utility in bituminous mixes for road construction, Laboratory performance studies were conducted on bituminous mixes. Improvement in properties of bituminous mix provides the solution for disposal in a useful way.

Plastic in different forms is found to be almost 5% in municipal solid waste, which is toxic in nature. It is a common sight in both urban and rural areas to find empty plastic bags and other type of plastic packing material littering the roads as well as drains.Polymer modified bitumen is emerging as one of the important construction materials for flexible pavements. Use of plastic waste in the construction of flexible pavement is gaining importance because of the various reasons. Use of higher percentage of plastic waste reduces the need of bitumen by 10% to 12 %.The use of virgin polyethylene as an additive to asphaltic concrete is not new; however, two new processes also use recycled plastic as an asphalt cement additive: NOVOPHALT^{R} and Polyphalt^{R}. *(11, 12, 13)* These latter two processes both use recycled low-density polyethylene resin which is generally obtained from plastic trash and sandwich bags. The recycled plastic is made into pellets and added to asphalt cement at a rate of 4 to 7 percent by weight of binder (0.25 percent to 0.50 percent by weight of total mix). *(12,13).* Plastic waste after sieving, shredding and processing is cut into a size such that it passes through sieve using shredding machine. The aggregate mix is heated and the plastic is effectively coated over the aggregate.

This plastic waste coated aggregate is mixed with hot bitumen and the resulted mix is used for road construction. Plastics are durable and degrade very slowly; the chemical bonds that make plastic so durable

II.PLASTIC INDUSTRY AND GENERATION OF PLASTIC WASTE IN INDIA

A boom in the consumption of plastic is experienced with the economic liberalization since 1991. Plastic consumption in India has more than doubled from 0.85 million tonnes during 1990-91 to 1.79 million tons during 1995-96.

Various resins of plastic Polyethylene tetraphthalate(PET,PETE), Density polyethylene(HDPE),Vinyl(Poly vinyl chloride or PVC),Low densitypolyethylene(LDPE),Polypropylene(PP).According to central pollution control board India generates 56 lakh tonnes of plastic waste annually. As per the CPCB report in 2014-15, 51.4 million tonnes of solid waste were generated in the country, of which 91 per

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

cent was collected, and 27 per cent was treated and remaining 73 per cent disposed of at dump.

Table 1: Reprocessing in Recycling Industry: Region wise and Polymer wise in kTA

Region	PVC	HDPE	LD/LLD/ H/M	PP	Other	Total
West	60	113	78	65	12	328
North	135	45	38	35	14	267
South	53	41	30	29	09	162
East	34	29	04	20	04	91

Source: Nanavaty, 1997.

It was suggested that one million tonne of waste plastic would have been recycled or otherwise reused in 1996 - including 40% of 1995 consumption of virgin plastic and 30 % of pre 1995 production which had been reprocessed before.

A.Plastic is sorted in following varieties.

The pre-processing of plastic needs segregation and sorting the contents like Milk covers, oil and Ghee covers, thick variety of plastic packing bag, Carry bags, Sanitary pipes, irrigation pipes, window planks, vegetable cutting planks, radio case, Lids of all bottles, hard plastic, buckets, baskets, canes, toothpaste covers, disposable cups,cosmetics and detergent bottles, etc.Plastic roads mainly use plastic carry bags, disposable cups and bottles that are collected from garbage dumps as an important ingredient of the construction material.

III. RECYCLING TECHNOLOGIES

There are mainly three approaches to recycling: mechanical recycling, mixed waste recycling and feed stock recycling. A study of the thermal behavior of the polymers shows that these polymers get softened easily without any evolution of gas around 130-140^{0}C, this has been scientifically verified.At around 350^{0}C, they get decomposed releasing gasesand above 700^{0}C, they undergo combustion producing gases like CO and CO_2.

IV. PROCESS ADOPTED IN ROAD CONSTRUCTION

The process of construction for by this technology involvessegregation,cleaning process, shredding process, field trials. The details of the processes are as follows:

Segregation: Plastic waste collected from various sources must be separated from other waste, maximum thickness of 60 micron.

Cleaning process: Plastic waste gets clean and dried.

Shredding process: Plastic material will be shredded or cut into small piece

Field trials: There are two types of field trials dry process wet process

A.Material Used: Aggregate of 20mm, 10 mm, Stone Dust and Lime as Filler, 60/70/80/100grade bitumen, Waste plastic in the shredded form.

B.Methodology: The processing is required for the various constituents of plastic and analytical study is done on its operational behavior on the aggregates. The details are as follows:

1.Plastics waste cut into a size between 2.36mm and 4.75mm using shredding machine.

2. Theaggregate mix is heated to 165°C (as per the HRS specification) and transferred to mixing chamber. Amount of plastic to be added is @8% of bitumen

3. Bitumen is to be heated up to a maximum of 160°C (HRS Specification) to have good binding and to prevent weak bonding.

4.At the mixing chamber, the shredded plastics waste is to be added. It get coated uniformly over the aggregate within 30 to 60 seconds

5.The plastics waste coated aggregate is mixed with bitumen and the resulted mix is used for road construction.

6.The road laying temperature is between 105°c to 120 °c. And the rollers are used.

The processed plastic undergoes various tests as mentioned below:

C.Tests for the Investigation of the Properties of Aggregate and Bitumen

- **Tests for aggregate**

The tests for aggregates involves Sieve Analysis of Aggregates, Specific Gravity and Water Absorption Test [IS: 2386 (Part 3) 1963], Aggregate Impact Value Test [IS: 2386 (part 4) 1963], Aggregate Crushing Value [IS: 2386 (Part 4) 1963], Flakinessand Elongation Index Test [is: 2386 (part 1) 1963].

- **Tests for bitumen**

Various penetration test for bitumen includes Penetration Test [Is: 1203-1978],Softening Point Test [Is: 1205-1978],Ductility Test [IS: 1208-1978], Viscosity Test: ,Flash Point and Fire Point.

D.Preparation of design mix

This process involves mixing the constituents with respect to their operating parameters, which are given below

a. Plain Bituminous Mix: Bitumen is also known as asphalt or tar. A good design of bituminous mix is expected to result in a mix which is adequately strong,

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

durable, resistive to fatigue and permanent deformation.

b. Selection of Mix Constituents: The binders are selected based on some simple tests. These tests could be different depending of the type of binder e.g. penetration grade, cutback, emulsion, modified binder etc. Number of tests is recommended in the specifications to judge the properties of the aggregates, e.g. strength, hardness, toughness, durability, angularity, shape factors, clay content, adhesion to binder etc.

c. Coated Bituminous Mix: The plastic coated aggregate bitumen mix and plastic modified bitumen forms better materials for flexible pavement construction as the mixes shows higher Marshall Stability value and suitable Marshall Coefficient.

V. PROCESS ADOPTED FOR PAVEMENTS PREPARATION

The process of pavement preparation involves the following phases. In-house Sorting and Cleaning, Size Reduction, High Speed Mixing,Addition of Additives, Extrusion, Pelletizing.

- Size Reduction; material is reduced in size depending upon type of plastic. Thin carry bags of LDPE, LLDPE or even PP are directly fed into extruder with or without washing.
- High Speed Mixing: increasing the bulk density and homogeneity of the matter, is to mix additives and colors. Adequate mixing is essential to achieve uniform color and shade (Balachandani, 1980).
- Additives: achieve their effect by chemical reactions such as PVC heat stabilizers, antioxidants, ultraviolet absorbers and flame retardants
- Extrusion: fundamental principle of the extrusion is plastic material is forced through an orifice of the required shape under pressure to achieve the desired shape.
- Pelletizing semi-solid material emerges; it is passed through a trough of water to harden, and then passed into a chopper which chops it into small pellets. During this pulling through water the cord thins further, to reduce the diameter to about 2mm at the chopper.In case of PP, first lumps are made which are again ground and extruded to make granules. Finally the granules are again extruded to be molded into appropriate product shape.

A.Method of Road Laying

The methodology of laying and casting theroad pavements includes various process.

1. Dry process is recommended for isolated worksIt is recommended that the percentage of shredded waste plastic will be 8% by CRRI
2. Mini hot mix plant: The stone aggregate mix (as per specification) is transferred to the mix cylinder where it is heated to 165^0c (as per the IRC specification) and then it is transferred to the mixing puddle while transferring the hot aggregate into the puddle, calculated quantity of shredded plastics is sprayed over the hot aggregate within 30seconds. The sprayed plastic films melts and gets coated over the aggregate, thus forming an oily coating. The further curing and commissioning pavement and the wearing course isidentical as regular pavement laying procedure. The surfaces are obtained are as workable as regular pavements.

VI.ADVANTAGE OF WASTE PLASTIC BITUMINOUS MIX

The bituminous mix obtained shows outstanding results showing stronger road with increased Marshall Stabilityvalue**,**better resistance towards rain water and water stagnation.There are no stripping and no potholes and has increased binding and better bonding of the mix.There is reduction in pores in aggregate and hence less rutting and raveling occurs. The load withstanding property increases and it helps to satisfy today's need of increased road transport. The use of waste plastics on the road has helped to provide better place for burying the plastic waste without causing disposal problem thus shouldering the responsibility of avoiding land pollution.

VII. CONCLUSION

Current research on the beneficial use of waste byproducts as highway construction materials has identified several promising uses for these materials. Some of these materials include:Blast furnace and steel slags,Carpet fibers,Coal ash byproducts, including fly ash, bottom ash, and Recycled plastic.

The experimentation by several researchers indicates that the waste plastic, when added to hot aggregate will form a fine coat of plastic over the aggregate and such aggregate, when mixed with the binder is found to give higher strength, higher resistance to water and better performance over a period of time. Therefore, it is proposed that we may

use waste plastic in the construction of roads. The use of the innovative technology not only strengthens the road construction but also increases the road life as well as will help to improve the environment.Plastic roads are a simple way to make eco-friendly constructions. It will save large amount of revenue in future and reduce the amount of resources used for construction.Despite all researches on potential use of recycled materials in road structures, yet there aremajor concerns due to lack of definite procedures on implementation of laying recycled concrete in pavements and requires intensive investigation to adopt it globally on massive scale.

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ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Road Accident Prediction Models based on Geopathic Stress

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Abstract :- **This paper attempts to contribute to the research by suggesting 3 models – one relating the current measured on the geopathic stress zone with the body voltage of the drivers, secondly the average number of accidents with respect to the body voltage and thirdly the average number of accidents with respect to the current on the geopathic zone. In this paper the geopathic stress is one of the cause for road accident has been studied. For this, in all 50 accident spots were selected on the Mumbai-Pune Expressway, the Mumbai-Bangalore highway NH-4, the Pune-Nagar highway and the Mumbai-Pune National highway.**

Keywords: **- Geopathic stress, accident, bio-voltage, current**

I. INTRODUCTION

Importance of geopathic stress in spatial planning is recognized and used by many researchers; Bachler (1970), Bergsmann (1989), Croome (1994), Bird 1997), Christpher and Cantab (1997), Silk and Cown (1999), Agarwal (2004), Assa (2004), Chouhan (2004), Bogus (2010), Tsai (2010), Underwood (2011), Khan (2013).

However, the significance of geopathic stress as a causative factor of road accidents has been studied only by few researchers; Maston (1955), Mazharul (1988), Meliknow (1997), Kharat (2000), Bradna (2002), Read (2006), Pimplikar (2005), Jarad (2013) Sorte (2015).

Furthermore, many mathematical models exist for road accident prediction such as accident prediction models using generalized linear models, negative binomial models, regression model, dynamic analysis model, roller model, predictive model, accident causation model, mixed traffic condition model and Smeed's model.

However, these models are based on the conventional causes of accidents such as heterogeneous traffic flow, negative binomial, mixed traffic flow, number of vehicles passing, length of road, geometric and vehicle factors.

It may be noted here, that there does not exist any quantitative model which enables to predict the road accidents at specified spots, arising due to the existence of geopathic stress.

This paper attempts to contribute to the research by suggesting 3 models – one relating the current measured on the geopathic stress zone with the body voltage of the drivers, secondly the average number of accidents with respect to the body voltage and thirdly the average number of accidents with respect to the current on the geopathic zone.

II. RESEARCH METHODOLOGY

In all 50 accident spots were selected on the Mumbai-Pune Expressway, the Mumbai-Bangalore highway NH-4, the Pune-Nagar highway and the Mumbai-Pune National highway. These spots were so selected that the conventional causes of road accidents as mentioned above did not exist at these locations; yet the number of accidents averagely occurring per year ranged from 6 to 32, as obtained from the traffic authorities.

For detecting and confirming the existence of geopathic stress at these locations, 3 methods were used;

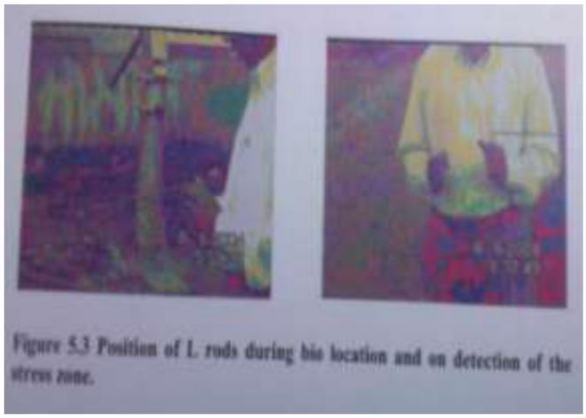
a) Bio-location using 2 copper L rods as transducers
b) Polycontrast Inference Photography (PIP) scans on the roadway
c) Selenium photo-cell using normal bulb source as well as laser beam source. Refer figure 1,2,3 and table no. 1 based on the detection of Current (I).

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

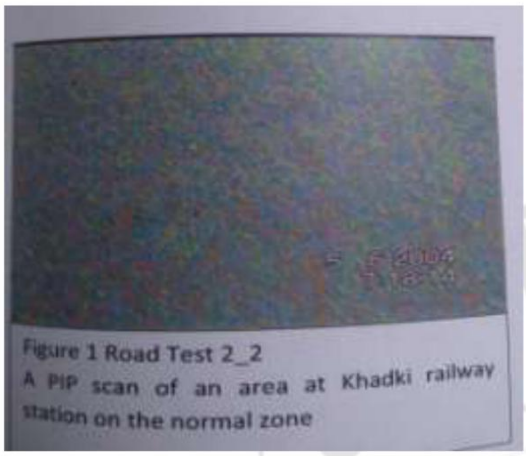
Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India



Position of L rods during bio location of the stress zone

Figure No. 1



A PIP scan of an area at Khadki railway station on normal zone

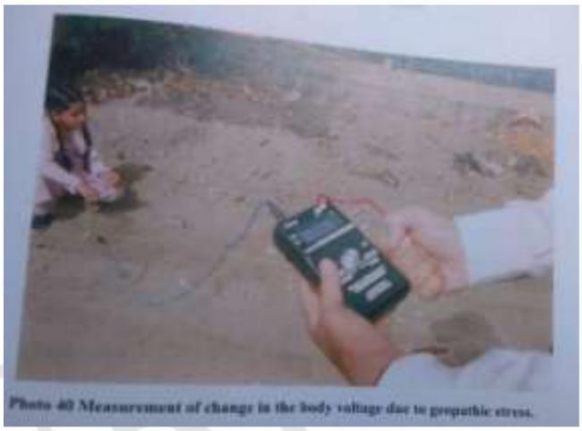
Figure No. 2

A reference reading being set on a non-stress zone ***Figure No. 3***

Body voltage of the drivers were measured on the Stress Zones using an electro-stress meter, in the following conditions

1. While standing on and off the stress zone
2. While walking from outside the stress zone, into the stress zone and moving out again and
3. While driving on the road at a constant speed of 40 Km/hr.

Refer to figure 4 and table no. 2.



Measurement of body voltage due to geopathic stress

Figure No. 4

Based on the data generated, Karl Pearson's co-relation coefficients were determined, graphs were drawn and the empirical mathematical models were generated.

Results and Discussion:

1) Based on the bio-location experiences, the geopathic stress zones were qualitatively classified as medium, strong and very strong.
2) PIP scans at accidents spots showed combinations of very bright colors as well as dull colours, contrasting red and green colours as against the uniform green colour on a non-accident spot. Also at few spots, magnetic polarity was exhibited in the scan.
3) Current difference values between the stress zones on accident spots and the non-stress zones, using the laser beam source varied from 164 µA to 1000 µA depending upon the level of intensities as mentioned above. It was also observed that the sensitivity of the laser source used was more than 30 times that of the normal bulb source.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Table No. 1 Electro-stress meter readings at accidents spots

Sr. No.	Name of expressway/Highway	Location of the accident spot or chainage	Reference reading on electro-stress meter on normal zone (mV)	Electro-stress meter reading on stress zone (mV)	Difference (mV)
1	Mumbai-Pune-Banglore (NH-IV)	120 m ahead of spot No 41	5	305	300
2	Mumbai-Pune-Banglore (NH-IV)	On the connecting road between Mumbai-Banglore Highway and JSPM's JSCOE,Hadaspar	7	217	210
3	Mumbai-Pune-Banglore (NH-IV)	On the road entry to JSCOE college, Hadapsar	6	381	375
4	Mumbai-Pune-Banglore (NH-IV)	At well on an internal road, Hadapsar	9.5	360	350.5
5	Mumbai-Pune-Banglore (NH-IV)	At intersection of 2 water veins, on an internal road, Hadapsar	10	405	395
6	Mumbai-Pune-Banglore (NH-IV)	Shirwal	4.5	294.5	290
7	Mumbai-Pune-Banglore (NH-IV)	Shivapur	3	418	415
8	Mumbai-Pune Expressway	50 Km	8	115	107

Table No. 2 Bio Voltmeter readings in mV

Sr. No.	Day	Bio Voltmeter readings in mV at						
		0˚ Non stress zone	30˚ Stress zone	60˚ Stress zone	90˚ Stress zone	120˚ Stress zone	150˚ Stress zone	180˚ Non Stress zone
1	22-06-08	1.2	31	70	65	51	33	1.8
2	23-06-08	0.8	23	50	42	40	19	1.0
3	24-06-08	0.4	72	80	80	62	31	4.5
4	25-06-08	4.5	77	76	72	43	25	1.9
5	26-06-08	6.5	66	76	70	40	28	4.0
6	27-06-08	2.5	45	53	47	42	18	6.0
7	28-06-08	1.5	39	55	50	43	20	2.1
8	29-06-08	1.5	36	53	48	43	25	3.1
9	30-06-08	3.5	40	51	46	41	23	2.3
10	1-07-08	4.5	38	51	48	40	31	4.0
11	2-07-08	2.5	55	72	68	60	28	2.1
12	3-07-08	3.5	78	92	88	82	55	6.1
13	4-07-08	2.5	15	28	26	24	12	3.1
14	5-07-08	4.5	75	88	82	78	35	5.1
15	6-07-08	1.6	15	30	28	24	12	2.1
16	7-07-08	4.5	76	80	72	63	36	1.2
17	8-07-08	4.8	65	92	88	80	41	4.8
18	9-07-08	2.5	46	50	43	38	29	1.5
19	10-07-08	0.5	26	29	25	24	9	1.5
20	11-07-08	0.3	24	27	21	20	6	0.8
21	12-07-08	4.5	61	64	68	63	55	3.5

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Figure No. : 4

4) Body voltage of drivers on non-stress zones varied from 3 mV to 10 mV, whereas those on the stress zone varied from 15 mV to 545 mV, indicating the sudden increase of about 5 times to upto 50 times. This clearly indicates that the normal functioning of the human body is affected on the stress zones. Averagely, the body voltage increase on the stress zone is about 20 times the normal value. Also while entering the stress zone there was an increase of about 16 times, but while coming back from zone, the decrease in the voltage was only about 12 times, indicating that there is retention of electricity within the body.

5) For variation of body voltage during motion, refer to figures (6, 7, 8, 9, 10 the variation clearly indicate that when a number of stress zones are transited sequential the initial body voltage pattern existing on the non-stress zones is not recovered. Also sudden peaks are observed.

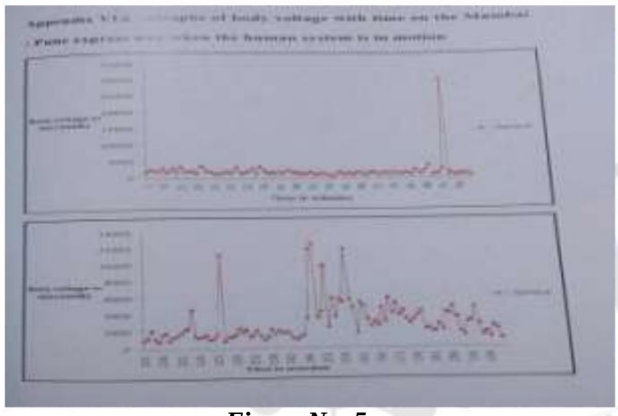


Figure No. 5

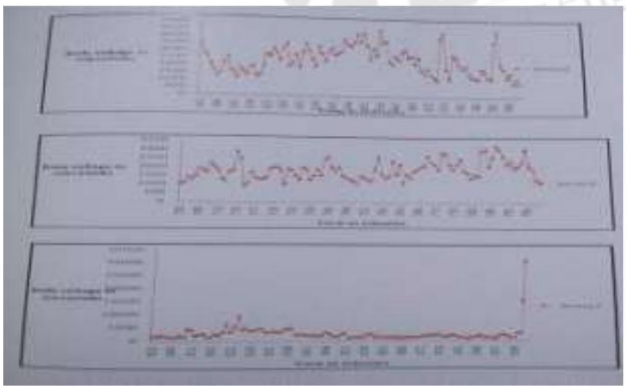


Figure No. : 6

Body voltage in micrometer vs time in minutes

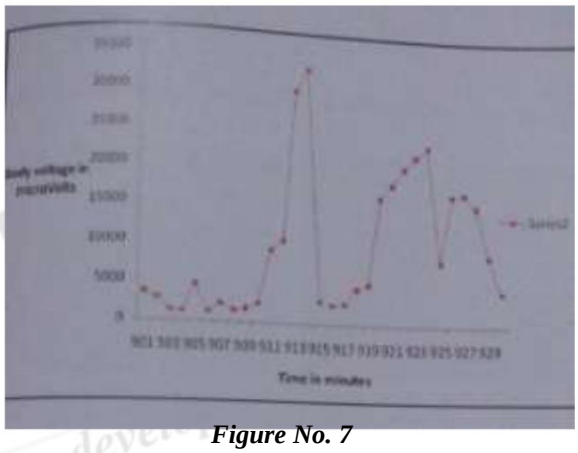


Figure No. 7

Body voltage in micrometer vs time in minutes

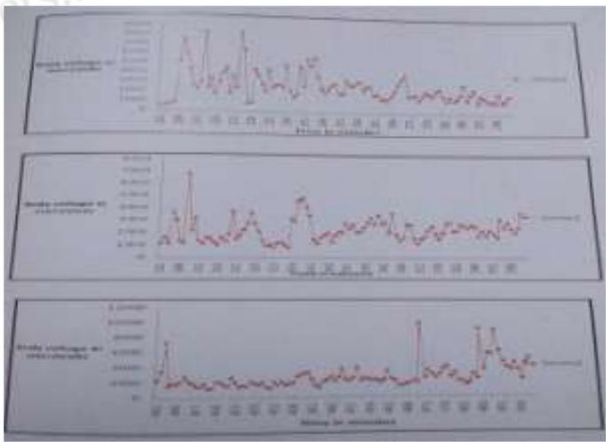


Figure No.: 8

Body voltage in micrometer vs time in minutes

Model Suggested:

1) Relationship between the current (I) measured on the stress zone in micro Amperes and the driver's body voltage (BV) measured in milli Volts is,

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

$I = 120 (BV)^{1/3}$ ……Equation 1

Or

$BV = 5.787 \times 10^{-7} I^3$ ……..Equation 2

Knowing the current, based on precise measurement from the stress zone using equation (1), body voltage can be forecast.

2) Linear equations relating the average accidents due to geopathic stress ($\bar{A}$) with current (I) on stress zone and the driver's body voltage (BV) are:

$\bar{A} = 0.010 (BV) + 13$……Equation 3

$\bar{A} = 0.079 I – 26.22$……..Equation 4

Utility of the Prediction models

In this study, a simple, speedy, precise experimental system has been developed, using the selenium photo-cell and the laser beam source. Using this system, the value of current "I" can be easily measured on the geopathic stress zone. Using equation 2 the body voltage of the driver passing the stress zone can be forecast. If the forecast value is within 0 to 10 milli Volts, there is no chance of an occurrence of an accident.

If the forecast value is in between 10 milli volts to 100 millivolts, there is a lower probability of occurrence of an accident. If the forecast value is between 100 milli volts to 1000 milli volts, based on the value, there exists a very high probability of occurrence of an accident on a geopathic stress zone.

Further, forecast value of the body voltage can be substituted using equation 3, so as to predict the average number of accidents likely to occur per day, at any geopathically stressed location. Equation 4 can also be used to predict the same, based on the value of current I.

A large database can be generated at various geopathically stressed locations along different National Highways and Expressway, using the above equations. This database can be used to classify the accidents spots as black spots or otherwise, based on the value of $\bar{A}$. This, in turn will enable in the strategic planning of such locations.

For very critical locations, nullification work can be prioritized. The model can further help in predicting the success or failure of the nullification process by re-measuring the reduced or nullified current and repeating the above calculations. Based on this, it is possible to obtain the road user satisfaction, through fulfillment of functional needs, economic needs from the transportation system.

Geopathic Stress as – A Novel Road Design Parameter:

The empirical investigations carried out in this study, have shown that geopathic stress does exist and it affects in a detrimental manner, the human system using the road. Considering the research objectives aforementioned for this study, it is suggested that the geopathic stress should be considered as a design parameter by Indian Road's Congress (IRC) and similar such organizations in various countries**.** As per IRC-37 and IRC-58, the design parameters which presently considered for the flexible and rigid pavements include only the roads, the subgrade characteristics and the temperature variations.

Critical observations of these parameters reveal that they focus mainly on the pavement itself. There is no consideration given to the interaction of the subterranean features like underground water veins, or geological anomalies, with the pavement. Furthermore, the interaction of such features with the road user is also completely ignored, whereas the safety considerations of the road user are basic in nature, for the road accidents. Based on the results obtained in the study, it is therefore argued that geopathic stress should be considered as a road design parameter. This will enable the planners to reduce the pavement deterioration, economize on the road maintenance and most important, reduce the number of road accidents.

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ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

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Safe and Intelligent Transport Systems

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Abstract :- **Transportation is one of the basic and most important sectors to be considered in development of a country. India as an evident developing nation totally depends upon its transportation system. Over 40% of the passenger transport is done by the railways, 38% by the roadways and remaining 22% by airways. As this huge amount of people travel through the railways, safety becomes an important issue. Road and railway accidents have considerably increased as per the survey carried out in tenure of 6 years from 2009 to 2015. 47% of the rail accidents in India mainly take place due to derailment. Fire safety is also an important concern. Many innovative ideas need to be implemented in case for safe and intelligent transports. Not only passenger safety is important but safety in goods transport also counts for the same. The construction and introduction of new ideas in building railway tracks and airplane is extremely important. The exclusive idea which deals with the aviation safety is the main highlight. Which is really an important topic as the number of increasing airplane crashes are considered.**

Keywords: **- Transportation system, Railways, Roadways, Airplane crashes, Intelligent Transports, aviation safety**

I. INTRODUCTION

The Inspiration of topic "Safe And Intelligent Transport Systems" came by observing day to day scenarios or the events occurring around us. Events can be in the form of Rail Accidents, Airplane crashes or Road Accidents. Considering the Safety of the human life has now become important to think on some smart approaches to avoid and to survive from such events. Such Scenarios endangering the Human Life can be solved by making minor changes in our traditional Constructions approaches or Techniques. Thus in following topic we will discuss on some of such techniques that came be implemented in real world to tackle with accidental events like Derailing or Airplane Crashes. Our Prime focus will be on Railway Safety then Followed by Aviation Safety.

II. TRADITIONAL METHODOLOGIES

Traditional Methods Construction and Safety of Railway Tracks

There are three distinct methods of construction of railway track. These are:

A. Telescopic Method
B. Tramline Method
C. Mechanical Method

A. Telescopic Method of Construction of Railway Track

In this method, rails, sleepers and fastenings are unloaded from the material train as close to the rail head as possible. The sleepers are carried by carts or men along the adjoining service road and spread on the ballast. The rails are then carried on pairs to the end of last pair of connected rails and linked.

To carry rails manually over a long distance is a tedious job. So certain carriers called Anderson rail. Carriers are used to carry rails to the ends of the rail head.

It can also take rails up to a head last pair linked with the help of temporary track consisting of 3" x 3" angle irons of the same length as rails and fastened to the sleepers.

A further consignment of the material is deposited at the advances rails head and the procedure is repeated.

B. Tramline Method Railway Track Construction

This method is used where tram carrier are installed for carrying earthwork or in rainy season due to difficulty in movement of cart. Some tramline is established on with a gauge of 2'-2'-6". The basic difference between this and telescopic method lies in the conveyance and spreading of the sleepers.

The track can be assembled at more than one point simultaneously, which is the great advantage of this method. Sometimes an additional track is laid on the side of existing track for which this method is best.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

C. Mechanical Method Railway Track Construction

This method is extensively used in Britain and America by using special track laying machine. There are two types of machines available. In first type of machine, the track material carried by the material. Train is delivered at the rail head and laid in the required position by means of projecting arm or mounted on the truck nearest to the rail head. The material train moves forward on the assembled track and operation is repeated.

In the second type of machines a long cantilevered arm projecting beyond. The wagon on which is fitted. A panel of assembled track consists of pair of rail with appropriate number of sleepers on the ballast layer. This panel is conveyed by special trolley running over the wagons of material train to the jibs. It is lowered by the jib in the required position and connected to the previous panel. The track laying machine then movies forwarded and operation is repeated.

Traditional Method Adopted for Aviation Safety

Traditionally aviation safety designed for the sake of protecting the aircraft from bad weather. Weather radars and censors are used to detect the bad weather and take some preventive measures for it. Passenger safety is also taken into consideration by providing seat belts, oxygen masks and all necessary medical aids.

The Air Traffic Control (ATC) ensures the safe and smooth running of flights. But there is still much more scope for improvement in air transport regarding hijacking, engine failures and lot more technical calamities.

Traditional Method Adopted for Road Safety

Road safety traditionally is deals with providing dividers or increasing the lanes of highway. Traffic signals also help in smooth running of road transport. But considering the number of accidents that take place it is very important and crucial to seek attention in case of road safety. Road safety techniques also need to be modernized on large scale for better transport.

III. PROPOSED IDEAS

Following are some Sectors where Safety Place Important role,

A. Railway Safety
B. Aviation Safety
C. Road Way Safety

Following are details about above Ideas.

A. Railway Safety

Railway safety is really very important topic to be taken into consideration. Almost 40% of passenger transport is carried out by trains. According to the survey taken by the government authorities in the tenure of 6 years from 2009 to 2015 the number of rail accidents has increased considerably. Amongst which 47% of accidents take place due to derailments. So rail safety has become an important issue. It is very important to modernize the safety techniques that are in use currently.

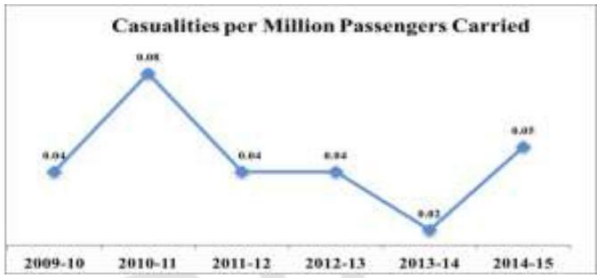
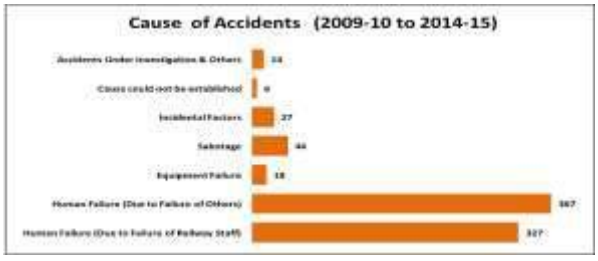


Fig - Causalities per Million Passenger carried

Following are some modern approaches that can prevent rail accidents due to derailment

- The railway tracks must be inspected every month for any cracks or loose joints. A single crack can lead to a huge disaster. It is very important in order to prevent rail accidents.
- Automatic Crack Detecting Machines are very modern and accurate instruments that can be used for detection of the cracks instead of infusing a large amount of manual staff.
- The provision of alarming signs in areas whose terrain is likely to lose its stability in case of natural calamities.
- Tracks and slippers should be constructed on firm base in order to prevent the shocks experienced when train passes over them.
- The coupling in the tracks should be checked very often.
- The expansion of metal takes place when temperature increases and sudden decrease in the temperature gives rise to cracks. In order to prevent these thermally stable conditions should be maintained at the level of tracks.



ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Fig:- Graph Showing Causes Of Road Accident From 2010-2015

B. Aviation Safety

Aviation safety is main concern now days. For better treatment and safety of passengers innovative safety techniques are to be used. One of such is mentioned below:

The construction of planes has become more modernized these days but still it needs some improvement. The idea deals with the construction of cockpit and passenger compartments separately. As the passenger compartment is constructed separately it will be constructed in more precise manner. The dimensions of different parts of airplane while constructing it are known to engineers.

This will help in providing safety equipment on it. The parachutes with strings of high tensile strength will be provided at the center of gravity of the passenger compartment and at equal distance from it on either side for better stability. In case the engine failure occurs and plane starts falling down there would be the provision of remote controlled system as manual approach and sensors will be provided for most modern technique for operating the parachute system. This will open the parachutes situated at their respective places.

This provision of parachutes will lift the plane and decrease the falling speed considerably. In case the plane was flying above an water body that can be a river, an ocean or a sea the tube will be provided at the bottom of the plane covering the whole span of passenger compartment. This will ensure the safe landing even in water. Now for pilot and copilot which are present in cockpit compartment. As there is provision of eject system in fighter planes same can be provided for pilots in cockpit of a passenger plane. This can definitely save numerous lives and make air transport even safer.

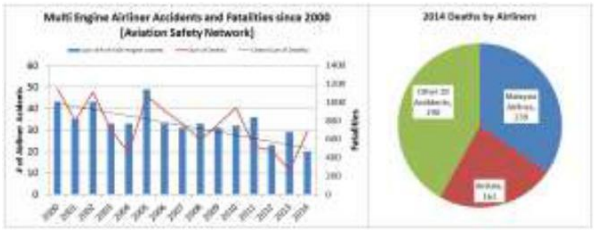


Fig: Aviation Accidents Graph (2000- 2014)

C. Road Way Safety

Road transport is another important transport way besides railway transport. About 38% passenger transport is done by means of roadways. So road safety is also an important concern. The casualties due to road accidents are very high. The death rate has increased since high speed vehicles have come into picture.

There are no strict rules for preventing road accidents. The road safety has to be looked upon again for betterment in it.

Following are some techniques that can help in reducing road accidents considerably:

There should be speed limit for every road according to what function it plays and area alongside road.

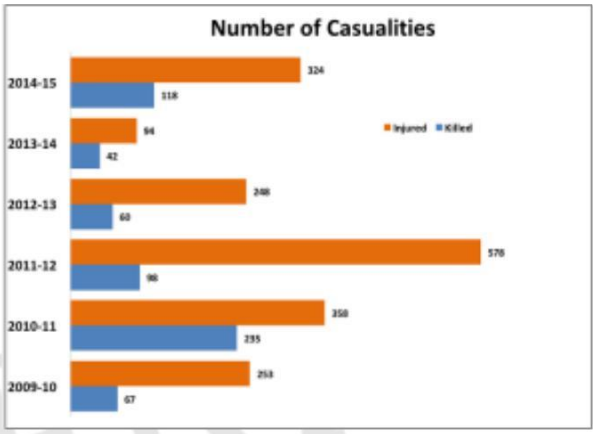


Fig: Number Of Casualties In Road Accidents (2009-14)

For example;

- If the road is passing through the town or nearby a place where population is more there the speed limit should be less i.e. 30 to 40 km/hr
- Using seat belts while driving will help reduce the chances of injury by 30%.
- Using baby seats while driving will help in handling small children so that one can concentrate on driving and avoid accidents.
- Increasing network of traffic signals instead of manual control and also providing CCTV cameras for preventing any malpractices.
- The construction of roads must be proper in order to ensure smooth transport. The maintenance roads must be checked regularly for proper running of traffic.
- The awareness and information must be spread widely among the people in order to educate them about road safety rules and regulations.

IV. CONCLUSION

As India is totally dependent on its transport system the safety in transport was really important concern. The transport safety in Railways, airways and roadways has been addressed in this paper. The safety

measures introduced will definitely help in improving the transport system and will lead to more safe and efficient transport.

Safety of people which is the first priority of any government has been addressed with help of innovative and modern ways in this paper. After all a safer nation leads to a developed nation.

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Soil Stabilization

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Abstract :- **This paper focus on the improving the properties of the soil which are required for road subgrade by adding admixtures. Construction of any type of structure along with roadways over soft subgrade is one of the most common problem in many parts of the world as well as in India. After the road construction, many problems usually arise like deterioration of the surface (potholes), maintenance problems, etc. thus making the road maintenance is costly and disruptive to the traffic flow. Therefore, during the construction stabilization of subgrade using some locally available material is necessary. The usual approach to soft subgrade stabilization is to remove the soft soil, and replace it with the stronger material of crushed rock is may be affordable for limited area of structure but the high cost of replacement has caused highway agencies to evaluate alternative methods of highway construction on soft subgrades. This paper highlights the importance of improving the properties of soft subgrade using huge amount of industrial waste like fly ash and also addressing the disposal problems. This study stresses that such admixtures can be used to achieve desired properties for construction of subgrade so that it meets the pavement design requirements making it economical.**

Keywords: **- Stabilization, Soft sub-grade, Pavement, Admixtures.**

I. INTRODUCTION

Soil stabilization is the process of altering some soil properties by different methods, mechanical or chemical in order to produce an improved soil material which has all the desired engineering properties.

Soils are generally stabilized to increase their strength and durability or to prevent erosion & dust formation in soils. The properties of soil vary at different places. The success of soil stabilization depends on soil testing. Various methods are employed to stabilize soil & the method should be verified in the lab with the soil material before applying it on the field.

II. OBJECTIVE

Evaluation the soil properties of the area under consideration.

Deciding the property of soil which needs to be altered to get the design value & choose the effective & economical method for stabilization.

Designing the stabilized soil mix sample & testing in the lab for intended stability &durability values.

III. LITERATURE REVIEW

Anita Agrawal and Rajendra Prasad proposed waste products from various Industries, normally deposited in landfill can be used as an alternate construction material. The utilization of these alternate materials needs to be encouraged for economy of construction and conservation of materials. One by-product that has shown as an alternate construction material is fly ash. In this paper an effort is made to use fly ash to stabilize soils for road construction, in order to reduce the amount of waste globally. In the present assignment, black cotton soils were stabilized with different quantities of fly ash. On the basis of preliminary investigations, it has been found that stabilization with fly ash, improves the CBR and plasticity characteristics of black cotton soils.For hydration of fly ash, the lime content is responsible, so substantial improvements in desired properties can be achieved by addition of small quantity of lime.

F. G. Bell researched that with the addition of lime, the plasticity of montmorillonite was reduced whilst that of kaolinite and quartz was increased somewhat however, the addition of lime to the till had little influence on its plasticity but a significant reduction occurred in that of laminated clay. All materials experienced an increase in their optimum moisture content and a decrease in their maximum dry dencity, as well as enhanced California bearing ratio, on addition of lime. Some notable increases in strength an Young's Modulus in this materials when they where treat with lime. Length of time curing and temperature at which curing took place had important influence on the amount of strength developed

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

IV. METHODOLOGY

A. Material Used:

i. Soil stabilization by adding fly ash:

Fly ash is a pozzolonic material that consists mainly of silica and aluminum compounds that, when mixed with lime and water, forms hardened cementations mass capable of obtaining high compression strengths. Fly ash is a by-product of coal-fired, electric power-generation facilities. The liming quality of fly ash is highly dependent on the type of coal used in power generation. Fly ash is categorized into two broad classes by its calcium oxide (CaO) content. They are:

a) Class C
b) Class F

Class C:

This class of fly ash has a high CaO content (12 percent or more) and originates from sub-bituminous and lignite (soft) coal. Fly ash from lignite has the highest CaO content, often exceeding 30 percent. This type can be used as a standalone stabilizing agent. The strength characteristics of Class C fly ash having a CaO less than 25 percent can be improved by adding lime.

Class F:

This class of fly ash has a low CaO content (less than 10 percent) and originates from anthracite and bituminous coal. Class F fly ash has an insufficient CaO content for the pozzolanic reaction to occur. It is not effective as a stabilizing agent by itself; however, when mixed with either lime or lime and cement, the fly ash mixture becomes an effective desired lime content.

ii. Soil Stabilization by Adding Lime

Lime stabilization is done by adding lime to soil. This is useful for the stabilization of clayey soil. When lime reacts with soil there is exchange of cations in the absorbed water layer and a decrease in the plasticity of the soil. The resultant material is more friable than the original clay, and is more suitable as subgrade. Lime is produced by burning of limestone in kiln. The quality of lime obtained depends on the parent material and the production process. And there are basically5 types of limes

1. High calcium quick lime (CaO)
2. Hydrated high calcium lime [Ca(OH)
3. Dolomite lime [CaO+MgO]
4. Normal, hydrated Dolomite lime [Ca(OH) +MgO]
5. Normal, hydrated Dolomite lime [Ca(OH) 2+MgO]
6. Pressure, hydrated dolomitic lime[Ca(OH)2+MgO)]

The two primary types of lime used in construction today are quick lime and hydrated lime (calcium hydroxide). For this project we use quick lime.

B. Procedure

i. Scarification And Initial Pulverization

After the soil has been brought to line and grade, the sub grade can be scarified to the specified depth and width and then partially pulverized. It is desirable to remove non-soil materials larger than 3 inches, such as stumps, roots, turf, and aggregates. Scarification is done because a scarified or pulverized sub grade offers more soil surface contact area for the lime at the time of lime application.

Fig.no.1

ii. Lime Spreading

The soil is generally scarified and the slurry is applied by distributor truck. Because lime in slurry form is much less concentrated than dry lime, often two or more passes are required to provide the specified amount of lime solids. To prevent runoff and consequent non-uniform lime distribution, the slurry is mixed into the soil immediately after each spreading pass.

Fig.no.2

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Special Issue

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iii. Preliminary Mixing and Watering

Preliminary mixing is required to distribute the lime throughout the soil and to initially pulverize the soil to prepare for the addition of water to initiate the chemical reaction for stabilization. During this process or immediately after, water should be added to ensure the complete hydration and a quality stabilization project.

Fig.no.3

iv. Final mixing and pulverization

To accomplish complete stabilization, adequate final pulverization of the clay fraction and thorough distribution of the lime throughout the soil are essential.

v. Compaction

Initial compaction is usually performed as soon as possible after mixing, using a sheeps foot type roller or a vibratory pad foot roller. After the section is shaped, final compaction can be accomplished using a smooth drum roller. The equipment should be appropriate for the depth of the section being constructed.

Fig.no.4

vi. Final curing:

Before placing the next layer of sub base (or base course), the compacted sub grade (or sub base) should be allowed to harden until loaded dump trucks can operate without rutting the surface. During this time, the surface of the lime treated soil should be kept moist to aid in strength gain. This is called "curing" and can be done in two ways: 1) Moist curing, which consists of maintaining the surface in a moist condition by light sprinkling and rolling when necessary, and 2) Membrane curing, which involves sealing the compacted layer with a bituminous prime coat emulsion, either in one or multiple layer.

Economic Benefits Of Lime Stabilization

a) Limitation of the need for embankment materials brought in from outside and the elimination of their transporting costs.
b) Reduction of transport movements in the immediate vicinity of the construction site.
c) Machines can move about with far greater ease. Delay due to weather conditions are reduced, leading to improved productivity. As a result, the overall construction duration and costs can be dramatically reduced.
d) Structures have a longer service life (embankments, capping layers) and are cheaper to maintain.
e) Lime is used as an excellent soil stabilizing materials for highly active soils which undergo through frequent expansion and shrinkage.

V. CONCLUSION

Comparative study

Particulars	Test results					
	Liquid limit	Plastic limit	Specific gravity	OMC	MDD	CBR (for 5cm) penetration
1. Original soil	49.72	26.87	2.85	30.14	1.79	3.70
2. Original soil +fly ash (5%)	54.40	28	2.13	27.87	1.79	5.59
3. Original soil +fly ash (10%)	56.48	31.93	2.32	30.01	1.80	8.75
4. Original soil + lime	55.20	40.06	2.31	25.34	1.69	3.69
5. Original soil +fly ash(12%) +lime(3%)	36.25	31.65	2.24	24.79	1.74	12.06

Table no.1

Above table shows comparison between the properties of original soil on the site and the soil which contents proper proportion of lime and fly ash (1:4).

This study shows that the strength of soil can be considerably improved by stabilization. The strength attainable depends on the composition of added stabilizer and on the choice of the stabilization. The increase in California bearing ratio and maximum

dry density is maximum for 10% fly ash mixture with black cotton soil. Black cotton soil of low or medium plasticity can be used for subgrades by stabilizing with fly ash due to improvement in its plasticity characteristics. Lime acts immediately and improves various properties of soil such as carrying capacity of soil, resistance to shrinkage during moist conditions, reduction in plasticity index, increase in CBR values and subsequent increase in the compression resistance with the increase in time. Thus, soil stabilization improves the strength, soil workability, durability and gradation of soil. It reduces the plasticity of soil and pavement thickness.

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Stabilization of soil by Using Fly Ash & Lime

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Abstract :- **For any typeof structure, the foundation is very important and it has to be strong to support the entire structure. In order for the strong foundation the soil around it plays a very critical role. To work on soils, we need to have proper knowledge about their properties and factors which affect their behavior. By consolidating under load and changing volumetrically along with seasonal moisture variation, these problems are manifested through swelling, shrinkage and unequal settlement. In this paper the experimental results obtained in the laboratory on expansive soils treated with industrial waste (fly ash and lime) are presented. A study is carried out to check the improvements in the properties of expansive soil with fly ash and lime in varying percentages. The test results such as liquid limit, standard proctor compaction, and differential free swelling test obtained on expansive clays mixed at different proportions of lime and fly ash admixture are presented and discussed in this paper. The results show that the stabilized clay has lesser swelling potential whereas increase in optimum moisture content has been observed.**

Keywords: **- Fly ash, lime, unequal settlement, expansive soil, stabilization.**

I. INTRODUCTION

Improving an on site soil's engineering properties is called soil stabilization. Soils containing significant levels of silt or clay, have changing geotechnical characteristics: they swell and become plastic in the presence of water, shrink when dry, and expand when exposed to frost. Swelling soil always create problem for lightly loaded structure, by consolidating under load and by changing volumetrically along with seasonal moisture variation. As a result the superstructures usually counter excessive settlement and differential movements, resulting in damage to foundation systems, structural elements and architectural features. In a significant number of cases the structure becomes unstable or uninhabitable. Even when efforts are made to improve swelling soil, the lack of appropriate technology sometimes results volumetric change that are responsible for billion dollars damage each year. It is due to this that the present work is taken up. The purpose was to check the scope of improving bearing capacity value and reduce expansiveness by adding additives. There are many methods of stabilizing soil to gain required engineering specifications. These methods range from mechanical to chemical stabilization. Most of these methods are relatively expensive to be implemented by slowly developing nations and the best way is to use locally available materials with relatively cheap costs affordable by their internal funds.

Site traffic is always a delicate and difficult issue when projects are carried out on such soils. Inother words, the re-use of these materials is often difficult, if not impossible. Once they have been treated with lime, such soilcan be used to create embankments or subgrade of structures, thus avoiding expensive excavation works and transport. Use oflime significantly changes the characteristics of a soil to produce long-term permanent strength and stability, particularly with respect to the action of water and frost. The mineralogical properties of the soils will determine their degree of reactivity withlime and the ultimate strength that the stabilized layers will develop.In many centuries, coal is the primary fuel in thermal power plant and other industry. The fine residue from these plants which is collected in a field is known as fly ash and considered as a waste material. The fly ash is disposed of either in the dry form or mixed with water and discharged in slurry into locations called ash ponds. The quantity of fly ash produced worldwide is huge and keeps increasing every day. Four countries, namely, China, India, United State and Poland alone produce more than 270 million tons of fly ash every year. This work has been done to see the effect on swelling aspect and on strength of some swelling soil by adding fly ash & lime in different proportion into it as additive. Soil stabilization improves the engineering properties of soil such as strength, volume stability and durability. The percentage addition of fine, coarse fly ash improves the strength of stabilized black cotton soil and exhibit relatively well-defined moisture-density relationship. It was found that the peak strength attained by fine fly ash mixture was 25% more when compared to coarse fly ash.[10] The addition of lime

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

and class C fly ash to highly plastic clay also showed a reduction in shrinkage with increasing additive percentages. However, the addition of lime arrested the shrinkage at almost twice the rate of class C fly ash. The shrinkage arrest was not linear but occurred more readily with small amounts of additive and the rate of shrinkage arrest slowed as the amount of additive increased [2] It is seen that the thickness of pavement decreases by 66% as the CBR value goes on increasing. The improved CBR value is due to addition of Lime and Fly ash as admixtures to the BC soil. It also reduces the hydraulic conductivity of BC soil. There will be no need of drainage layer after treatment of BC soil as sub grade with lime and fly ash. In combination, the admixtures are beneficial for lower plasticity and higher silt content soils. In terms of material cost, the use of less costly fly ash can reduce the required amount of lime [5] This paper presents the results of the Experimental study on expansive soil by stabilizing it with fly ash and lime. Compaction test and free swelling index test on fly ash –lime mixed swelling soil have been performed. The clayey soil was mixed with 5% lime and varying percentage of fly ash (5%,10%,15%,20%,25%) to see the effect on swelling aspect and. optimum moisture content and modified dry density. The swelling potential, optimum moisture content and liquid limit decreases with increase in the fly ash content from 5% to 25%.

II. MATERIALS USED

- **Soil:** The properties of the expansive clay used in this investigation are given below:

Table:1

Properties	Soil
Grain size distribution	40% particles are below 2 micron
Liquid Limit	57%
Plastic limit	30.43%
Plasticity Index	26.57% (CH) According to USCS
Free swelling index	100%

- **Lime:** Industrial grade lime approx 4kgs was purchased. Lime which contain calcium oxide (cao) commonly known as burnt lime, or quicklime, is a white, caustic and alkaline crystalline solid at room temperature. As a commercial product, lime often also contains magnesium oxide, silicon oxide and smaller amounts of aluminum oxide and iron oxide.

- **Fly ash**: Fly ash and Bottom ash (waste material) was collected from the Thermal Power Plant in Nashik Fly Ash was collected from the ash pond about 150 m from the thermal power plant. About 12kg of fly ash was collected. The Bottom ash approx 10 kg was collected from the boiler area. The fly ash was sieved and dried, in case of Bottom ash only drying was required.

Results of geotechnical classification tests of fly ash:

Table:2

Properties	Rajghat Flyash
Grain size distribution	
1.Fine sand, 0.475-0.075mm (%)	21
2.Silt size, 0.075-0.002mm (%)	76
3.Clay size, 0.002mm (%)	3
Liquid Limit	50%

III. TESTS CONDUCTED

Fly Ash and Bottom Ash were mixed in a ratio of 4:1 In addition to the mixture, 5% of lime was also added to the soil mixture by weight. The percentage of Lime was maintained at a constant 5%by weight of the expansive soil sample, whereas the mixture of Fly Ash and bottom ash was increased in multiple percentages of 5% to obtain test samples on which tests were carried out and their properties studied. The proportions of flyash used along with the soil in the study are 5%, 10%, 15%, 20%and 25% respectively. The following Tests were performed in order to check the properties of the stabilized expansive soils:

- **Liquid limit**
- **Free Swelling Index (F.S.I)**
- **Standard Proctor Test**

All the tests were conducted in the controlled conditions as per the standard procedures given in the respective codes of Indian Standard.

IV. RESULTS AND DISCUSSION

Liquid Limit The liquid limit (LL) is the water content at which a soil changes from plastic to liquid behavior.

Table:3

S.No	Samples	Liquid Limit
1	SOIL SAMPLE +5%LIME +5%(FA+BA)	54.7
2	SOIL SAMPLE +5%LIME +10%(FA+BA)	51.1
3	SOIL SAMPLE +5%LIME +15%(FA+BA)	48.42
4	SOIL SAMPLE +5%LIME +20%(FA+BA)	47.67
5	SOIL SAMPLE +5%LIME +25%(FA+BA)	44.02

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Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

From the above it shows that the liquid limit decreases with increase in the fly ash content from 5% to 25%.

Free Swelling Index (F.S.I): Differential free swell test was performed in 100 ml cylindrical jar with 10 g soil sample. The graph showing variation of the readings for different samples is as follows:

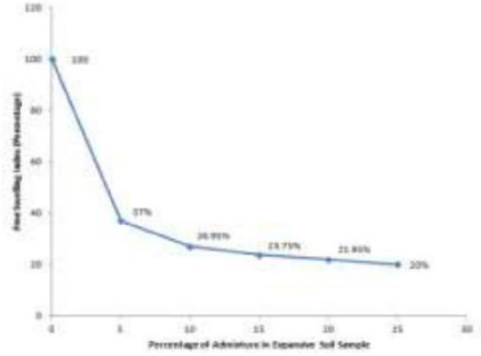
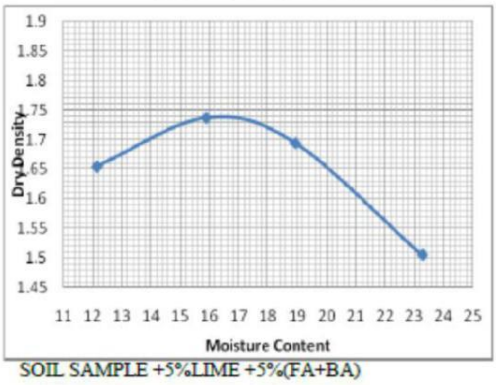


Fig 1

Standard Proctor Test The degree of compaction of a soil is measured in terms of its dry density. The degree of compaction mainly depends upon its moisture content, compaction energy and type of soil. For a given compaction energy every soil attains the maximum dry density at a particular water content which is known as optimum moisture content. The readings for different Percentage are as below:



SOIL SAMPLE +5%LIME +5%(FA+BA)

Fig 2

SOIL SAMPLE +5%LIME +10%(FA+BA)

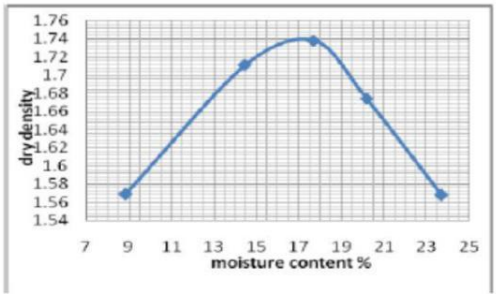


Fig 3

SOIL SAMPLE +5%LIME +15%(FA+BA)

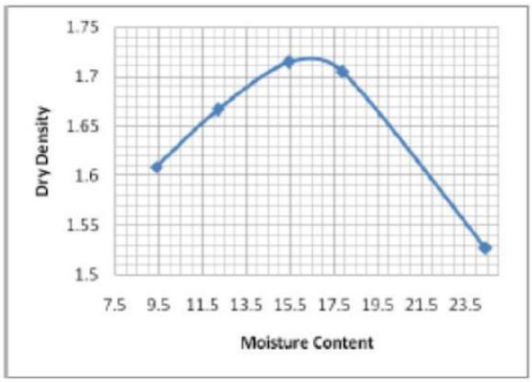


Fig 4

SOIL SAMPLE +5%LIME +20%(FA+BA)

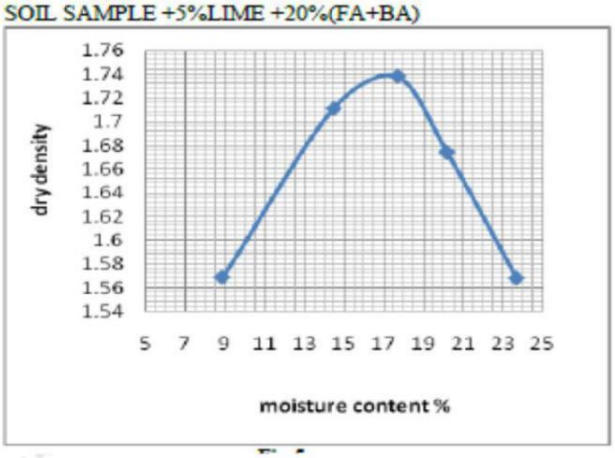


Fig 5

SOIL SAMPLE +5%LIME +25%(FA+BA)

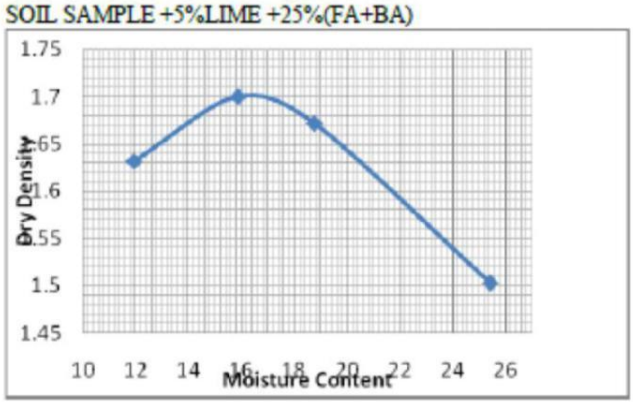


Fig 6

CONCLUSION

From the results it is clear that a change of the expansive soil texture takes place. When lime & fly ash are mixed with the expansive soil, the Plastic limit increases by mixing lime and liquid limit decreases by

mixing fly ash, which decreases plasticity index. As the amount of fly ash & lime increases there is apparent reduction in modified dry density & free swell index (shown in figure1 & 2) and increase in optimum moisture content. It can be concluded that the mixing lime & fly ash in specific proportion with the expansive soil is an effective way to tackle the problem of shrinkage, swelling and unequal settlement.

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Study on properties of lateritic soil using fly ash and coir fibers.

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Abstract :- **The feature of a flexible pavement depends on the strength of its subgrade. Materials selected for use in the construction of subgrade must have sufficient strength and at the same time it must be cost-effective for use. For soils to be fit in civil engineering projects, they must meet obtainable local requirements for index properties in addition to certain strength criteria. Some lateritic soils in their natural state need some treatment/alteration to meet the specification requirements. Fly ash (FA) is a waste produced from the burning of coal in thermal power stations. Efforts are underway to improve the use of fly ash in several ways, with the geotechnical utilization also forming an important aspect of such efforts. An experimental program is to be undertaken to examine the effects of fly ash and coir fibers on the compaction and strength performance of lateritic soil. The soil samples are prepared with different proportions of fly ash and coconut fiber content, i.e. (5%, 10%, 15% of FA) and (0.25%, 0.50%, 1.0% fibers) respectively. A series of test are conducted including Index Properties, Consistency Limits, Modified Proctor Test, laboratory Unconfined Compression Strength Tests properties of soil. The probable variations in the strength of Fly ash specimens, fiber specimens and the combination of Lateritic Soil + FA + Coir Fiber specimens are observed and recorded. Based on the laboratory test data variance in the test results is found by using data analysis tool in Microsoft Excel and a value of each test result is established.**

Keywords: **- Coir fiber, fly ash, lateritic soil, UCS, variance**

I. INTRODUCTION

Lateritic soils are extensively used as fill materials for various construction mechanisms. These soils are weathered under conditions of high heats and humidity with well-defined alternating wet and dry seasons resulting in poor engineering properties such as high plasticity, poor workability, low strength, high permeability, tendency to retain moisture content. The effective use of these soils is therefore often hindered by difficulty in handling particularly under moist and wet conditions typical of tropical regions and can only be utilized after modification/stabilization.

The modification/stabilization of engineering properties of soils is recognized by engineers as an important process of improving the performance of problematic soils and makes marginal soils perform better as a civil engineering material. Stabilization, in a broad sense, includes the various methods the engineering properties and performance of soil. Every year millions of tonnes of fly ash is produced all over India which is categorized as hazardous waste material. It is better to use such waste materials in variety of ways, including roadbeds, construction fill or cement admixture.

Latest studies have shown that many of the soil problems can be enhanced by addition of fly ash and fibers, like S.M. Hejazi et al. [20] reviewed the history, benefits, applications, and possible executive problems of using different types of natural and/or synthetic fibers in soil reinforcement through reference to published scientific data, S.Chakraborty et al. [18] carried out investigation with easily available materials like lime and rice husk ash mixed individually and also in combination with locally available clayey soil in different proportions at optimum moisture content (OMC). The laboratory test results show marked improvement of strength of soil on addition of admixtures in terms of California Bearing Ratio (CBR). Based on the laboratory test data a correlation has been established in the form of an equation of CBR considering it as a function of different soil parameters by multiple linear regression analysis. Afeez Adefemi BELLO [2] considered the use of regression analysis that may have correlation between index properties and California Bearing Ratio (CBR) of some lateritic soil within Osogbo town of South Western Nigeria. Saravut Jaritngam, William O. Yandell and Pichai Taneerananon [17] found the strength properties of lateritic soil-cement and modulus using multiple regression models. The study presented a methodology

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

for predicting the unconfined compressive strength (UCS) and modulus of lateritic soil-cement (LSC) by making use of the cement content and the curing time values. P. Suroso et al. [14] discussed the addition of fiber in this mix can reduce or even eliminate the process of shrinkage and hydration. It was found by the study that Palm fibers can increase the compressive strength of soil-cement between 54, 71%-68, 38% and CBR between 1, 91%-43, 39%. Palm fibers 5% by weight of cement is an ideal amount of soil-cement mixture. C. Gumuser, A. Senol [3] investigated the effect of fly ash and different lengths of polypropylene fibers content on the soft soils. The soil samples were prepared at three different percentages of fiber content (i.e. 0.5%, 1% and 1.5% by weight of soil) and two different percentages of fly ash (i.e. 10% and 15% by weight of soil). A series of tests were prepared in optimum moisture content and laboratory unconfined compression strength tests, compaction tests and Atterberg limits test were carried out. The fiber inclusions increased the strength of the fly ash specimens and changed their brittle behavior into ductile behavior. A.A. Bello and C.W. Adegoke [1] presented a study on the geotechnical properties of lateritic soil found within Southwestern Nigeria and environs. For this to be achieved, the following laboratory soil tests were carried out during the course of research viz: particle size analysis test, Atterberg limit test, British standard light compaction test, specific gravity, and California bearing ratio in accordance with British Standard 1377 (1990) and Head (1992). Shah, S.J, Abdurahiman, P and Shah, S.H. [19] presents an excel sheet providing a collection of correlations of different soil properties so that practicing engineers can get immediate insight into the empirical and engineering behaviour of soils. Correlations of the index and engineering soil properties have been collected and entered as formulae into the spread sheet so that upon entering test result data, possible behaviour of soil will be output C. Pohl [15] discussed that there is significant discretion in the determination of characteristic soil values and this influences the results of geotechnical verifications. If results of field- and laboratory tests are available in an adequate sample size, statistical methods are an effective tool to determine characteristic soil values in a verifiable way and to get best possible information from realized site investigations. B. Pandey, K. Bajaj and A P Singh [5] described about making economical pavement following pozzolanic materials such as fly ash, jute, lime and water proofing compounds are used for improving the properties of black cotton soil. It is concluded that mixing of 1% jute fiber, 20% fly ash and 5% lime together in a soil gives better result.

By studying and reviewing the above presented literature, it is found that no study has been reported on the use of fly ash and coconut coir fiber in different percentages for stabilization of lateritic soil. The present investigation deals with the effect of fly ash and coir fiber on the engineering properties of lateritic soil.

II. MATERIALS USED

a. Lateritic Soil

Representative soil sample used for this investigational study was Lateritic soil, which is generally observed soil type. The engineering properties of the soil are shown below.

Table 1- Properties of soil used

Soil Properties	Values
Soil IS Classification	CH
Sand (%)	23
Silt (%)	72
Clay (%)	5
Specific Gravity (G)	2.59
Liquid Limit (%)	55.55
Plastic Limit (%)	63.33
Maximum Dry Density (g/cc)	1.3
Optimum Water Content (%)	19.73
Unconfined Compressive Strength (kN/mm^2)	61.6
Cohesion (c) (N/mm^2)	7.67
Angle of internal friction (φ)	39.7°

The following are the engineering problems of lateritic soil in relation to its property/condition.

Table 2- Engineering Problems of lateritic soil

Condition/Property of soil	Related Engineering Problems
Variation in parent rock material & extent of weathering	Difficulty in quality control
Presence of sesquioxides	1) High Plasticity
	2) Difficult to obtain reproductive results of classification & index tests.
	3) Difficulty in handling / workability
Collapsible behaviour of the soil structure	Loss of strength & compressibility due to wetting.
Wet field condition due to frequent seasonal & heavy rainfall.	1) Difficulty in handling.
	2) Effective compaction.

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

b. Fly Ash

The physical, geotechnical and chemical parameters to characterize fly ash are the same as those for natural soils, e.g., specific gravity, grain size, Atterberg limits, compaction characteristics, permeability coefficient, shear strength parameters and consolidation parameters. The procedures for determination of these parameters are also similar to those for soils. The engineering properties of the fly ash are shown below.

Table 3- Geotechnical properties of fly ash

Parameters	Range
Specific Gravity	1.90 – 2.55
Plasticity	Non plastic
Maximum dry density (gm/cc)	0.9 – 1.6
Optimum moisture content (%)	38.0 – 18.0
Cohesion (c) (N/mm^2)	Negligible
Angle of internal friction (φ)	$30^0 - 40^0$

c. Coconut (coir) Fibers

The fiber is also very long lasting, with infield service life of 4-10 years. The water absorption of that is about 0.1-0.6 mm. Coir contains much of its tensile strength when wet. It has low tenacity, but elongation is much higher.

For coir stabilized lateritic soils, the maximum dry density (MDD) of the soil decreases with addition of coir & optimum moisture content (OMC) increases.

IV. OBJECTIVE AND SCOPE OF PRESENT STUDY

The investigation is carried out on Lateritic soil. Objectives of present investigations are:

1. To determine the optimum measure of fly ash and coconut coir fiber for the locally available lateritic soil.
2. To study the engineering properties of lateritic soil stabilized with optimum measure of fly ash and coir.
3. To determine the variance in the test results and perform the analysis using Microsoft Excel.

V. METHODOLOGY

The following method was adopted for preparation of lateritic soil, fly ash and coir fibers combinations in all tests.

Table 4- Combinations of fly ash and coir fibers with soil

Components	No. of Mix
Original Soil Sample	1
Soil + Fly ash	3
Soil + Coir fibers	3
Soil + Fly ash + Coir fibers	9

Variances related with many uncertainties, which are combined by simple addition when the uncertainties are additive and statistically independent. Laboratory tests on soil specimen with or without mixing fly ash and coir fibers are prepared. The test program for the investigation is carried out as per the following table.

Table 5- Test program

Soil Properties	No.of tests
Soil IS Classification	16
Specific Gravity (G)	16
Liquid Limit (%)	16
Plastic Limit (%)	16
Maximum Dry Density (g/cc)	16
Optimum Water Content (%)	16
Unconfined Compressive Strength (kN/mm^2)	16

Table 6- Mix Designations for various mixes with

Description	Mix Designation
Soil	S
Soil + 5% FA	Mix 1
Soil + 10% FA	Mix 2
Soil + 15% FA	Mix 3
Soil + 0.25% Fibers	Mix 4
Soil + 0.5% Fibers	Mix 5
Soil + 1% Fibers	Mix 6
Soil + 5% FA + 0.25% Fibers	Mix 7
Soil + 10% FA + 0.25% Fibers	Mix 8
Soil + 15% + 0.25% Fibers	Mix 9
Soil + 5% FA + 0.5% Fibers	Mix 10
Soil + 10% FA + 0.5% Fibers	Mix 11
Soil + 15% + 0.5% Fibers	Mix 12
Soil + 5% FA + 1% Fibers	Mix 13
Soil + 10% FA + 1% Fibers	Mix 14
Soil + 15% FA + 1% Fibers	Mix 15

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Fig.1. Samples of (b) lateritic soil, (a) coir fiber and (c) fly ash

Fig. 2. Mixture of lateritic soil, coir fiber and fly ash

Fig.3. Sample preparation for compaction test

Fig.4. Samples of Unconfined compression test

VI. RESULTS AND DISCUSSIONS

Laboratory tests are performed on soil samples as per standard procedure including tabulation of test results. The results of these tests have been presented in the form of tables and graphs in this chapter.

Table 7- Test Results

Mix Designation	Sp. Gr.	LL (%)	PL (%)	Modified Proctor		UCS kN/m^2
				MDD (g/cc)	OMC (%)	
S	2.69	55.5	18	1.3	19.73	61.66
Mix 1	2.6	43.4	17.1	1.32	17.07	7.95
Mix 2	2.69	41.7	18	1.1	22.06	2.39
Mix 3	2.66	47.3	17.7	1.26	22.88	62.15
Mix 4	2.71	40.3	14.6	1.13	23.16	59.3
Mix 5	2.7	37.3	18	1.22	17.7	2.43
Mix 6	2.7	44.2	18.6	1.3	17.95	60.85
Mix 7	2.65	49.8	17.6	1.2	28.38	60.85
Mix 8	2.74	36.5	18.7	1.35	15.58	2.5
Mix 9	2.72	36.3	18	1.31	19.17	60.85
Mix 10	2.68	44.7	17.5	0.96	19.5	76.49
Mix 11	2.73	37.4	18	1.14	18.97	3.38
Mix 12	2.73	34.9	19.9	1.12	20.49	70.81
Mix 13	2.73	35.7	21.4	1.26	22.88	76.4
Mix 14	2.59	34.8	21.3	1.26	22.62	3.5
Mix 15	2.64	35.3	21.4	1.28	20.24	70.81

Brief discussions on the laboratory test results are given below.

A. Specific Gravity test as per IS: 2720, Part – III.

The specific gravity was found out for lateritic soil, fly ash and coir fiber mixtures in different proportion. The specific gravity of soil is 2.69and as per the variance analysis specific gravity is 2.702 which have the highest frequency of results.

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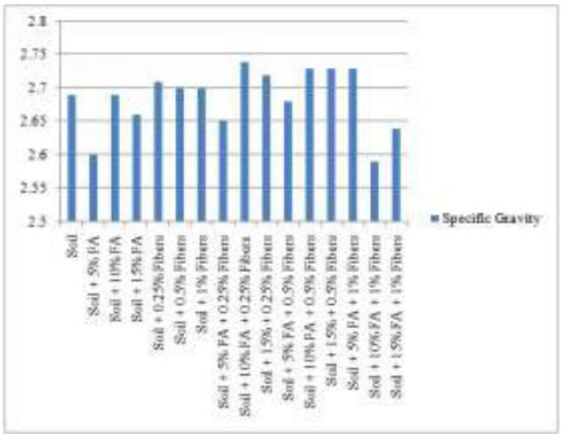

Fig.5.Results of Specific gravity test

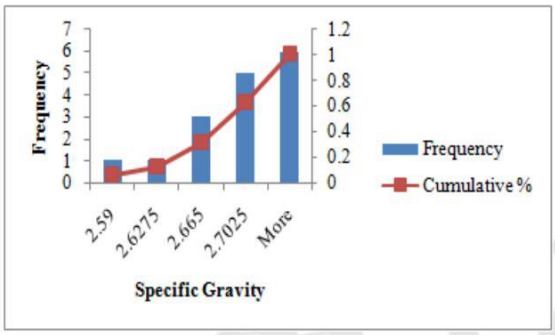

Fig. 6.Variance in Specific Gravity

B. Liquid Limit test as per IS: 2720, Part-V

The liquid limit with different percentages of fly ash and coir fiber has been plotted in fig.7.As per the variance analysis the value of liquid limit is 39.97% as shown in fig. 8.

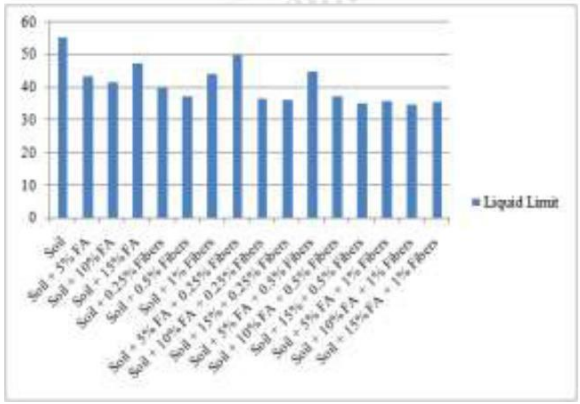

Fig. 7. Results of liquid limit test

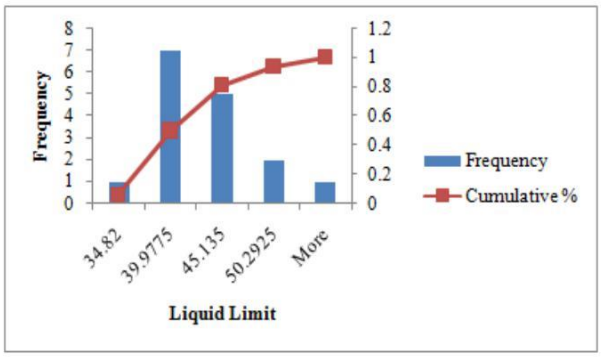

Fig. 8. Variance in liquid limit

C. Plastic Limit test as per IS: 2720, Part-V

The plastic limit has been plotted against different percentages of fly ash and coir fibers as in fig. 10. Fig.11. shows the percentage variance as 16.315% observed in the test result.

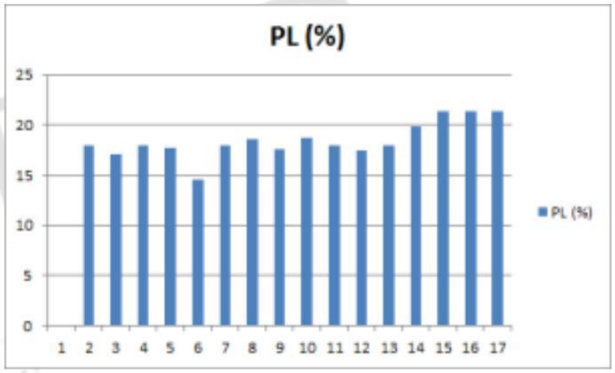

Fig. 9. Results of plastic limit test

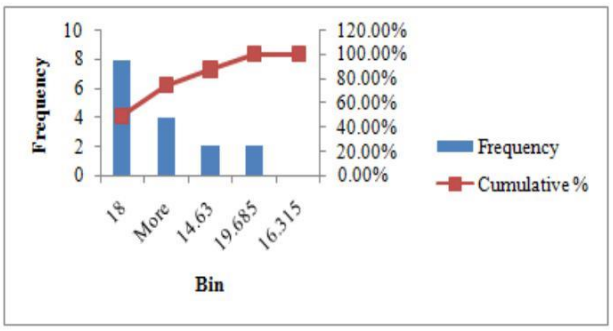

Fig. 10. Variance in Plastic Limit

C. Compaction Test (Modified Proctor) as per IS: 2720, Part-II.

The variation of MDD and OMC with the different percentages of fly ash and coir fiber combinations has been shown in fig 11, 12, 13. It is observed that the MDD value is constant for the varying percentages of fly ash and coir, whereas the OMC values decrease due to the addition of coir fibers.

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Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

As per the variance analysis value of MDD is 1.25 g/cc and that for OMC is 21.98%.

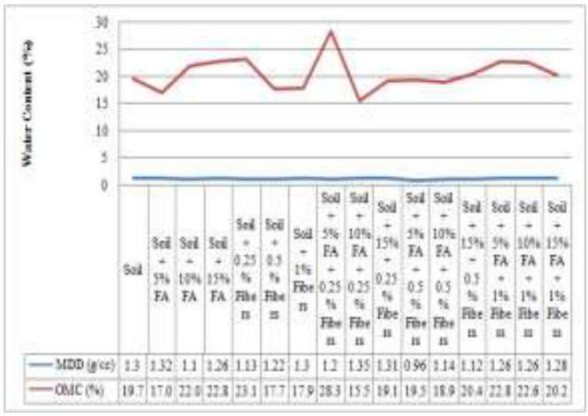

Fig. 11. MDD v/s OMC for Soil + % Fly ash + % Fibers

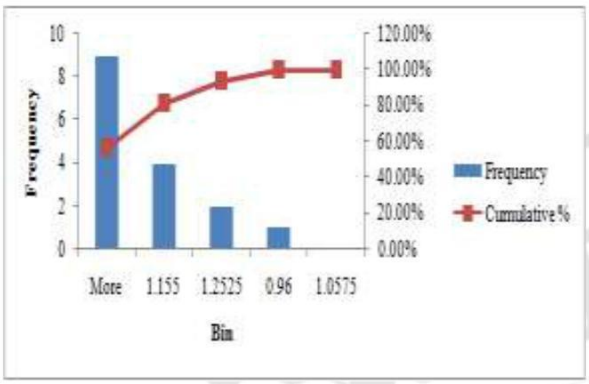

Fig. 12. Variance in MDD

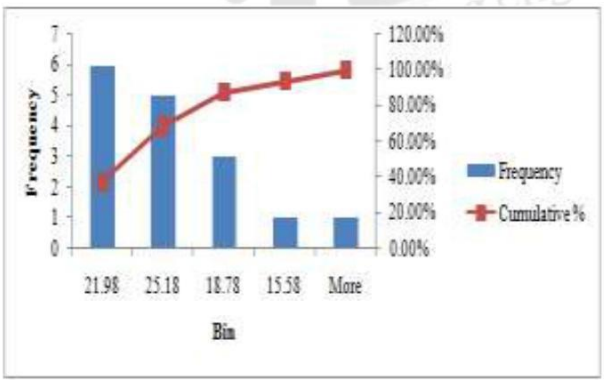

Fig. 13. Variance in OMC

D. Unconfined Compression Test as per IS: 2720, Part-X.

It is found in the experimentation that the value of unconfined compression test increases due addition of different percentages of fly ash and coir. As per variance the UCS value found is 2.39 kN/mm^2.

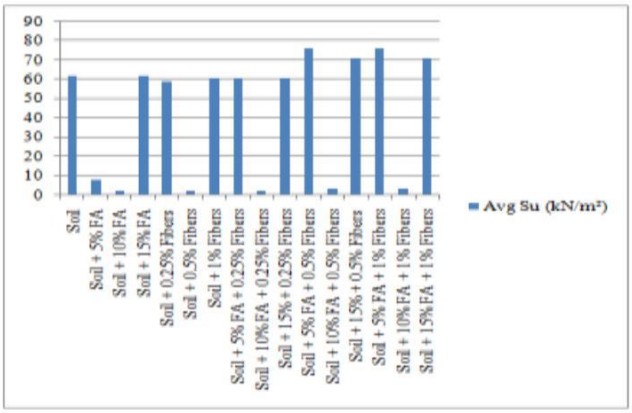

Fig. 14. Results of UCS test

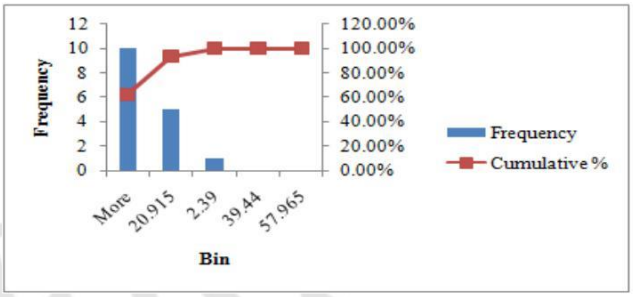

Fig.15. Variance in UCS test results

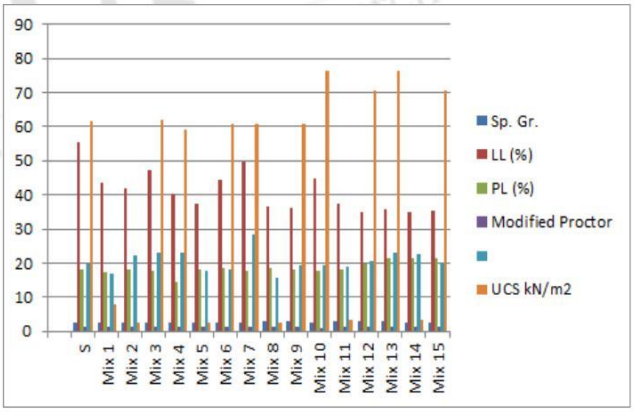

Fig.16. Various test results

VII. CONCLUSION

From the results of the study, the following conclusions are made in relation to the objectives of the study:-

- For the mix Soil + 5% FA + 0.5% Fibers the UCS value is maximum i.e., 76.49 kN/sq.m;
- The compaction characteristics of the soil has been improved due to the addition of fly as & coir fibers, as per the variance analysis value of MDD is 1.25 g/cc and

that for OMC is 21.98%.

- The plastic limit of the mix of soil has decreased to a greater extent.
- For the mix Soil + 5% FA + 0.5% Fibers, most of the tests give the optimum results.

VIII. ACKNOWLEDGMENT

The authors sincerely acknowledge Dr. G. K. Kharate Principal MCOER, Dr. V. K. Sharma Guide and P. G. Coordinator, Prof. U.P. Naik H.O.D. Civil Engineering Department MCOERC & Mr. D. O. Bhavar H.O.D. Civil Engineering Department GCOERC, Nashik for providing material and technical support.

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Traditional Building Material and its Non-polluting Aspects

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Abstract :- **In recent years, Indiais facing an explosive growth in vehicles ownership and utilization, which has led to traffic congestion and pollution. However Indians prefer to use private vehicles because of many reasons due to lack of cleanliness, lack of technology, smart solutions, their implementationsand bad services.This can be addressed by making smart assistance, using GPS, giving real time updates, updating regular stop and time table, making application which shows availability of public buses and various advanced technologies. In this regard, public transport operators are forced to lay emphasis on the monitoring and improvements of the services provided. This research paper focuses on traveler's satisfaction and preference towards public transport with service quality attributes. The aim is to evaluate the parameters in passenger preference and satisfaction on public transportation network with respect to facilities, comforts and quality of services. The application of this study suggest that the public transport operation especially, buses must improve the quality of their services for the prospective passengers.**

Keywords: **- Traffic congestion, public buses, advanced technologies,smart solutions**

I. INTRODUCTION

The shelter is one of the primary needs of human beings with food since the begging. In the primitive era, the human was prop of natural shelters like chasms, cavities, trunks of old trees etc. When they adopted agriculture system they had needed to discover formalized artificial shelters so that they made up their huts by branches and leaves of the trees and use for living near the slots of cultivated land. From this stage, development in the shelter has been growing hasty. As per the need and environment, man built up their shelters and made useful changes in it generation to generation.

The people of Maharashtra had got successes in the making of very useful houses as the shelter with the employ of natural things from the medieval era. They developed science, technology and engineering from natural resources. Cutting of stone, making of white soil, use of cane and bamboo, use of limestone, use of wood, use of leaves and brushwood of same trees etc. were the adopted techniques. The folk improves this day to day life and generation to generation. Up to 1960, people of Maharashtra got expertise in the use of better building material, but after the impact of globalization, the above-mentioned building material is known as a traditional building material due to the use of a large scale of cement, iron and other modern building material. The modernity accepted new technology and engineering with the modern building material. In fact as compare to traditional building material, the modern building material is so costly and polluting. Due to this, the concepts like 'Green Building'; is come into existing.

II. HYPOTHESIS

In the last half century, the large scale of building construction had been made by use of cement, steel and other modern building material. Before this, people had been using the houses, which was made by nonpolluting materials. So, the hypothesis of the paper is as follow-

1. Traditional building material had some nonpolluting aspects.
2. Traditional building material was eco-friendly material.
3. Traditional building material was very low-cost material.
4. Traditional building material has been supporting to sustainable development.

III. METHODOLOGY

The terms 'Traditional Building Material' and 'Polluting Aspects' are related to the interdisciplinary research methodology. Because tradition covered all kinds of discipline like Social Sciences, Arts, Humanities, Commerce, Management, Technologies, Sciences, Religious studies and so on. Apart from this pollution is also related to many of the things of varies

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Special Issue

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disciplines like all kinds of sciences and humanities. So, the interdisciplinary research methodology is applied for the researching of the problem mention in this paper.

Collection of Samples and Study

There are many remains of traditional buildings which were constructed all over India with its splendor of the past. I have just collected some of them from Marathwada region of Maharashtra for this study. Basically, I want to find out the material which was used in the building and nonpolluting aspects of the materials.

Image 1.1

Image 1.2

The building shown above is made up of stone and joints of the stone are filled by the paste of limestone. There was a particular procedure for making the paste of limestone and also one proper method adopted by the *patharwat*, the stone maker for the forging of the stone.

Image 2

Image 3

Traditional Brick, Limestone Paste, Wood, Tiled and White Soil are the material used in the buildings shown above. There was a particular procedure for making the paste of limestone as well as the brick and tiled also. The material used in the building is totally traditional building material. The flooring of the building is made up of the white soil and it has been daubing with liquid dung and white soil. The wall plaster is made up of the paste of limestone and red ochre or yellow soil. All material collected by the natural resources.[2]

Image 4

The building shown above is made up of brick and joints of the bricks fill up by the paste of limestone. Wood is used for the upper side ventilation windows frame. Windows are not seen up to lentil level.

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Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Image 5

Traditional Brick, Limestone Paste, Wood, and steel are the material used in the semi-modern above building images. The material used in the building is totally semi-traditional and semi- modern.

Image 6

The wall shown above is made up of stone and the joints are filling up by the paste of limestone.

Image 7

Image 8

The multistory building shown above is made up of stones and brick with wooden door. Joints of the wall fill up by the paste of limestone. Image 8 is known as a *Buruj* in Marathi language. *Buruj* is the important part of the Wada Culture of the Maharashtra. The *Buruj* is made up of white soil. The strength of the white soil has been more than the cement.

IV. FINDINGS

Apart from the technology and engineering of the buildings, I just search about the types and kinds of the building material and its nonpolluting aspects. I had some interview with old civiler, villagers, building workers, and interdisciplinary researcher for this paper. After the studies and interaction with the all above-mentioned personalities, I conclude the problem and findings are as-

1. The building with traditional walls are totally safe from the cold and hot atmosphere, inside the building the temperature is maintain between 20 to 28 0 C. due to the material like white soil, bricks, stone, and limestone3.
2. The inner side of the building is totally non-volatile organic compounds (VOCs free), due to the building material. Therefore, prevention of diseases like *Asthma* is possible. VOCs can be emitted into the indoor air from a variety of sources, such as building materials; flooring etc.[4] The prevention of pollution by VOCs is possible by the daubing floor with liquid dung and white soil.

3. Limestone pasted walls are able to prevent the air and water pollution.
4. Walls of unbaked white soil bricks and daubing floor with liquid dung and white soil also create an air pollution free atmosphere in the inner side of buildings.
5. The traditional building material is very low-cost in compare of modern building material and it is available everywhere.
6. Traditional building material like traditional brick, limestone paste, wood, tiled and white soil are eco-friendly material.
7. Remains of the traditional building material are useful for recycling of the material, so, it supports to sustainable development.

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Application of Porous Concrete for Tunnel Lining

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[2]Associate Professor Civil Engineering Department, MITCOE, Pune.

Abstract :- **The maintenance and life of tunnel is a vital aspect of a HighwayTransportation Engineering System. The tunnel installation, execution and maintenance play an important role in healthy traffic movement all over the year. An innovative modification in the process of lining of tunnels can assist help an efficient draining system by usingporous concrete before the lining layer of concrete. This study focuses on the application and utilization of porous concrete to drain off the water from the tunnel site.**

Keywords: **- Tunnel, porous concrete, draining system, lining, Highway Transportation**

I. INTRODUCTION

Water is the tunneller's enemy, it causes problems during excavation; it introduces additional expense into the tunnel lining and ground support; it frequently causes ongoing problems during the working life of the tunnel, sometimes affecting not only the tunnel lining but also the structures and fittings within the tunnel. Lining of tunnels is very important to stop seepage of water through the pores and fractures present in the rocks of roof and walls of tunnel. This can prove fatal to life and property as well as longer halting of vehicles in case of roadway and railway tunnels.

A) Effects of Lining on natural Flow of Water

Modern grouting techniques, and especially modern grouts, enable us to seal even considerable water inflows, although the unit cost of hydrophilic and latex grouts is high. Small leaks are often difficult to seal by grouting alone.It must be remembered that sealing of leaks does not remove water and harmful chemicals that may have permeated the lining,or chemicals deposits that may have been left after evaporation of water. These leaks will continue to affect the lining unless other remedial measures are taken.

Due to provision of lining, the pores and fractures are blocked which were the natural flow paths forthe seepage of water. The water gets collected within them and forcing them to widen/open up. This loosens the rocks leading to separation of boulders from the parentrock which again exerts extra pressure on lining causing it to fail.

B) Damaging effects of water on tunnels during their working life:

Segmental concrete tunnels are generally reinforced with steel bars, which are subject to corrosion if adequate concrete cover or positive corrosion protection is not provided. Corrosion may lead to spallingof the concrete and loss of structural capacity. Lack of watertightness in segmental concrete lined tunnels may occur where inadequate provision is made for sealing the joints between segments or whereprovisions have become defective. Moisture, particularly in cases involving dissolved salts, may cause corrosion of reinforcing steel.

Infiltration of ground water containing chlorides has caused electrolytic action with the steel reinforcement, causing corrosion and consequent cracking of the surrounding concrete. Corrosion of metallic fixing within the tunnel is also noted. Rising groundwater table are apparent in many of the industrialized capitals. Where tunnels were constructed above the water table and no formal provision was made for waterproofing joints between the precast concrete segments, a rising groundwater may enter the tunnel quite freely.

In permeable soils, typically of silts and sands, loss of fines from the surrounding ground into the tunnel may result from high groundwater inflows. The inflow of fines into the tunnel has led to settlement and ovalisation of the tunnel.

In rail tunnels, where stray currents from the traction supply may occur, the electrolytic action of the moisture may be particularly severe, with the rapid migration of the chloride ions to the steelwork attracting the current. In this respect it may be noted

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that under wet conditions, the insulation of rails used for current return may be severely reduced, increasing the likelihood of stray currents.

The accumulated water exerts pressure on lining of the tunnel. It is impossible to construct segmental cast iron tunnel with large amount of water seeping into the tunnel. The power supply made within the tunnel can be short circuited and is prone to accidents.

II(a). CASE STUDY 1

Darekasa Railway Tunnel

This tunnel is situated on the Howrah-Bombay railway line in India. Tunnel is easily accessible from the Darekasa railway station. The tunnel has a total length of 223.41Mts. The height of the DRT is 16.15 Mts. The DRT was completed in 1962. Frequency of train movement through DRT is 23 regular scheduled trains and 30-35 goods trains per day on an average. During the study of the DRT and the site around tunnel, it was found that the roof of DRT had developed 2 cracks extending up to a level of 22 Mts. or so. In addition, there were small clay pockets observed in roof towards Salekasa end of tunnel. To know the nature and the danger potential of the cracks a close study of the site was made and the following conclusion was drawn. The tunnel rock consists of Quartzite, Quartzite-Breccia with minor intrusion of Pegmatite. Two types of joints are parallel to strike and other is trending in South-East direction. Minor intrusions of pegmatite were along strike direction of Quartzite. The Quartzite is pink in color and offer resistance to weathering because of their hard and compact nature. The Pegmatite is coarse grained and also pink in color. The microcline feldspar in pegmatite is prone to weathering and gives rise to Kaolin clay. The same phenomenon has been noticed in tunnel roof while exposures of hard and compact Pegmatite were seen above the tunnel. The presence of clay pockets is indicative of weathering due to Water and weathering Damage (WWD).

II(b). CASE STUDY 2

Use of High Density Polyethylene Drainboards in Gothard,Switzerland:

An attempt has been made earlier to drain excess water from tunnel site by use of High Density Polyethylene drainboards (HDPE). It proved to be efficient to drain water from site as well as have resistance to acidic and alkaline medium. The main disadvantage lies in the manufacturing of such polymer sheets and its local availability.

III. METHODOLOGY

The methodology elaborates the application of porous concrete layer, so as to drain off the water from tunnel site.

Methodofdrainingwater

This is achieved by providing porous concrete above the tunnel lining.As explained in Fig.No.1, in this method Porous concrete is provided in place of grouting. A thick layer of this concrete sufficient to drain the seeping water through the adjoining rock is layed first. Then the water proofing material is placed. Finally regular lining(as per the structural suitability) is placed. Chamber/drains leading out of tunnel are built at the bottom of tunnel.

As the compressive strength of the porous concrete is very less (maximum compressive strength obtained in laboratory test is 25 MPa and may differ according to use of cement, aggregates and methods of making concrete)it cannot be provided for the lining of tunnel directly. But the porous concrete can be supported by the original lining as shown in the above figure. Due to placing of porous concrete the natural flow of the water will not be blocked and the water can be led easily out of the tunnel. The water draining capacity of porous is as high as 200 lts/ hr as observed by some laboratory test (the draining capacity may vary with thick of concrete and density). The Single Infilltrometer is being used to test the draining capacity of porous concrete efficiently.

This can also help to keep the ground water table below the tunnel lining which can help to reduce the hydrostatic pressure on lining.

A water insulating material can be provided in between the original lining and porous concrete layer. Which can be assured of not getting damaged due to any cause such as weathering (as it is being sandwiched between two concrete layers) The original lining is to be designed well in advance to carry the load of porous concrete. The grade of concrete may vary with soil conditions on tunnel site and other parameters.

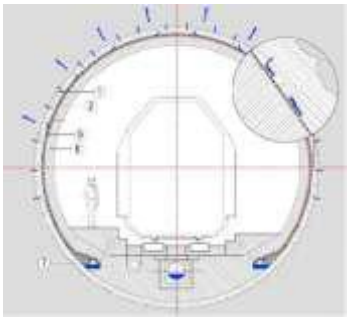

Fig.No.1: Detail of tunnel wall showing rock (1), porous concrete (2), waterproofing (5), concrete liner (6), Drainage pipes leading water out of tunnel(7).

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Permeability Test of Concrete

The permeability test of concrete is conducted by using Single Infiltrometer. As explained in Fig.No.2, Single infiltrometer is a simple device used to determine the amount of water seeping through the concrete per unit time. It consist of hallow rectangular box which is open at top and bottom and is placed just over the concrete block prepared beforehand. All the edges and corners are made watertight by lime so that no water can spill out. While performing the test a measured quantity of water is poured from top in the hollow box and stopwatch is started. The time required to drain off the whole quantity of water is measured and from this data the draining capacity/permeability of porous concrete is calculated. This test can also be performed at constant head.

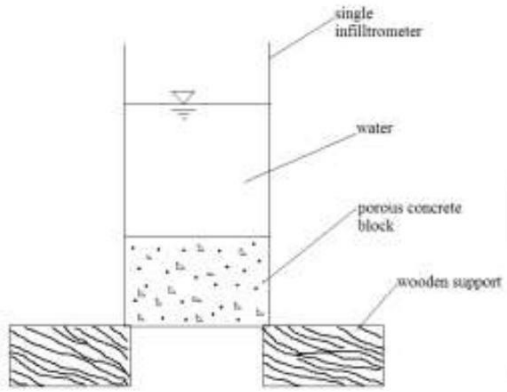

Fig.No.2 Single Infiltromete

Fig.No.3 Free Draining of porous concrete.

IV. CONCLUSIONS

It is obvious that remedial work operation must not be allowed to cause damage to sound linings. Without causing any changes to original structure of tunnel and its stability, the use of porous concrete has following advantages

1. Life of The tunnel lining is increased
2. The originalstructure of rockand soil adjoining tunnel remains undisturbed.
3. The natural flow of water is retained.
4. Safety of life and property against sudden failure.
5. Suitable for all types of rock and soil conditions.
6. The tunnel is dry and free from moisture for most of the year.

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Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Bus Rapid Transit System (BRTS) in India: An Overview

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Abstract :- **Bus Rapid Transit System (BRTS) is a high user capacity transport system which delivers very fast, reliable, comfort and cost effective mode of movement for the customers. Since BRTS run in their exclusive lanes, there are very less chances of congestion and accidents. Even due to application of green technologies, air and noise pollution are very less. BRTS has proper provisions for right of ways, easy boarding and alighting facilities for passengers. Moreover with the use of artificial intelligence BRTS stands out quite better than other public transport systems. The first BRTS was implemented in Curitiba, Brazil in the name of Rede Integrada de Transporte in 1974. This service inspired many services around the world. As of November 2016, about 35 million passengers use BRTS every day. Particularly Latin American countries have excelled in their approach towards BRTS. Currently TransJakarta is considered as the longest BRT route in the world with 210 km connecting the Indonesian capital Jakarta. But the operation of such systems fails due to poor planning and management. Government of India has emphasized on creating SMART cities. In this regard, BRTS will definitely ensure to achieve a good smart city in terms of public transportation system. With increasing population and growing demand for speedy inter-city and intra-city transportation services, BRTS will play a major role. This paper examines two successful cases; TransMilenio in Bogota, Colombia and Ahmadabad BRTS, India. It also tries to find out new approaches in terms of cost, quality and time of BRTS in future**

Keywords: **- BRTS, Artificial Intelligence, SMART city, TransMilenio**

I. INTRODUCTION

A country's growth is very much dependent on the adequate transportation systems available to the citizens. Bus Rapid Transit Systems is one of successful mode of transport to solve the congestion, delays, accidents and other issues. The cost involved in the construction of BRTS is quite cheaper than metro rails and light rail transits because existing roads can be converted to BRTS routes. As most of our towns and cities face huge problems of public transport, BRTS stands out very well in achieving the needs of the society. The major advantages lie in it is its way of high capacity design, high durability and use of artificial intelligence for common public. This paper is divided into five sections. First section is introduction. Second section is literature review. This section describes past studies on this field. In the Third section, two case studies have been discussed. Some suggestions are being made in the Fourth section on the basis of the literature and case study. In section five, conclusion is drawn.

In India, currently BRTS is functioning in Ahmadabad, Indore, Jaipur, Rajkot, Bhopal, Delhi and Pune. But the functioning of these systems is not at par with standards set by international authorities except Ahmadabad. Improper design, increase in number of private vehicles, inadequate facilities at bus stops makes life very difficult. Introduction of green systems like pollution free vehicles is still a dream in India. This paper tries to find the new ways that can be introduced in current BRTS so that the efficiency can be increased in terms of cost, time and quality. Government of India has laid emphasis on creating SMART cities across the country. Smart transportation systems can act as major contributor in success of such proposal. BRTS fulfills this basic criterion. In future, BRTS will be flagship system in Indian cities' public transport system.

II. LITERATURE REVIEW

Chen et al. (2007) in their research studied two core techniques of Bus Rapid Transit (BRT): exclusive bus lanes and transit signal priority (TSP). The background of BRT development in China is first introduced, followed by a synthesis of state-of-the-art on the simulation-based evaluation of BRT effectiveness. For a comparison purpose, two BRT scenarios are designed: median bus lanes versus curb bus lanes, and with versus without TSP. The micro-simulation model VISSIM is used to simulate different

scenarios, and the traffic flow characteristics under different scenarios are analyzed according to the simulation results. Analysis indicates that: (1) Exclusive bus lanes and signal priority should be implemented simultaneously in order to effectively improve the BRT's operational performance; (2) After the signal priority is applied, the traffic flow status of the intersections along the BRT route is considerably improved; and (3) with respect to the exclusive lane layout, when it is divided from other lanes by physical infrastructure, median bus lane and curb bus lane have different impacts on traffic flows on the roadway and traffic flows at the intersection. The study further depicts that mean delay at intersection, the mean number of stops, and the queue lengths for overall systems increase slightly when the exclusive lanes change from median bus lane to curb bus lane. But after Total Signal Priority has been implemented, the mean queue lengths and mean number of stops have decreased remarkably at each intersection.

Liu et al. (2007) discussed the benefit of BRT exclusive lanes and analyzed the changes of the vehicle passing capacity and passenger carrying capacity with and without the BRT exclusive lane, as well as proposes an approach for the corresponding calculation. It is shown from the research that (1) the installation of BRT exclusive lane may reduce the vehicle passing capacity of the road, but it can effectively bring benefits the operation efficiency of BRT and improve the passenger carrying capacity of the road; (2) to exert the advantage and benefit of BRT, reasonable coordination between regular bus lines and BRT corridors is very important, especially under the condition that BRT has not formed a network; (3) the reduction of the regular bus volume along the BRT corridor cannot be too big. It is found that for the Beijing North-South Center Axis Corridor, 40 per cent is the critical point to increase the passenger carrying capacity. The other similar cases can be calculated using the method proposed in this paper. The authors observed that the vehicle passing capacity of road with BRT exclusive lanes is lower than that without BRT exclusive lanes (Reduced by 6 per cent) whereas the passenger carrying capacity is increased by 11.9 per cent.

Lu and Chen (2009) stated the cost analysis models of public transport aimed at maximizing social benefits or minimizing total costs, considering both users and operators. To investigate optimal frequency of bus rapid transit (BRT), cost analysis models were established based on the demand data which is described in detail as a matrix of flows between every stops of BRT in a single line service. The optimal conditions for the frequency were established. Taking BRT lines 1 of Changzhou as an example, this paper examined the effect of this method on the optimal values of frequency and provided the suggested values of the frequency. Sensitivity analysis of users' cost and operators' cost were investigated respectively. The theoretical analysis and the example suggest that the cost analysis models can be used to obtain optimal frequency properly. The study has shown that users' cost have descend trend with an increasing of frequency, while the operator's cost have a positive relationship with frequency. The positive relationships between operators' costs and frequency suggested that enterprises in their own interests can't unlimited increase the frequency.

Yang et al. (2007) in their study developed new model using ACO algorithm to maximize the efficiency of bus rapid transit (BRT) system (i.e. maximize direct-through travelers on unit length of BRT route). Since the problem is NP-hard, a heuristic algorithm, based on ant colony optimization, is developed. With a numerical test from Dalian City, China, the effectiveness of the model and the algorithm is examined. The study emphasizes that it is necessary to reduce the public bus routes in the service BRT route. Public special bus lane must be employed to ensure fast operating speed.

Cui et al. (2010) in their analysis stated that since the BRT corridor takes up road resources, thus affecting other vehicles, it is necessary to study how to improve the efficiency of the BRT corridor, so as to enhance the public transport service level and to increase public acceptance of the BRT. This paper proposes a way of appropriately introducing some regular bus lines as the "quasi-BRT" on to BRT corridor under the premise that it does not greatly affect the service level of the BRT lines. The "quasi-BRT" routes can be divided into three categories, namely, on-line, off-line and merging-line, according to the position from where they enter and leave the BRT corridor. Taking Nanning as the background city, it also analyzes the necessity and feasibility of introducing ordinary bus lines onto the BRT corridor, and studies the way to guarantee bus priority at intersections in the presence of ordinary bus lines as well. The study suggests setting up a Bus Waiting Zone before the stop line for buses waiting for the green signal to pass through intersection and forbid other motor vehicles to get into the zone during the red signal.

Zhou and Su (2011) in their study stated that vehicles and stations are crucial elements of a BRT

system, and the vehicle-to-station interface is important to the efficiency and functionality of the BRT system; a logical interface will facilitate boarding and alighting for riders to reduce dwell time, ease movement for passengers with disabilities, and enhance customer convenience and safety. The paper discusses the interface between vehicles and stations from three aspects, including vertical gap, horizontal gap, and transverse gap, and then it reviews international and Chinese practices to provide information on some technologies and methods used to eliminate the gap between vehicles and stations. The authors concluded to effectively use PSDs, Kassel Kerb, Mechanical guide wheels, optical guidance, and magnetic guidance to eliminate the transverse and horizontal gaps at bus stops

Sharma and Swami (2013) stated in their study highlighted the availability of bus lanes to other traffic for a reasonable distance before intersection considerably reduces the average queue length, maximum queue length, average delay time per vehicle and emission per vehicle, while there is an increase in vehicle throughput and average speed of all the vehicles. Thus it results in reduction of congestion and performance enhancement of at-grade intersections and network. The authors have further shown that emissions reduced as average delay time reduces. There is net decrease in fuel and energy consumptions. If bus way ends in a good time before the stop line at busy signalized intersection and dedicated bus lanes are made available to all traffic at intersection, average queue length decreases by 45 per cent. Average delay time per vehicle is reduced by is reduced by 34 per cent.

Henke (2013) in his paper analyses to employ bus ways and bus rapid transit running ways that can be converted to future light rail operation. This also examines the reasons why, and the present barriers and costs associated with such convertible BRT/design way approaches. The study suggests that a raised platform could be devised to accommodate low floor BRT vehicles initially which then could be raised to accommodate the higher floor LRVs in future. Standard floor buses could be procured. Alternate bus routes must be established while LRV conversion.

Zhou et al. (2010) in their paper stated that Platform screen Doors (PSD) screens the platform from the bus lane to offer a safe and comfortable environment for passengers. This article discusses the design and implementation of PSDs systems for BRT. The application of PSDs-BRT in China is reviewed first, and then the paper gives a requirement analysis and affordable system design including system architecture, overall dimension and control system. The study concludes that implementation of PSDs in BRT have increased the safety and comfort of passengers. It gives rise to cost affordable system architecture.

Wang and Ye (2015) in their paper examines the influence of bus stop location on bus priority efficiency for arterials with segmented signal progression control. A simulation approach is used to explore the effects for an arterial with five intersections and three bus-bay stops. Analyses are conducted to investigate the relationship between traffic volume and delay (bus or car delay) for given bus stop locations (far-side, near-side, and midblock). The results suggest that a far-side bus stop is generally a better choice than a near-side one, especially when intersection spacing is tight. When intersection spacing increased to 300 or 450 meters, bus stop locations have a smaller effect on the efficiency of bus priority, and results showed that a far-side stop location is still a better choice. The study concludes that bus delay for far side bus stop is lower than for a near side bus stop when volume/capacity ratio is 0.75.With increase in intersection spacing, the effects of bus stop locations on bus priority decreases. But near side stop gains advantages if volume/capacity ratio is more than 0.85.
Wang et al. (2015) in their paper focused BRT as the public transit network's backbone. For achieving a reasonable utilization of public transport resources using minimum total cost of bus transit system and making necessary adjustments to the existing transport network, harmonization of the services and establishment of direct bus line and feeder bus route in the BRT corridor is necessary. The study outlines that feeder bus service has the advantage of attracting passengers to transfer to BRT from regular bus service. Public transport system should clearly focus on planning and management of feeder bus routes.

Wang et al. (2016) in their study describes a multi-objective optimization model developed to minimize the total time of bus system including passenger travel time and bus operating time. In addition, bus emission was introduced to assess the bus operation based on the pollutant emissions CO, HC, and NOx. Finally, the proposed methodology was applied to a bus route in Nanjing, China. The results showed that the total time decreased by 520197s by adding a new station between the Gulou station and the Zhujiang Road station, and the corresponding emissions of CO, HC, and NOx merely increased by 0.87 per cent, 1.07 per cent, and 0.79 per cent, respectively. It indicated that the model was well

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

validated in terms of reliability, and could be used for the analysis and design of bus stop location. Sensitivity analyses were also conducted to investigate the effects of service frequency on the performance of the proposed method. The study concludes that bus operating time will increase because of the increasing service frequency. As a result the total service time increases gradually. Emissions of pollutants increase with increase in number of bus stops. This is caused by low speed and frequent acceleration and deceleration at the bus stop area.

III. CASE STUDY

TransMilenio Bogota

TransMilenio is a bus rapid transit system in Bogota, Colombia resulting from successful public-private partnership (Sandoval and Hidalgo 2002). This system comprises of specialized infrastructure including exclusive bus lanes for high capacity articulated buses, efficient private operation, advanced fare collection system and separate authority for planning, developing and controlling the system.

Inspired by Curitiba's Rede Integrada de Transporte (Integrated Transportation Network), TransMilenio consists of several interconnecting BRT lines, each composed of numerous elevated stations in the center of a main avenue, or "troncal". Passengers typically reach the stations via a bridge over the street. Usually, four lanes down the center of the street are dedicated to bus traffic**.** There are both express and local buses, the latter stopping at every station to pick up passengers. The outer lanes allow express buses to bypass buses stopped at a station. Users pay at the station entrance using a smart card, pass through a turnstile, and wait for buses inside the station, which is typically 5 m wide. The bus and station doors open simultaneously, and passengers board by simply walking across the threshold. Like in a subway system, the elevated station platform and the bus floor are at the same height. The buses are diesel-powered, purchased from such manufacturers as the Colombian-Brazilian company Marcopolo-Superior, German conglomerate Mercedes-Benz, and Swedish companies such as Volvo and Scania.

Since the system was quite new to the citizens of Colombia, they needed to be trained by the Government regarding that. Govt. adopted promotional campaigns in TV, radio, and newspapers which stressed the benefits of the system and usage instructions. Community workshops were conducted by local organizations and educational institutions. Telephone service facilities were introduced for enquires regarding bus timings. Though ticketing operations started manually, it got smart cards installed in very less time. The control system was equipped with 6 workforce stations, each able to control 80 articulated buses. The system has voice and permanent communication with all buses and its supervisors.

This system is very easily accessible by youngsters, elders, disabled persons. Strict standards are being followed to maintain the quality and efficiency. The system is very affordable as a single trip costs only US$0.40. This whole money consists of investment, operation and maintenance of bus fleet and ticketing system. But this cost is only 6 per cent higher than the average public transport cost. Total investment for the 41 kilometers of Phase 1 was US $213 million, funded with a local 25 per cent fuel surcharge (46 per cent of investment), general local revenues (28 per cent mainly from a capital reduction from the partially privatized power company), grants from the National Government (20 per cent), and a loan from the World Bank (6 per cent). In 2006, at a cost of US $245 million Phase 2 added 43 km of exclusive BRT corridors. The first phases of the BRT system included feeder routes leading into the BRT corridors and a new integrated fare card system to allow free transfers. Phase 3 is under construction and more corridors are planned, which will expand the length of the bus ways to 388 km.

TransMilenio earned the distinction of becoming the world's first mass transit project registered with the UNFCCC for Clean Development Mechanisms (CDM) credits in 2006. The project generated 277,044 Certified Emission Reduction credits under the Kyoto Protocol's CDM for 2006-2009, which were sold to provide additional funding for bus purchases. The expected additional income from the sale of CER credits is US $25 million by 2012 (assuming a total estimated reduction of 1,725,940 tCO2eq is achieved in the first crediting period 2006-2012 and price of US $14.5/tCO2).

TransMilenio stations comply with easy access regulations because they are elevated and have ramps leading to the entrance. The alimentadores (feeders) are normal buses without handicapped accessibility. A lawsuit by disabled user Daniel Bermúdez caused a ruling that all feeder systems must comply with easy access regulations by 2004, but this has not happened yet.

Ahmedabad BRTS

Ahmedabad Janmarg Limited (AJL), the parent company which governs BRTS operations in Ahmedabad, was constituted as a Special Purpose Vehicle by Ahmedabad Municipal Corporation, Ahmedabad Urban Development Authority and Government of Gujarat. AJL introduced automated fare collection system through

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

smart cards for commuters. It has a mixed fleet of air conditioned and non-air conditioned buses. It has 220 Euro III and Euro IV-compliant diesel buses. The system runs on Integrated Transportation Management System (IMTS) which includes Advanced Vehicle Tracking System (AVLS), Fleet Management System (FMS), Automatic Fare Collection System (AFCS), Passenger Information System (PIS), Passenger announcement (PA), and Vehicle Scheduling and Dispatching (VSD). These technologies are provided by the consortium of Vayam Technologies and GMV Innovating Solutions since 2010. The bus stops have following characteristics:

- Aesthetic materials used giving distinct and unique look.
- Low maintenance and less wear and tear.
- Safety for all kinds of people for movement
- Good Ventilation and natural light
- Climate consideration of heat and rain

Fuel systems in this BRT are quite efficient. Ahmadabad BRT uses CNG which is quite environment friendly. In Ahmadabad, as per the recommendation of the Supreme Court, AMTS has been operating CNG buses. Gujarat state also has an advantage of CNG resource state and hence use of CNG would be an automatic choice for BRTS buses. Integration of a BRT system in an urban setting presents within itself a challenge and an opportunity to improve and enrich the existing streetscapes. One of the most important roles of the BRT facilities design such as a shelter is to support an appealing, cohesive visual identity for a quality and safe transit service. The shelter roofs should be such that rain water is directed away for the vehicle side.

All the stops are provided with a standard form for presenting passengers information such as signage's, route details and graphics. Specifically they comprise of bold identification signage, transit route maps, neighborhood maps placed at prominent locations. Signage and graphics readily distinguish the BRTS stations from the regular stops. The stops should also facilitate advertising at specific locations that does not conflict with the other directional and information signage. IT Display could be optionally placed at station entries and on platforms indicating the system wide schedule and delay at each platform. Apart from all these, other issues like safety, security, customer friendly attitude are very important which are discussed below:

Safety and security is essential for the safe operation and public acceptance of the transit system. Security is essential as the BRT stops would be open for extended hours and likely to be unattended. Visibility is also an important criterion to security. Passengers should be able to see the surrounding locations and be seen from the locations outside the station. Security equipment such as closed circuit television for monitoring may be used while upgrading the BRT shelters over a longer period of time. Adequate illumination, especially at nights is necessary.

The BRT stations should be made accessible to by the physically challenged. The internal layout of the shelter should be barrier free to facilitate easy circulation. Access via ramps need to be provided for stops having high platforms. Protection from weather is a major consideration in the BRT stations. Ahmadabad, being a city having hot and humid conditions almost through the year, open designs for stations are not preferable. Completely enclosed stops, although preferable due to high concentration of RSPM in the city, would require the provision of air conditioning and ventilator fans. This however escalates the cost involved in the maintenance of the station. Passive solar design and natural cooling techniques could be sought after solutions to overcome climatic extremes.

Fare Collection also forms an important influence on the design of the passenger facilities within the BRT station. Off board fare collection policy reduces the dwell time at bus stations and enables rapid boarding and lighting. The station can be divided into paid areas and free areas. Entry into the paid area of the station can be controlled by introduction of turnstiles or other control devices. Bogotá is one such example of a controlled access station. Since Ahmadabad does not have the high level of passenger traffic that exists in cities like Curitiba, Jakarta and Bogotá, it is not necessary to provide costly infrastructure as ticket vending machines, although provisions are made for incorporating it while upgrading the system.

As we know that despite BRTS being a cost effective method, poor planning by officials destroys the whole design. For example, BRTS in Delhi has failed. It is due to following reasons

- Wrong Place: Construction started in South Delhi which has highest number of car users. Constructing BRTS in rich class area has no meaning at all.
- Failed Trial Run: Even the trial runs started without completing the whole work. This caused heavy confusion among the commuters.
- Less Frequency: Buses didn't run as per the requirement. Passengers faced heavy problems of time wastage at bus stops.
- No Link to Metro: Passengers were more conversant with metros rather these buses. So

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

IV. SUGGESTATIONS

- Exclusive bus lanes and signal priority are not implemented simultaneously in order to improve the BRT's operational performance. Traffic flow conditions will surely improve after this.
- The installation of BRT exclusive lane can effectively bring benefits to improve the operation efficiency of BRT and the passenger carrying capacity of the road. But regular bus lines along the BRT corridor are not well coordinated with the BRT lines in order to fully take the advantage of express corridor.
- Sensitivity analysis of users' cost and operators' cost suggested that bus enterprises can reduce passengers' waiting time costs by increasing the frequency, but it does not have a good effect on reducing the in-vehicle time costs. The optimal frequency is rarely decided to provide a efficiency bus services under the lower operating costs.
- The major problem lies in developing more effective models for BRT. ACO algorithm can be used as an optimization model of BRT routes which helps in maximizing the density of direct travelers flow and minimizing transfer times.
- Regular bus services are not introduced in BRT routes with proper signal priority process.
- For safety and comfort of passengers, concept of vertical, horizontal and transverse gap should be studied before constructing bus stops. Newer technologies such as PSDs must be introduced as practiced in other countries.
- For creating a greener environment, engineers must optimize the road system at intersection for better benefits of BRT. Bus way should end in good time before stop line because it decreases average queue, maximum queue length and average delay time per vehicle. This reduces pollution also.
- City authorities should plan for the future conversion of BRT into LRT. BRT should be designed keeping in mind the structural loading and geometrical constraints of LRT.
- Location of bus stop is a major challenge in India for BRT. Far side bus stop is a better choice than a near side one when segmented signal progression is implemented properly. Even if intersection spacing is increased to 400-500m bus stop locations have minimal effect on the efficiency of bus priority.
- Inadequate direct and feeder bus services creates inconveniency for the commuters. These services must be introduced to minimize total cost and time of service.
- Sensitivity analysis may be used to predict the effect of toxic gases on environment. A multi objective optimization model must be developed which can study passenger travel time, passenger walking time and passenger waiting time.
- The rate of road accidents can be minimized significantly with clear Road Signs and Markings. For example GIVE WAY signs, SPEED LIMITS, OVERTAKINGS, BUS WAYS, CURVES, CHEVRONS and LANES must be clearly visible to driver.
- Successive pedestrian signalized crossings must be synchronized to reduce the probability that vehicles will have to wait at more than one signal in same midblock.
- Excessive gaps in horizontal and vertical directions must be reduced between bus and platform so as to reduce any injury and risk of accidents. PSDs with electronic sensors can be introduced to avoid all these.
- A divider marking must be clearly present between BRTS lanes. Also pedestrian mid block crossings should be introduced for the safety of passengers.
- Intelligent transport systems consisting of bus signal time preference, automatic vehicle location systems, passenger information systems, smart fare collection must be thought of quickly. Application of ITS will be great boost to the smart city proposal of Indian Government.
- Traffic calming measures, pricing, parking policy and land use planning must be extensively studied.
- Training of employees and staff is a major concern. Customer's satisfaction should be major agenda. Following the Bogota example, employees should be customer centric.
- Providing a customer service leadership and innovative management with client focused strategies must be taken care of.
- Green energy technologies like having solar panels installed above buses and bus stops can be thought of. Solar buses can be implemented in less dense areas with less speed.
- Service should be such that it is suitable for old/young; students/workers; men/women.
- For physically disabled persons BRT buses should be specially designed to carry the person easily. Special seats should be designed as per

medical standards for the comfort of such passengers.

- Walk over Bridges should be provided for the pedestrians to cross safely. Waiting places with proper lighting arrangements is necessary to ensure safety during night.

V. CONCLUSION

As the government of India is planning for building 100 smarts cities across the country, BRT will be a major contribution towards a sustainable and cost effective mode of transport system. With the increasing population, with expansion of the city limits geographically there is a tremendous pressure on the existing modes of transport systems in the cities. Adoption of better techno-management practices, and proper planning, adequate budgetary provision for funding etc. can make BRTS an effective and efficient mode of public transport system in India.

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Bus Priority Lane on Sarjapur Road, Bengaluru: A Smart Initiative

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Abstract :- **Sarjapur road (from iblur – sarjapur, 15 kms long) is an emerging commercial and residential real estate destination in the IT sector in Bengaluru (Karnataka) due to its easy accessibility to SEZs and IT parks along the stretch on the Outer Ring Road (ORR). This corridor possesses a character similar to Electronic city, Whitefield and other IT/BT corridors of Bengaluru. Also the presence of Carmelaram railway station acts as one of the important gateways for the inflow of employees working in several IT/BT companies. Development of IT/BT has taken place all along Sarjapur road and new SEZ is expected to be a part of the corridor near Kodathi gate area. The corridor also possesses several Springfield apartment complexes, Wipro campus along with the multitude of schools. The existing corridor is not capable of carrying the large volume of traffic that it carries today and it needs improvement. Although there are BMTC buses with almost a headway of 3 minutes, once the new SEZ comes up and influx of people will increase, even this headway will not be sufficient to carry people. The main objective was to examine the feasibility of bus priority lane on the 15 km long Iblur-Sarjapur corridor, the only link between the Bengaluru city and Sarjapur town located on the Southeast side of Bengaluru. The purpose was to promote the public transport and thus, prepare a corridor development plan emphasizing on safe junction designs and improved pedestrian facilities. Thus after proper considerations a corridor development plan including bus priority lane plan has been made from Iblur till Kodathi gate (as new SEZ is expected to come near Kodathi gate) along with safe junction designs, improved pedestrian facilities and station accessibility plan for Carmelaram Railway Station has also been worked upon.**

I. INTRODUCTION OF BENGALURU

Bengaluru, the capital of Karnataka, is India's fifth largest growing metropolis and is known world over as India's Silicon Valley. In the last decade or so, a genial small city, dotted with breathtakingly beautiful gardens; dominated by large defense establishments and government funded labs, transformed quickly into a teeming metropolis with large public sector companies, educational institutions and a global IT hub.

Due to the unprecedented growth of the city, the trip lengths have increased up to 11kms per day presently. These increased trip lengths have led to the increased dependency on private vehicle use. Public Transport (PT) is the backbone of mobility in any city. Even in Bengaluru, 42% of trips are made by PT. However, the mode share of PT is declining with the rapid increase in private vehicle ownership, i.e., 10% per year. As more and more people are moving to the city due to job prospective, the pressure on PT is increasing constantly.

II. INTRODUCTION TO SARJAPUR

Sarjapur road is an emerging commercial and residential real estate destination in the IT sector in Bengaluru due to its easy accessibility to SEZs and IT parks along the stretch on the Outer Ring Road (ORR).

Sarjapur road connects the Sarjapur town to the Outer Ring Road and thus serves as a medium for better connectivity to the core of Bengaluru. The length of this corridor is about 18 km, which begins from Iblur junction and runs until Sarjapur bus stand. Smaller streets that branch out of the central spine acts as connectors to Electronic City, Whitefield and Marathahalli.

The area is considered very important for upcoming investments in terms of a commercial corridor and the fact was triggered after the setup of Wipro campus in past few decades. This corridor possesses a character similar to Electronic city, Whitefield and other IT/BT corridors of Bengaluru as the presence of Carmelaram railway station acts as one of the important gateways for the inflow of employees working in several IT/BT companies.

The corridor also possesses several

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INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Springfield apartment complexes, Wipro campus along with the multitude of schools. Due to the presence of many international schools, it can also turn out to be the educational hub for the city in upcoming years. Motherhood hospital is one of the important features in terms of the medical facilities on this stretch. Apart from these, there are few lakes in the vicinity of Sarjapur road like Iblur Lake, Kaikondranahalli Lake, Saul Kere Lake and Doddakanahalli Lake, which serves the requirement of public spaces on the corridor. Figure 1

III. DATA COLLECTION AND ANALYSIS Primary Data

Speed and delay

Speed and delay survey was conducted on the project corridor only for the public transport as the focus was to estimate the average journey time and average running time of buses on the corridor.

The following analysis has been carried out of the speed and delay survey:

- Total Journey time
- Total Running time
- Delay time
- Average speed
- Average moving speed
- Max. speed
- Cause of Delays

The survey was done by dividing the corridor into 2 parts i.e., Iblur to Carmelaram and Carmelaram to Sarjapur bus stand depending upon the different land use.

Parameters	Iblur-Carmelaram	Carmelaram-Sarjapur bus stand	Sarjapur bus stand-Carmelaram	Carmelaram-Iblur
Total distance (km)	4.8	10.3	10.3	4.8
Total Journey time (mins)	13.27	17.51	21.53	16.36
Total Running time (mins)	11.34	17.20	21.13	15.41
Delay time (mins)	1.53	0.31	0.40	0.55
Average Speed(km/hr)	21.51	34.54	29.48	17.14
Average Moving Speed (km/hr)	25.04	35.57	30.4	18.13
Max Speed (km/hr)	53.4	75.02	54.54	51.18

Table 1: Speed Delay Survey

Figure 2,

Secondary Data

Public Transportation along the corridor

The existing condition of public transportation on the project corridor defined as per the routes of buses, number of buses, number of trips, and frequency of buses; was provided by Bengaluru Metropolitan Transport Corporation (BMTC) as follows:

- Total number of Bus routes on the Iblur - Sarjapur corridor = 50
- Total number of buses on Iblur - Sarjapur corridor = 114
- Total number of bus trips on Iblur - Sarjapur corridor = 855

Furthermore,

- Through – through bus trips on Iblur-Sarjapur corridor = 324
- Number of buses running from Iblur to Sarjapur bus stand = 54
- Thus, the present headway of buses = 3 minutes

Classified volume counts at junctions

From the counts in the table 2, the Existing Mode Share was calculated to be as follows: Fig3

In the present mode share, it can be observed that, predominant road users are two wheelers followed by four wheelers and others that include LCVs and Trucks. This share is based on the total vehicular counts where occupancy of the vehicles is not taken into consideration. Therefore, the mode share for public transport is quite low.

Moreover, from the volume counts mentioned in the table above, the existing PCU per hour was calculated to be 1614.

The following counts in table 1 on were noted at the junctions as per the survey done by DULT (Directorate of Urban Land and Transport):

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Location	Volume	V/C Ratio	LOS
Wipro Intersection [Towards Sarjapur	1664	0.7	B
Wipro intersection [Towards Iblur]	1754	0.7	B
Iblur Intersection [Towards Sarjapur]	1827	0.8	C
Iblur intersection [Towards silk board]	1981	0.8	C
Carmelaram Intersection [Towards Sarjapur]	1115	0.5	B
Carmelaram intersection [Towards Iblur]	1340	0.6	B
Harlur intersection [Towards Sarjapur]	1965	0.6	B
Harlur intersection [Towards Iblur]	2400	0.6	B

Table 2: Traffic volume count done at different junctions of Iblur-Carmelaram corridor

IV. PROPOSALS

There are five different purposes that are considered to be served through our proposal:

- **Bus Priority**- The most important concern was that the buses should be able to move fast and easily without being hindered by private vehicle. It was difficult to decide how it can be managed if they were to access the bus stops on extreme left of the road and simultaneously, the private vehicles would require to access the private properties along the road.

  However, buses were to be given priority but private vehicles were also not to be neglected. Therefore, the bus priority lane, 3.5 meters wide, was not kept on extreme left to minimize the conflict points between buses and the private vehicles accessing the buildings next to the road. Moreover, a service lane of width 3.25 meters was proposed to make it easier for the private vehicles to access the buildings on the road edge. So the bus priority lane is placed between the service lane and the mixed-traffic lane (that shall allow easy flow of traffic). Fig 4

- **Access Management** - The service lane has been proposed to provide direct access to private properties and commercial complexes without hindering the bus priority lane. A physical barrier, 0.2 meter wide placed between service lane and bus priority lane shall stop the private vehicles from moving in bus priority lane while getting merged or diverged from the mixed-traffic lane. Moreover, the entry and exit into the service lane shall be only one at the end of the junctions. At points where the service lane starts mid-way, a weaving section shall be limited up to 25 meters for entering or exiting the service lane after which the physical barrier shall be present so that the private vehicles are forced to use only the provided entries and cannot enter or exit the service lane in any other way. Fig 5

- **Junction Improvement** - IRC guidelines were referred to decide on the type of signalized junctions but the presence of T-junctions compelled us from providing rotary intersections even where it was required. The next idea was to provide channelizers at left turns that would force vehicles in service lane to take a left turn and thus the service lane cannot be used by straight moving traffic to pass through without accessing the service lane for its actual purpose. Moreover, the bus stops and bus bays are provided after 60 mts from the junction to reduce the conflict points between the left turning vehicles from minor street entering the mixed traffic lane and the buses from bus priority lane entering the bus bay. Fig 6,7,8

- **Pedestrian Facilities** - The proposal was to have table-top crossings at the same level as that of the footpath in order to give priority to pedestrians and force the vehicles to slow down before the ramps. These table-tops shall be restricted by bollards to stop two-wheelers from entering the pedestrian sidewalks.Another important aspect was to have stop lines at junctions before the pedestrian crossing to avoid any possible conflicts during the queuing of vehicles at red light on the traffic signal. Fig 9

- **Station Accessibility Plan** - The proposed ROW would include the space for carriageway as well as footpaths. There would not be an inclusion of median along this stretch and the width of the carriage way shall be 9 meters for the easy flow of vehicles via this stretch. Also, the provision of 2.5 meters wide footpath on either side of the carriageway would encourage the pedestrians to walk. At the entrance of all the private properties, there shall be a ramp for the vehicles to pass through and the footpaths shall remain continuous and at the same level along the whole stretch. Moreover, there will be bollards wherever necessary to avoid the vehicles from riding on the footpaths in any condition. Plantation would be done at an average interval of about 15 meters to improve the pedestrian facilities. At the entrance of railway station, the carriageway is kept 20.5 meters wide in order to ease the turning movement

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of the buses.

Fig 1: Location of Sarjapur Corridor in Bengaluru

Also keeping in mind the demand of parking during the peak hours, parking space of about 1400 sq. meters is provided that can be utilized for the parking of Two wheelers and four wheelers. Fig 10

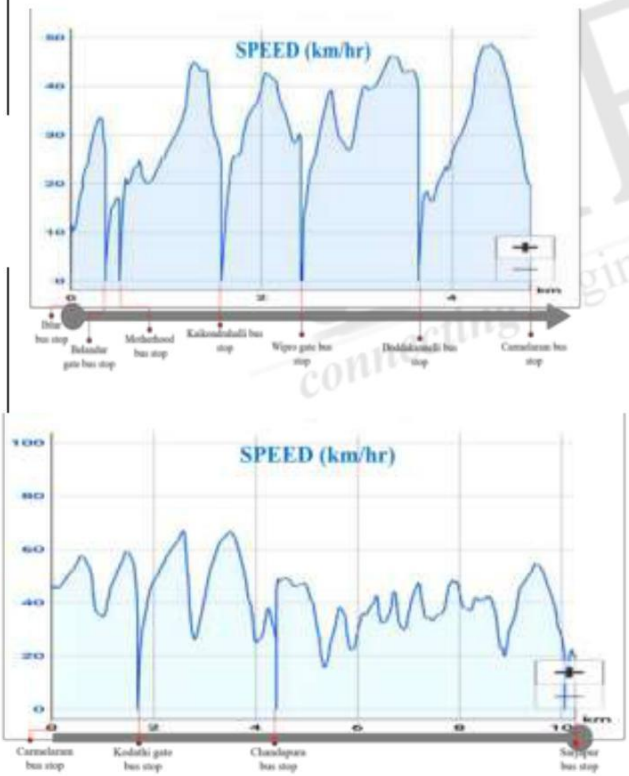

Fig 2: Snapshot of Speed and delay survey carried out in BMTS Bus (1)

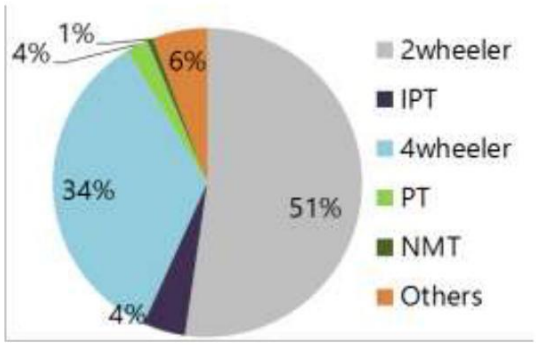

Fig 3: Present mode share of vehicles on Iblur-Carmelaram corridor

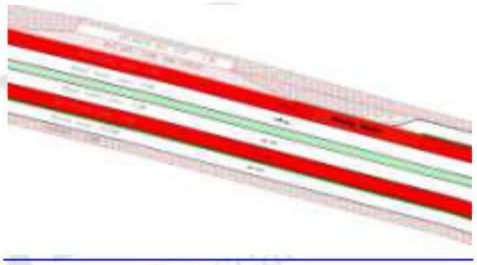

Fig 4: A part of corridor showing Bus priority lane (highlighted in orange color) with other elements.

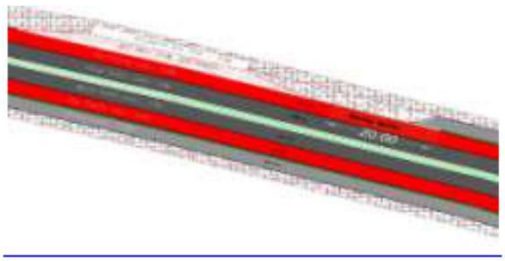

Fig 5: Final Proposed corridor for bus priority lane

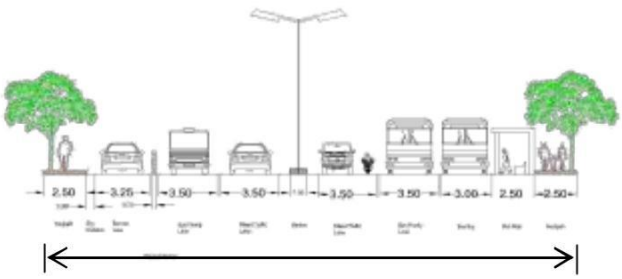

Fig 6: Section of stretch in fig 5.

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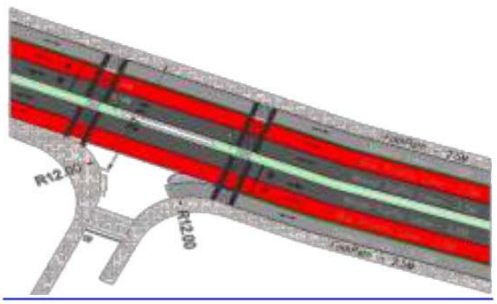

Fig 6: Junction design for Harloor Junction

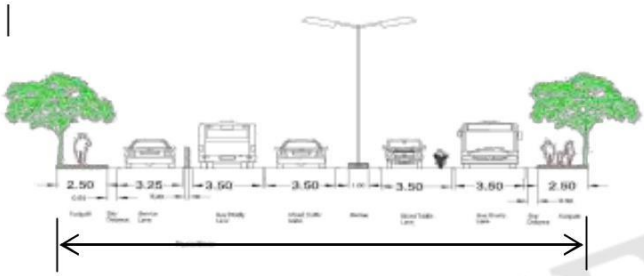

Fig 7: Section across stretch in fig 6

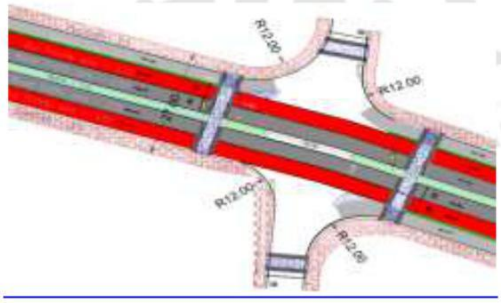

Fig 8: Junction design for Kaikondrahalli Junction

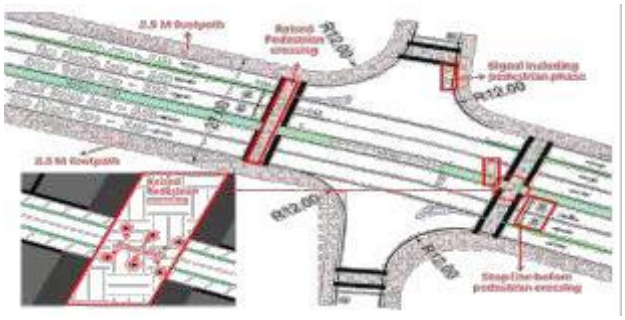

***Fig 9: Improved Pedestrian facilities at Kaikondrahalli** Junction*

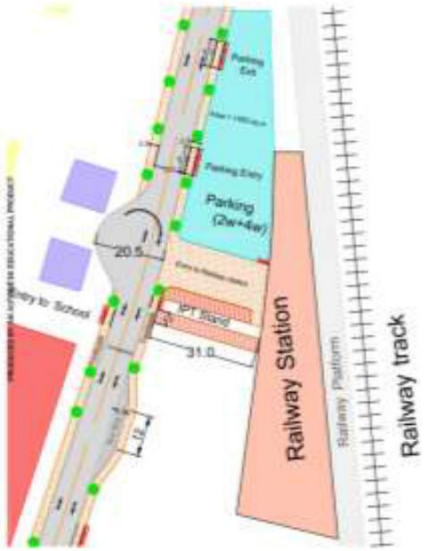

Fig 10: Carmelaram Railway Station Accessibility Plan

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Pedestrian Safety: National and International status

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Abstract :- **With the increase in growth of urbanization and automotive sector, India has to face the side effects in the form of increasing the number of road accidents. Out of various causes of accidental deaths, 34.8% of deaths are due to road accidents. According to the report published by Ministry of Road transport and Highways, one person dies every 3.7 minutes in road accident. Out of these, pedestrians, cyclists and two wheeler drivers are most vulnerable. Various countries are taking steps to reduce these accidents. World Health Organization has published a Pedestrian Safety Manual which encompasses method of assessing pedestrian safety and preparing for action plan by implementing pedestrian safety interventions. IRC:103-2012 states the guidelines for pedestrian facilities which covers necessities of pedestrians with various disabilities. In the Urban street design guidelines published by Pune Municipal Corporation, street designs at intersections, foot walks and cross walks are standardized. Various researches are been conducted around the world to decrease the accidents and make travel safer. This paper covers the national and international status related to pedestrian safety.**

Keywords: **- pedestrian safety, safety codes, safety manuals, construction sites**

I. INTRODUCTION

According to the report by World Health Organization, more than 2.7 lacs of people lose their lives on road accidents, 22% of it are the pedestrians. Increase in urbanization has brought many ill effects on the mankind. Accidents on roads are one of most severe of it as it takes away lives of the people with or without mistakes. Pedestrians are one of such most vulnerable road users due to following reasons

1. Speedy vehicles
2. Use of alcohol by drivers
3. Lack of safe road infrastructure for pedestrian
4. Inadequate visibility on roads

It is stated if a pedestrian is hit by a motor vehicle traveling 40 mph, the risk of dying increases to 85 percent. This highlights the traffic calming provisions to be made on the streets.

Definition of pedestrians

WHO gives the definition of pedestrian as "a person who is travelling by walking for at least part of his or her journey". IRC 103-2012 has stated the definition of pedestrians to include people who walk, sit, stand in public spaces or use a mobility aid like walking stick, clutches or wheel chairs, be they children, teenagers, adults, elderly persons, persons with disabilities, workers, shoppers or people watchers.

Principles of Urban Street Design Guidelines published by Pune Municipal Corporation in July 2016 are stated as follows:

1. All people should be able to move safely, smoothly and conveniently
2. Make streets safe, clean, attractive & comfortable for people to walk and drive
3. Streets to reduce impact on natural and built environment.

Various International codes / guidelines/ manuals

1.1 National Highway Authority of India

In the safety manual submitted to National Highway Authority of India by IIT Delhi (September 2010), traffic safety measure to be taken by the field engineers under construction sites. The procedures, contracts conditions are standardized while managing the construction sites that will accommodate the safety of pedestrians, cyclists, motor cyclists and vehicular traffic. Total five phases of traffic control for major projects are considered viz: planning phase, design phase, implementation, Operation & maintenance phase and closeout phase. It is to be ensured that there is no danger due to falling objects or sharp edges. Proper care should be taken to make scaffolding by providing white bands at eye level with head room of

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Special Issue

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2.1m. Kerb ramps are to be provided for the temporary footpaths. Portable traffic signs and signals are to be installed at proper locations which can be easily seen. Alternative routes must be provided taking into consideration, the needs of children and people with disabilities. Rigid barriers are to be provided to protect pedestrians from traffic, excavations, plant or materials.

1.2 Federal Highway administration of US Department of Transportation

It states the reasons in making road unsafe for pedestrians as:

1. Lack of pedestrian facilities
2. Wide and multiple lanes that are difficult to cross
3. Vehicles with high speeds
4. Wide roads with complex intersections that create long delay for pedestrian crossing
5. barren, unsafe, and unattractive environment for pedestrians

The objectives that are addressed to improve pedestrian safety and mobility that are given in the guidelines are as follows:

- Reduce the speed of motor vehicles.
- Reduce pedestrian risks at street crossing locations.
- Provide sidewalks and walkways separate from motor vehicle traffic.
- Improve awareness of and visibility between motor vehicles and pedestrians.
- Improve pedestrian and motorist behaviors.

Some good practices that involves the stakeholders such as Citizen's Pedestrian Advisory Board, "Cross the Street As If Your Life Depends On It" Education Campaign, University of North Carolina "Yield to Heels" Campus Safety Campaign, Sustainable Transportation Education Project (STEP), Gandhi walked, Get active Orlando, neighborhood speed watch program, "KEEP KIDS ALIVE, DRIVE 25" Campaign, Heed the Speed neighborhood safety program, Comprehensive Pedestrian Safety Programs are discussed.

Broadly the steps involved are

1. Planning and Designing for Pedestrian Safety by understanding pedestrian characteristics, by considering major planning, design, and policy elements that impact pedestrian safety include Street design, Street connectivity, Site design, Land use and Access management.
   1. Involving Stakeholders.
   2. Collecting Data to Identify Pedestrian Safety Problems.
   3. Analyzing Information and Prioritizing Concerns.
   4. Selecting Safety Solutions.
   5. Providing Funding.
   6. Creating the Pedestrian Safety Action Plan.

It also states that, Pedestrian networks should be planned in combination with land uses to provide residential access to mixed use centres and bus routes within a 400m walk, and access to train stations within 800m of strategic and secondary activity centres. Pedestrian networks should be designed with passive surveillance and good lighting to provide an attractive and safe walking environment.

1.3 Indian Road Congress specifies the guidelines for road infrastructure.

Some of them are given as follows:

Parameter	Dimensions or provisions
Foot path width	2m to 1.5m
Dead width	0.5 m
Clear height	2.4m
Ht above Road level	150mm
Cycle track width	2m
Cross fall gradient	1:50
Provision of guard rail	√
Kerb height	150mm
Specifications of kerbs	√
Ht of median	250mm
Specifications of tactile pavers	√
Specifications of level change	√
Maintenance of footpath	√
Pedestrian crossing width	3m
Cycle crossing width	2.5m
Spacing	80 – 250 m
Specifications for zebra crossing	√
Refuge island	Mandatory on all roads with 4 lanes and more
	Width 2m min
At-grade crossing	√
Grade separated crossing	√
Uncontrolled crossing	√
Controlled crossings	√
Pedestrian facilities at round-abouts	√
Pedestrian subways	
Width	4.8m
Vertical clearance	2.75m
Specs for hump subway	√
Specs for full subway	√
Specs for steps	√
Multi functional zone	Width 1.8m
Street furniture	√
Lighting	20-30m interval At max 4m height. White lighting with 25-40 lux
Provision of wash room and toilets	√
School zone improvement	√
Parking facilities	√
Provision for physically challenged pedestrians	√

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1.4 Urban Street Design Guidelines, Pune, India

Urban Street Design Guidelines, Pune Version I:2016 follows the guidelines given by IRC 103-2012. In addition, it also includes specifications for speed brakers, provisions of traffic signs, utilities and services, storm water drainage and BRT route specifications.

1.5 Public Transport Authority, Australia

In the guidelines given in Planning and designing for pedestrians, Australia, following design elements are considered.

Key design elements	Important design elements
Principles of Pedestrian Network Planning	• Connected • Comfortable • Convenient • Convivial • Conspicuous
Pedestrian Accessibility	Pedestrian networks should be planned in combination with land uses to provide residential access to mixed use centres and bus routes within a 400m walk, and access to train stations within 800m of strategic and secondary activity centres
Pedestrian Safety	Pedestrian networks should be designed with passive surveillance and good lighting to provide an attractive and safe walking environment
Minimum path widths for different pedestrians	Pedestrians in a wheelchair – 1.2m Pedestrian in wheelchair passing pram – 1.5m Two pedestrians in wheelchairs passing – 1.8m
Typical Walking Speeds	Fit adult – 1.5m/s Elderly person – 1.0m/s to 1.2m/s Typical speed used in crossing assessments – 1.2m/s
Footpath Widths	Minimum pedestrian through route width: • 1.2m over short distance (allows 1 wheelchair) • 1.8m desirable to allow 2 wheelchairs to pass (1.5m minimum), 2m near schools and small shops • At least 2.4m in commercial or shopping environments • 3m – 4m in busy CBD pedestrian area
Street Furniture	The colour of street furniture should contrast with the background Street furniture should be located in the Street Furniture Zone
Grates/ Covers	Slots should be sized and aligned to prevent canes, wheels and other mobility aids from falling through
Vertical Clearances	Vertical clearance is an absolute minimum of 2m above a footpath (2.5m for shared paths) 2.5m clearance is required under traffic signs over a path
Surfaces	Surfaces must be slip resistant, flat and even
Gradient and Ramps	Ramp gradient is 1:14 - 1:20. Landing intervals between 9m-15m, dependent on gradient
Steps and Stairs	Treads: 275mm-300mm wide Risers: 150mm-165mm high
Crossovers/ Driveways	Crossfall < 1:40
Barricades (includes chicanes and bollards)	Barricades require special consideration for people with disability and other users
Kerb Ramp Alignment	Ramps on either side of a crossing must be aligned and located perpendicular to the direction of travel
Kerb Ramp Gradient	maximum gradient is 1:10, absolute maximum is 1:8 (AS1428.1 – 2009) across a maximum length of 1.52m
Kerb Ramp Landings	Must be installed at the top and base of ramps with a maximum gradient of 1:40. Preferred minimum width is 1.5mm (absolute minimum 1.33m), reduced to 1.2m where wheelchair users are not required to change direction
Cut-Throughs across Refuges and Traffic Islands	Should be used on traffic islands less than 4.5m in depth. The cut-through width should match the crossing width, absolute minimum width of 1.2m, and minimum length of 1.8m
Grab Rails	Preferred height is 0.9m Length varies from 0.6m – 1.5m depending on depth of crossing. Grab rails should not be located in medians or ramps
Audio - Tactile Facilities	Push buttons are to be placed on signal poles within 0.3m of the kerb crossing ramp & TGSI, at a height of 0.9m
Sight Lines	All crossing points must provide adequate sight distance for pedestrians and approaching vehicles
Raised and Painted Medians	Minimum desirable median width of 1.8m (1.5m minimum if pedestrian facilities are included) to provide protection to cyclists, person pushing pram, person in wheelchair Pedestrian cut-throughs or refuges should be provided at regular intervals for wheeled pedestrians, with a desirable cut-through width of 2.5m
Refuges	Require a minimum depth of 1.8m (1.5m minimum) to provide protection to cyclists, person pushing pram, person in wheelchair The desirable cut-through width is 2.5m (absolute minimum width of 1.2m), other than signalised intersections where pedestrians are not required to wait within the island / cut-through. Parking restrictions and lighting must be provided to meet visibility requirements Grab rails can be installed in refuges ≥ 2m Pedestrian warning signs should be installed on roads with speed limits ≥ 70km/h
Kerb Extensions	The depth of kerb extensions should extend to the edge of parking lanes Kerb extensions should narrow the road to 10 m where there are on-road cycle lanes, narrower on other routes to match the desired speed environment
Zebra Crossings	In addition to warrant requirements, zebra crossings can only be installed on roads with: • No more than 1 lane of traffic in each direction • Adequate sight distance • A maximum posted speed of 50km/h (excluding slip lanes), maximum 85%ile speed of 60km/h (except at slip lanes)
Non-Signalised Intersections	Design details such as kerb radii and provision of refuges or kerb extensions can greatly influence pedestrian safety at unsignalised intersections Recommended kerb radii are 6m for local access streets and 9m for intersections with neighbourhood connectors
Signalised Intersection Crossings	Pedestrian crossing facilities should be provided at all signalised intersections, either: • Parallel pedestrian phases with partial protection (minimum of 3 seconds) • parallel pedestrian phases with full Protection •

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Special Issue

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	Exclusive pedestrian phases (allows for diagonal crossings) Zebra crossings at slip lanes should be provided
Roundabouts	Roundabouts should be designed with adequate entry curvature or deflection to reduce the speed of approaching vehicles Recommended to locate kerb ramps and median cutthroughs at least 6m from the vehicle holding line (1 - 2 car lengths) Where pedestrian volumes are high and there is speed environment ≤ 40km/h, zebra crossings can be considered In some cases, signalised intersections may be more appropriate where pedestrian and traffic volumes are high, or there is a large proportion of children, elderly or pedestrians with disability
Grade Separated Crossings	Generally only provided along arterial roads with high traffic volumes and traffic speeds. To encourage pedestrian patronage across grade separated facilities: • Overpasses should be constructed with a maximum change in level of 6.5m • Underpasses should allow visibility along the length of the underpass and be constructed with a maximum change in level of 3.5m
Pedestrian and Guidance signs	Ideal sign heights are between 1.4m to 1.6m, absolute minimum height is 1m Where there are likely to be large crowds, minimum sign height is 2m Desirable sign height above pathways is 2.5m

III. CONCLUSION

In spite of the codes and guidelines designed and followed by various countries, road accidents are taking place throughout the world. These guidelines should be strictly followed by the Government, contractors, pedestrians and vehicle users. Use of public transport will reduce the accidents as the traffic intensity on roads will get reduced. Bus only routes will help to motivate commuters to use public transport by reducing time of travel.

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Comparison of Cold Mix and Hot Mix Asphalt

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Abstract :- **Asphalt is an excellent binding material which is accepted by everyone in road construction industry. Although this material is long lasting and economical; it has a very important role in road construction. Aggregate and Asphalt mix gives an excellent design aspect which is strength to the constructed road. The mix is classified into two different categories, one is Hot Mix Asphalt and the other is Cold Mix Asphalt. Cold Mix Asphalt as it is considered as most economical as other mixes; this project gives a detail comparison between Hot Mix Asphalt and Cold Mix Asphalt. In India the rate of construction of road is increasing tremendously with growing economy and the demand from population. Multi crore projects are been sanctioned for road construction in urban and rural areas. But because of various number of flaws , bad practices and unacceptable perpetual habits of the working men the constructed roads are in a no use situation because endless number of potholes in it and these hoes are not only common on rural roads but are also frequently observed on urban roads were we have strong administration. So in this case Cold Mix Asphalt could be used on a large scale to reduce the number of potholes. This will become a very essential part in reducing accidents and traffic pollution and ultimately developing the country. So at this crucial stage the need and importance of Cold Mix Asphalt has risen and with use of Hot Mix Asphalt causing a negative impact on climate change, therefore promoting and putting Cold Mix Asphalt into actual use is our main concern.**

Keywords: **- Aggregate, Asphalt, Cold mix, hot mi, pot holes.**

I. INTRODUCTION

In this chapter, extensive literature survey on the various laboratory studies conducted for cold mix asphalt has been discussed. While going through the literature review, few works were observed in this field in comparison to hot mix asphalt.

1.1 Use of Asphalt emulsion in hot mix asphalt

Hot mix recycling is one of the popular pavement rehabilitation techniques. In central plant hot mix recycling, Reclaimed Asphalt Pavement (RAP) intended for recycling is combined with required quantity of virgin asphalt binder and new aggregates in a hot mix plant, located away from the construction site. The resultant mix is transported to the paving site, placed, and compacted to the required compaction level. Amongst various pavement recycling methods, hot mix recycling has certain advantages, such as, comparable performance to that of conventional mixes and better quality control. This is due to the fact that constituents are mixed under controlled conditions and it is possible to monitor mixing process continuously. In this process, less workspace is required for laying the recycled mix. Hence, this is suitable for the roads where the right-of-way is restricted.

Large number of studies has been reported on laboratory performance, field performance and pavement design with virgin asphalt mix (i.e., mix containing virgin binder and new aggregates). However, published studies on engineering characterization and pavement design with hot recycled asphalt mix are rather scanty. Some studies indicate that the amount of RAP used in the recycled mix affects the property of the mix, whereas, other study indicates that mix property is not significantly affected by the quantity of RAP used. Some researchers have found the stiffness modulus of recycled mix to be better than virgin mix, whereas other researchers have found similar or lower stiffness. Similarly, the indirect tensile strength of recycled mix is found to be satisfactory or better, or even poorer than its corresponding virgin mix. In general, recycled mix has a greater resistance to rutting than virgin mix. From field studies, rutting performance of recycled mix has been found better than virgin mix . However, in some studies it has been found the initial rutting rate is higher in recycled mix and in other studies it is observed that there is no significant difference between the rutting behavior of recycled and virgin mix.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

1.2 Use of Asphalt emulsion in cold mix asphalt

Transportation research circular entitled Asphalt Emulsion Technology has provided detailed information regarding Asphalt emulsion. An emulsion is a dispersion of small droplets of one liquid in another liquid. Emulsions can be formed by any two immiscible liquids but in most emulsions one of the phases is water. Asphalt emulsion is a liquid product in which a substantial amount of Asphalt is suspended in a finely divided form in water in presence of emulsifiers. The Asphalt droplets range from 0.1 to 20 micron in diameter.

II. COLLECTION OF RAW MATERIALS

Aggregate

We collected the aggregate from Hot Mix Plant, Ajwani Infra.Pvt.Ltd,Ravet, as per requirement for dense graded bituminous mixture as per grading of aggregates as per MORTH coarse aggregate consist of stone chips up to 4.75 mm IS sieve collected from a local source.

Fine aggregate comprises of stone dust with fraction passing 4.75 mm and retained on 0.075mm IS sieve.

Stone dust less than 0.075mm IS sieve.

Asphalt

Asphalt is also collected from Hot Mix Plant, Ajwani Infra.Pvt.Ltd, Ravet, of grade VG 30.

III. TEST ON MATERIALS

Aggregate

Following are the test performed on aggregates.

Table 1: Test Results on aggregate

Sr No	Type of test	Value
1	Aggregate Impact Test	7.68%
2	Aggregate Crushing Value Test	20.45%
3	Shape Test	12.74%
4	Specific gravity and water absorption Test	2.8 &1.26%
5	Los angeles abrasion test	15.22%

Asphalt

Following are the test performed on Asphalt.

Table 2: Test Results on Asphalt

Sr No	Type of test	Value
1	Penetration Value Test	10.233 mm
2	Ductility Test	65.5 cm
3	Specific gravity	1.028
4	Softening Point Test	48.25^0C
5	Flash and Fire point Test	235^0C & 279^0C

IV. TEST ON MIX (HOT MIX)

Marshall Stability Test

Theory: In this method, the resistance to plastic deformation of cylindrical specimen of bituminous mixture is measured when the same is loaded at the periphery of 5 cm per minute. The test procedure is extensively used in routine test. There are two major features of the Marshall method of designing mixes namely; (i) Density- voids analysis (ii) Stability flow tests. The flow value is the deformation the Marshall Test specimen undergoes during the loading, upto the maximum load, in 0.25 mm units. In this test an attempt is made to obtain optimum binder content for the type of aggregate mix and traffic intensity.

Apparatus: (a) Mould Assembly: Cylindrical moulds of 10 cm diameter and 7.5 cm height are required. It further consists of a base plate and coller extension. They are designed to be interchangeable with either end of the cylindrical mould. (b) Sample Extractor: For extruding the compacted specimen from the mould, an extractor suitably fitted with a jack or compression machine. (c) Compaction Pedestal and Hammer: It consists of a wooden block capped with M.S. plate to hold the mould assembly in position during compaction. The compaction hammer consists of a flat circular tamping face 8.8 cm diameter and equipped with a 4.5 kg weight constructed to provide a free fall of 45.7 cm. (d) Braking Head: It consists of upper and lower cylindrical segments or test heads having an inside radius of curvature of 5 cm. The lower segment is mounted on a base having two vertical guide rods which facilitate insertion in the holes of upper test head. (e) Loading Machine: The loading machine is provided with a gear system to lift the base in the upward direction. On the upper end of the machine, a precalibrated proving ring of 5 tonnes capacity is fixed. In between the base and the providing ring, the

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

specimen contained in the test head is placed. The loading machine produces a movement at the rate of 5 cm per minute. (f) Flow meter: One dial gauge fixed to the guide rods of a testing machine can serve the purpose. Least count of 0.025 mm is adequate. The flow value refers to the total vertical upward movement from the initial position at zero load to a value at maximum load. Besides the above equipment, the following are also required: (i) Ovens on hot plates, (ii) Mixing apparatus (iii) Water Bath (iv) Thermometers of range upto 200 degrees with sensitivity of 2.5 degrees.

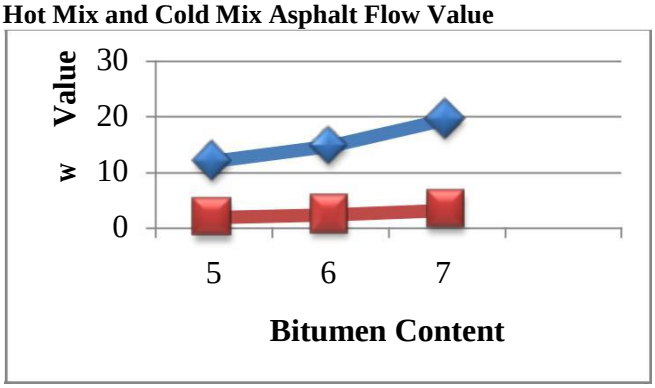
Figure 6.1.1 Marshall Stability apparatus

Observation and calculation

Table 3: Hot mix & Cold mix Asphalt values

	Hot mix Asphalt values			Cold mix Asphalt values		
Mass of aggregate in the mixing pan (gm)	1200	1200	1200	1200	1200	1200
Mass of Asphalt added (gm)	60	72	84	60	72	84
Asphalt content	5%	6%	7%	5%	6%	7%
Compacting temperature	28	28	28	28	28	28
Number of blow with hammer per face	50	50	50	50	50	50
DESCRIPTION						
Bulk specific gravity	2.26	2.29	2.18	2.13	2.17	2.25
Theoretical specific gravity	2.46	2.46	2.46	2.46	2.46	2.46
Volume of Asphalt (Vb)	11.08	13.24	14.96	10.44	12.92	6.51
Percentage air void (Va)	8.13	6.91	11.38	13.41	11.28	8.32
Void in mineral agg. (Va+Vb)	19.21	20.15	26.34	23.85	24.7	14.83
Void filled in Asphalt=100(Vb/Vma)	59.24	63.80	56.79	43.77	52.30	43.90
Measured stability (Kg)	812.7	767.3	662.8	7.03	6.78	5.88
Flow value(mm)	12	14.8	19.6	2.30	2.65	3.3

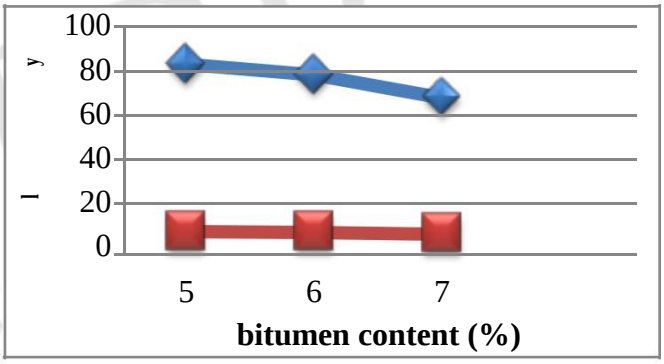
Hot Mix and Cold Mix Asphalt Flow Value



Graph of Comparison Hot Mix and Cold Mix Asphalt Flow Value

Interpretation: As compare to the Hot mix the Flow value increases in Cold Mix with increase in bitumen content.

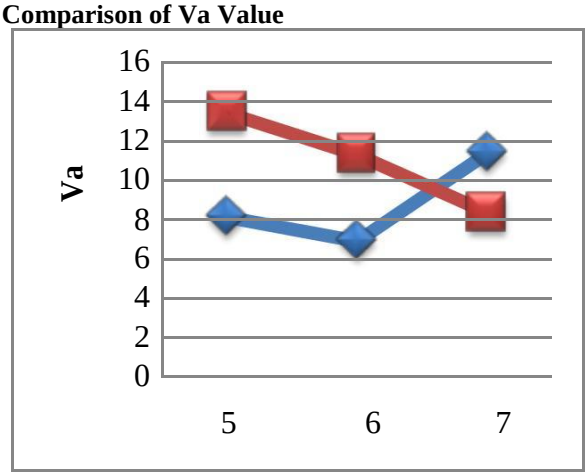
Comparison of Marshal Stability Value



Graph of Comparison of marshal stability value

Interpretation: Marshal Stability value of cold mix is greater than the hot mix asphalt.

Comparison of Va Value



Graph of Comparison of Va Value

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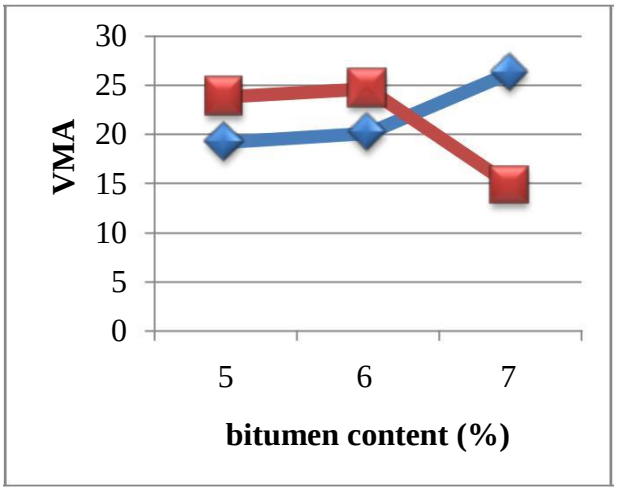
International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Interpretation: Va values of Cold mix and hot mix asphalt varies with vary in bitumen content.

Comparison of VMA Value



Graph of comparison of VMA value

Interpretation: VMA value of Cold Mix asphalt is greater than the hot mix at 7% bitumen content.

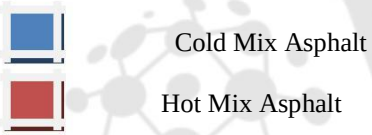


Table 4: Tentative Rate analysis of Hot Mix & Cold Mix Asphalt

RATE ANALYSIS (HOT MIX ASPHALT)	RATE ANALYSIS (COLD MIX ASPHALT)
• Length of road = 100m • Thickness of road = 0.43m **AGGREGATE** • Aggregate thickness = 100×7×0.2 = 140 cub mtr. • 1 Brass = 2.83 cub mtr = Rs. 3400/- • Rate of aggregate = Rs. 1,68,197/- **MIX** • Mix Thickness = 0.18 mtr. • Quantity required = 5100 cub mtr • Rate of Mix = Rs. 2,27,067/- **ASPHALT** • 1 Drum = 200 lit = Rs. 9500/- • Weight of Asphalt = 14×2300×0.06 = 1932 Kg • Rate of Asphalt = Rs. 91770/- **SEAL COAT** • Rate of 1 Brass Seal Coat = Rs. 4200/- • Total quantity of seal coat = 21 cub mtr. • Total rate of seal coat = Rs. 31,166/- **TOTAL RATE = Rs. 5,18,200/-**	• Length of road = 100m • Thickness of road = 0.43m **AGGREGATE** • Aggregate thickness = 100×7×0.2 = 140 cub mtr. • 1 Brass = 2.83 cub mtr = Rs. 3400/- • Rate of aggregate = Rs. 1,68,197/- **MIX** • Mix Thickness = 0.18 mtr. • Quantity required = 3900 cub mtr • Rate of Mix = Rs. 1,73,639/- **ASPHALT** • 1 Drum = 200 lit = Rs. 9500/- • Weight of Asphalt = 14×2300×0.06 = 1932 Kg • Rate of Asphalt = Rs. 91770/- **SEAL COAT** • Rate of 1 Brass Seal Coat = Rs. 4200/- • Total quantity of seal coat = 21 cub mtr. • Total rate of seal coat = Rs. 31,166/- **TOTAL RATE = Rs. 4,64,772/-**

V. RESULT AND CONCLUSION

According to all the tests carried out on both the mixes i.e. cold mix and hot mix Asphalt we conclude that cold mix Asphalt is more economical than hot mix but cold mix fails in providing the required strength and stability to the existing traffic density. Hence we conclude that cold mix can be used effectively and efficiently for rural road construction were traffic density is less and can be used on a large scale without harming the environment. Hot Mix Asphalt can be used for high density traffic conditions. To make this project up to the mark we calculated the overall cost for both Hot Mix Asphalt and Cold Mix Asphalt , this analysis concluded that the rate for 100 mtr. span of road is Rs.4,64,772/- and Rs.5,18,200/- for Cold Mix Asphalt and Hot Mix Asphalt respectively.

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

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The Impact of the Golden Quadrilateral Project for the Location and Performance of Indian Manufacturing

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Abstract :- **Reviewinvestigate the impact of the Golden Quadrilateral (GQ) highway project on the Indianorganized manufacturing sector using enterprise data. The GQ project upgraded the quality and width of5,846 km of roads in India. Use a difference-in-difference estimation strategy to compare non-nodaldistricts based upon their distance from the highway system. here find several positive effects for non-nodal districts located 0-10 km from GQ that are not present in districts 10-50 km away, most notablyhigher entry rates and increases in plant productivity. These results are not present for districts located onanother major highway system, the North-South East-West corridor (NS-EW). Improvements for portionsof the NS-EW system were planned to occur at the same time as GQ but were subsequently delayed.Additional tests show that the GQ project's effect operates in part through a stronger sorting of land-intensive industries from nodal districts to non-nodal districts located on the GQ network. The GQupgrades further helped spread economic activity to moderate-density districts and intermediate cities.**

Keywords: **- Highways, roads, infrastructure, India, development, manufacturing, density, rent.**

I. INTRODUCTION

Adequate transportation infrastructure is an essential ingredient for economic development and growth. Beyond simply facilitating cheaper and more efficient movements of goods, people, and ideas across places, transportation infrastructure

Impacts the distribution of economic activity and development across regions, the extent to which agglomeration economies and efficient sorting can be realized, the levels of competition among industries and reallocation of inputs towards productive enterprises, and much more. Rapidly expanding countries like India often face severe constraints on their transportation infrastructure. Many business leaders, policy makers, and academics describe infrastructure as a critical hurdle for sustained growth that must be met with public funding, but to date we have a very limited understanding of the economic impact of those projects.

This paper studies the impact of the Golden Quadrilateral (GQ) project, a large-scale highway construction and improvement project in India. The GQ project sought to improve the connection of four major cities in India: Delhi, Mumbai, Chennai, and Kolkata. The GQ system comprises 5,846 km (3,633 mi) of road connecting many of the major industrial, agricultural, and cultural centers of India. It is the fifth-longest highway in the world. The massive project began in 2001, was two-thirds complete by 2005, and mostly finished in 2007. Datta (2011), a study that we describe in greater detail below, finds that GQ upgrades quickly improved the inventory management and sourcing choices of manufacturing plants located in non-nodal districts along the GQ network by 2005.

II. INDIAN HIGHWAYS AND GOLDEN QUADRILATERAL PROJECTS

Road transport is the principal mode of movement of goods and people in India, accounting for 65% of freight movement and 80% of passenger traffic. The road network in India has three categories: (i) national highways that serve interstate long-distance traffic; (ii) state highways and major district roads that carry mainly intrastate traffic; and (iii) district and rural roads that carry mainly intra-district traffic. As of January 2012, India possessed 71,972 km of national highways and expressways and 3.25 millionkm of secondary and tertiary roads. While national highways constitute about 1.7% of the road network, they carry more than 40% of the total traffic volume.4

To meet its transportation needs, India launched its National Highways Development Project (NHDP) in 2001. This project, the largest highway

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Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

project ever undertaken by India, aimed at improving the Golden Quadrilateral (GQ) network, the North-South and East-West (NS-EW) Corridors, Port Connectivity, and other projects in several phases. The total length of national highways planned to be upgraded (i.e., strengthened and expanded to four lanes) under the NHDP was 13,494 km; the NHDP also sought to build 1,500 km of new expressways with six or more lanes and 1,000 km of other new national highways, including road connectivity to the major ports in the country. Thus, in a majority of cases, the NHDP sought to upgrade a basic infrastructure that existed, rather than build infrastructure where none previously existed.

The NHDP has evolved to include seven different phases, and our paper focuses on the first two stages. NHDP Phase I was approved in December 2000 at an estimated cost of Rs 30,300 crore (1999 prices). Phase I planned to improve 5,846 km of the GQ network, 981 km of NS-EW, 356 km of Port Connectivity, and 315 km of other national highways, for a total improvement of 7,498 km. Phase II was approved in December 2003 at an estimated cost of Rs 34,339 crore (2002 prices). This phase planned to improve 6,161 km of NS-EW and 486 km of other national highways, for a total improvement of 6,647 km. About 442 km length of highway is common between GQ and NS-EW.

The GQ network, totaling a length of 5,846 km, connects the four major cities of Delhi, Mumbai, Chennai, and Kolkata. Figure 1 provides a map of the GQ network. Beyond the four major cities that the GQ network connects, the highway touches many smaller cities like Dhanbad in Bihar, Chittaurgarh in Rajasthan, and Guntur in Andhra Pradesh. The GQ upgrades began in 2001, with a target completion date. of 2004. To complete the GQ upgrades, 128 separate contracts were awarded. In total, 23% of the work was completed by the end of 2002, 80% by the end of 2004, 95% by the end of 2006, and 98% by the end of 2010. Differences in completion points were due to initial delays in awarding contracts, land acquisition and zoning challenges, funding delays,6 and related contractual problems. Some have also observed that India's construction sector was not fully prepared for a project of this scope. As of August 2011, the cost of the GQ upgrades was about US$6 billion (1999 prices), about half of the initial estimates.

The NS-EW network, with an aggregate span of 7,300 km, is also shown in Figure 1. This network connects Srinagar in the north to Kanyakumari in the south, and Silchar in the east to Porbandar in the west. The NS-EW upgrades were initially planned to begin in Phase I of NHDP along with the GQ upgrades. The scope of the first phase of upgrades was smaller at 981 km, or 13% of the total network, with the remainder originally planned to be completed by 2007. However, work on the NS-EW corridor was pushed into Phase II and later, due to issues with land acquisition, zoning permits, and similar. In total, 2% of the work was completed by the end of 2002, 4% by the end of 2004, and 10% by the end of 2006. These figures include the overlapping portions with the GQ network that represent about 40% of the NS-EW progress by 2006. Since then, the planned upgrades for the NS-EW have expanded substantially. As of January 2012, 5,945 of the 7,300 kilometers in the project have been completed, at an estimated cost of US$12 billion.

III. EMPIRICAL ANALYSIS OF THE IMPACT OF HIGHWAYS ON ECONOMIC ACTIVITY

This section analyzes the impact of highway construction on manufacturing activity across districts. We use simple linear models with outcome variables expressed in logs, with the exception of TFP, which is expressed in unit standard deviations. Estimations include district and year fixed effects. These district fixed effects absorb long-run levels in manufacturing activity by district (along with any other fixed trait), while the year fixed effects absorb aggregate changes in the Indian manufacturing sector.

Estimations report standard errors clustered by district, weight observations by log total district population in 2001, and have 1,248 observations as the cross of four surveys and 312 districts.

Base Pre-Post Estimations of GQ Upgrades

Table 2a shows the simplest panel estimations where explanatory variables in Panel A are interactions of two indicator variables for how far a district is from the GQ highway network with an indicator variable for the post-GQ upgrades (equal to one in 2005 and 2007). The district fixed effects control for the main effects of distance, and the year fixed effects control for the main effects of the post-GQ upgrades period. Thus, the interactions quantify differences in outcomes after the GQ upgrades by spatial band compared to the excluded group that comprises districts located more than 50 km from the GQ network.

Column headers provide the outcome variables studied. Columns 1-3 present measures of total activity in each district, Columns 4-6 present measures of new entry specifically, and Columns 7 and 8 present our average productivity measures. The first row shows increases in nodal district activity for Columns 1-6. As we have noted, we do not emphasize these results much given that the upgrades were built around the connectivity of the nodal cities. The imprecision in these estimates is mostly due to the fact

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

that there are only nine nodal districts. As effects are being measured for each band relative to districts more than 50 km from the GQ network, the inclusion or exclusion of the nodal districts does not impact our core results regarding non-nodal districts.

This paper primary emphasis is on the highlighted row where we consider districts that are 0-10 km from the GQ network but are not nodal districts. To some degree, the upgrades of the GQ network can be taken as exogenous for these districts. Columns 1-3 find limited effects for the total activity contained in these districts. As foreshadowed in Table 1b, we find positive point estimates for higher establishment counts and output in districts 0-10 km from the GQ network after the upgrades, but small declines in employment. These effects are not statistically significant, and this is not due to small sample size as we have 76 districts within this range. Columns 4-6 examine instead the entry margin by quantifying levels of young establishments and their activity. We find much sharper entry effects than the aggregate effects in Columns 1-3, and these entry results are precisely measured. The districts within 0-10 km of GQ have a 0.4-0.9 log point increase in entry activity after the GQ upgrade compared to districts more than 50 km away. We further discuss these differences between total levels and entry rates when reviewing Table 2b.

Columns 7 and 8 show an increase in the average labor productivity and TFP in the districts 0-10 km from the GQ network. These increases are primarily driven by the incumbent establishments of the districts. We do not separately quantify the labor productivity and TFP changes of new entrants similar to Columns 4-6, as much of the impact of new entrants comes from the extensive margin and these plant-level traits are not defined in these cases. The labor productivity result is also evident in a comparison of Columns 2 and 3, with the difference being that Column 7's measure is calculated at the plant level. We return to the interpretation of these productivity results after viewing the dynamic specifications.

For comparison, the third row of Panel A provides the interaction for the districts that are 10-50 km from the GQ network. None of the effects that we measure for the 0-10 km districts are observed at this spatial band, which provides a first assurance that these effects can be linked to the GQ upgrades rather than other features like regional growth differences.

Panel B extends the spatial horizons studies in Panel A to include two additional distance bands for districts 50-125 km and 125-200 km from the GQ network. These two bands have 48 and 51 districts, respectively. In this extended framework, we measure effects relative to the 97 districts that are more than 200 km from the GQ network in our sample. Three observations can be made. First, the results for districts 0-10 km are very similar when using the new baseline. Second, the null results generally found for districts 10-50 km from the GQ network mostly extend to districts 50-200 km from the GQ network. Even from a simple association perspective, the manufacturing growth in the period surrounding the GQ upgrades is localized in districts along the GQ network.

As a final and more speculative point, the negative point estimates in Columns 4-6 have a pattern that might suggest a ―hollowing-out‖ of new entry towards districts more proximate to the GQ system after the upgrades. This pattern is similar to Chandra and Thompson's (2000) finding that U.S. counties that were next to counties through which U.S. highways were constructed were adversely affected. Chandra and Thompson (2000) described their results within a theoretical model of spatial competition whereby regional highway investments aid the nationally-oriented manufacturing industry and lead to the reallocation of economic activity in more regionally-oriented industries. The point estimates suggest a similar force might be occurring within Indian manufacturing as well, but the lack of statistical precision prevents strong conclusions in this regard

Returning to the differences between Columns 1-3 and 4-6, we suspect that three factors are behind the weaker response on total activity compared to entry. First, our post-upgrades data come from 2005 and 2007, which is just at the end of the GQ upgrades that began in 2001. It takes time for activity to shift spatially, especially if there are agglomeration forces or similar with existing industry bases, and we are likely under-estimating the ultimate changes that may occur in the spatial distribution of Indian manufacturing as a consequence. By contrast, the entry margin—where location choices are being made at present—adjust much faster to the changing attractiveness of regions, and thus register sharper effects in the short- to medium-run. A second reason why total shifts in activity may be dampened in districts on the GQ network is that entrants may be displacing incumbent establishments from the districts. In fact, this competition is a key reason cited by proponents for infrastructure investments. Unfortunately, this paper data do not allow us to study the exit margin with sufficient detail to make accurate assessments.

Table 2b presents evidence on a third rationale that partly overlaps with the other two. Prior to the GQ project, there existed some infrastructure linking these cities. In a minority of cases, the existing roads did not even comprise the beginning of a highway network, and so the GQ project built highways where none existed before. In other cases,

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

however, a basic highway existed that could be upgraded. Of the 70 districts lying near the GQ network, new highway stretches comprised some or all of the construction for 33 districts, while 37 districts experienced purely upgrade work.

In Table 2b, we split the 0-10 km interaction variable for these two types of interventions. The results are very interesting. Columns 4-8 show mostly similar entry and productivity consequences regardless of the initial roadwork's condition. Columns 1-3, however, show distinct effects regarding total activity. Places that completely lacked a highway before GQ exhibit increases in aggregate activity. In these cases, the entry has enough aggregate consequences to register during the time period of our study. On the other hand, upgrades of existing facilities display null effects. Because of the earlier two limitations noted, it could be that upgraded portions will also demonstrate increases in aggregate activity in the long-run.

Dynamic Specifications

Table 3a presents a dynamic version of the pre-post estimations using the shorter spatial horizon that measures effects relative to districts 50+ km from the GQ network. In this specification, we interact the indicator variables for district distance bands with indicator variables for the years 2000, 2005, and 2007. By separately estimating effects for each year, we can observe whether the growth patterns appear to follow the GQ upgrades hypothesized to cause them. Effects are measured relative to the 1994 period. We include but do not report interactions for nodal districts and each year, as well.

The patterns in Columns 4-6 are comforting for the entry results. We do not observe a substantial uptick in 2000 that would suggest a pre-trend to the GQ upgrades. This lack of pre-trend also extends to the total activity measures in Columns 1-3, although we did not observe a substantial pre-post effect for these results anyway with the full sample. Likewise, we do not observe any worrisome patterns for the districts 10-50 km apart from the GQ network. In fact, the latter provide additional support in that the coefficients for the 2000 interaction in the 0-10 km (top row) are similar to those for 10-50 km (fourth row), while the subsequent differences in entry rates in 2005 and 2007 are quite stark.

By contrast, the dynamic specifications suggest that some caution is warranted in interpreting the observed growth in labor productivity and TFP for districts 0-10 km from the GQ network. The first row in Columns 7 and 8 show non-trivial performance declines in 2000 compared to 1994 for these districts; they also highlight that much of the performance gain we observe in Table 2a is through a comparison of outcomes in 2005 and 2007 against outcomes in 2000, rather than compared to 1994.

There are two potential interpretations that could follow. The first, less-positive interpretation is that the performance gain we observe in Table 2a is a recovery from some short-term decline in productivity that is spuriously timed with the GQ upgrades. Some evidence in support of this story is registered in the fact that TFP growth reverts back to almost 1994 levels in Column 8. However, a second, more-positive interpretation is that the GQ upgrades managed to stop and reverse some adverse decline in productivity that these districts were experiencing. Some evidence in support of this story is evident in the fact that districts 10-50 km from the GQ network also experienced lower productivity in 2000 that did not subsequently recover. In the end, our analysis provides equal support to both interpretations.

In summary, the dynamic specifications of Table 3a provide support for a causal link in that the observed increases in entry rates from the simple pre-post estimations have a timing that appears well aligned with the GQ upgrades. On the other hand, the productivity results are more difficult to interpret and may suggest that our productivity findings in Table 2a are upwardly biased due to a rebound effect from spuriously lower productivity levels in 2000.

Table 3b takes a second dynamic approach. Due to the size of the GQ project, some sections were completed earlier than other sections. Using our framework from Table 2a, we further interact our indicator variable for being 0-10 km from the GQ network with indicator variables for whether the district's work was completed by March 2003, March 2006, or later. Of the 70 districts, 27 districts were completed prior to March 2003, 27 districts between March 2003 and March 2006, and 16 districts afterwards. In almost every case in Table 3b, the relative sizes of the effects by implementation date are consistent with the project's completion taking hold and influencing economic activity. Given that our final data survey comes from 2007, it is not surprising that we do not yet see substantial activity in the districts completed after March 2006. On the other hand, expansions in activity are generally strongest for districts that were completed by March 2003. Again, the timing of the GQ upgrades is consistent with the results we observe.

Comparison of GQ Upgrades to NS-EW Highway

Table 4 compares districts proximate to the GQ network to districts proximate to the NS-EW highway network that was not upgraded. The idea behind this comparison is that districts that are at some distance from the GQ network may not be a good

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

control group if they have patterns of evolution that do not mirror what districts immediately on the GQ system would have experienced had the GQ upgrades not occurred. This comparison to the NS-EW corridor provides perhaps a stronger foundation in this regard, especially as its upgrades were planned to start close to those of the GQ network before being delayed.

The upgrades scheduled for the NS-EW project were to start contemporaneous to and after the GQ project. To ensure that we are comparing apples to apples, we identified the segments of the NS-EW project that were to begin with GQ and those that were to follow in the next phase. We use separate indicator variables for these two groups so that we can compare against both. Of the 76 districts lying with 0-10 km of NS-EW, 40 districts were to be covered in the 48 NS-EW projects identified for Phase I. The empirical appendix provides greater detail on this division.

The powerful result from Table 4 is that none of the outcomes we measure for the GQ system in the post-upgrade period are observed for districts along the NS-EW corridor. The placebo-like coefficients from the interactions of post-GQ upgrades with districts lying between 0-10 km from the NS-EW highway are mostly negative and never statistically significant. The lack of precision is not due to too few districts along the NS-EW system, as the district counts are comparable and the standard errors are of very similar magnitude. In Appendix Table 1, we show that null results continue to hold when we combine the NS-EW indicator variables and that the coefficients are well estimated. Said differently, with the precision that we estimate the positive responses along the GQ network; we estimate a lack of a change along the NS-EW corridor. Along with the dynamic results in Tables 3a and 3b, these patterns speak to the likely link of the economic changes to the GQ upgrades.

Industry Heterogeneity in Entry Patterns

This paper last two analyses change the focus from estimating aggregate effects from the GQ upgrades to identifying in greater detail the heterogeneity in the effects observed by important industry or district traits. These exercises provide additional confidence around the patterns developed and, as highlighted below, have special policy relevance in India.

Table 5 describes a key feature of the industry heterogeneity in entry that occurred after the GQ upgrades. We focus specifically on the land and building intensity of industries. We select this intensity due to the intuitive inter-relationship that non-nodal districts may have with nodal cities along the GQ network due to the general greater availability of land outside of urban centers and its cheaper prices. This general urban-rural or core-periphery pattern is evident in many countries and is associated with efficient sorting of industry placement. Moreover, this feature has particular importance in India due to government control over land and building rights, leading some observers to state that India has transitioned from its ―license Raj‖ to a ―rents Raj‖ (e.g., Subramanian, 2012a,b). Given India's distorted land markets, the heightened connectivity brought about by the GQ upgrades may be particularly important for efficient sorting of industry across spatial locations.

This paper measure land and building intensity at the national level in the year 2000 through the industry's closing net value of the land and building per unit of output. Appendix Table 2 provides specific values, and we find similar results when only using land intensity. In Table 5, we repeat our entry specifications isolating district activity observed for industries in three bins: those with low land intensity (the bottom quartile of intensity), medium intensity (the middle two quartiles), and high intensity (the top quartile).

The patterns in Table 5 are striking. The districts 0-10 km from the GQ network show a pronounced growth in entry by industries that are land and building intensive. With all three outcome measures of establishments, employment, and output, there are no adjustments in entry for the least-intensive industries. This entry effect only becomes statistically and economically important at moderate land and building intensities, and the effect is largest for industries with the highest intensities. As remarkable, the opposite pattern is generally observed in the top row for nodal districts—where nodal districts areexperiencing heightened entry of industries that are less land and building intensive after the GQ upgrades—and no consistent patterns are observed for districts 10-50 km from the GQ network.

These patterns suggest that the GQ upgrades may have helped with the efficient sorting of industries across locations. Ghani et al. (2012) find that infrastructure aids efficient sorting of industries and plants within districts, and these patterns show a greater efficiency across districts. Many studies have warned about the misallocation in the Indian economy (e.g., Hsieh and Klenow 2009), and these results suggest better connectivity across districts may be able to reduce some of these distortions. More speculatively, these results also suggest that infrastructure may improve upon land market distortions caused by the ―rent Raj and similar.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Highways and Spatial De-Concentration

The development and growth of Indian economy in the last two decades has been accompanied by widening spatial disparities. Cities like Gurgaon in Haryana and Bangalore in Karnataka have experienced high growth in economic activity and real estate developments, while many other places remain mired in poverty and stagnation. These differentials are common to many developing economies (e.g., World Development Report 2009), as well as advanced economies. For instance, China's growth is attributable mainly to coastal provinces. However, unlike China, growth in India's moderate-sized cities is relatively lower. Desmet et al. (2012) argue that manufacturing in India is slowly moving away from high-density districts to districts that are less congested, allowing industrial activity to spread more equally across space.

In this section, we examine whether investment in infrastructure such as highways can play a role in facilitating the shift of manufacturing activity to intermediate-sized districts. We group districts into three bins based on their population density: low-density districts are below the median density for India (up to 353 persons per square km); moderate-density districts are those in the middle two quartiles (353-693 persons per square km), and high-density districts are those in the top quartile (over 693 persons per square km).

Table 6 presents the results of interacting the three repressors from paper study typical approach with indicator variables for the various density bins. The one exception is that all of the nodal districts are above the median density for India, and so we do not have a low-density nodal-district effect. Effects continue to be measured against districts farther than 50 km from the GQ network.

The results in Table 6 suggest that the GQ upgrades have increased new entry the most in high- and medium-density districts that lie 0-10 km from the GQ network. For instance, moderate-density districts, like Surat in Gujarat or Srikakulam in Andhra Pradesh, that lie on the GQ highway registered more than 100% increase in new output and new establishment counts after GQ upgrades. On the other hand, the GQ upgrades are not linked to heightened entry or performance in low-density areas. One interpretation of these results is that the improved connectivity enables manufacturing establishments to efficiently locate in intermediate cities, but that localization economies prevalent for the sector continue to preclude entry in low-density places.[12]

The findings are similar to Baum-Snow et al. (2012) who identify how infrastructure aided the decentralization of industrial production and population in Chinese cities from 1990-2010. Henderson et al. (2001) similarly find that industrial decentralization in Korea is attributable to massive transport and communications infrastructure investments in the early 1980s. These and similar studies form the foundation for development recommendations with respect to infrastructure found in the World Bank's (2012) Urbanization Review Flagship Report and comparable policy reports.

IV. CONCLUSIONS

This paper evaluates the impact of a large-scale highway project on economic activity in the Indian manufacturing sector using establishment-level survey data from 1994-2007. The Golden Quadrilateral highway project of India upgraded the quality and width of 5,846 km of highways linking four major hubs in India. In the process, this upgrade improved the connectivity and market accessibility of districts lying close to the highway compared to those more removed. Non-nodal districts located within 0-10 km from the GQ network experienced substantial increases in entry levels and higher productivity. Dynamic specifications and comparisons to the NS-EW highway system mostly confirm these conclusions, with the most substantial caveat being that the productivity gains may be upwardly biased by a pre-period dip. The GQ upgrades also appear to have facilitated a more natural sorting of industries that are land and building intensive from the nodal districts into the periphery locations; the upgrades also appear to be encouraging decentralization by making intermediate cities more attractive for manufacturing entrants.

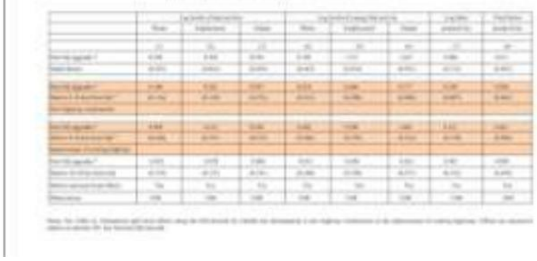
There are several points of future research that we hope to undertake. First, we are continuing to examine the extent to which the GQ project improved the allocative efficiency of the manufacturing sector in India. Given the high levels of misallocation with which India is starting, improvements in allocation are most important. Second, we intend to study next the impact of the GQ upgrades on the unorganized sector. Ghani et al. (2012) highlight the extent to which the organized and unorganized sectors are moving in different directions within India, with the unorganized sector becoming more urbanized, and we need to better understand the role that infrastructure connections across districts play in this process. This work will also examine issues like the gender of business owners to understand how improved highways affect sub-groups of the population differently. Finally, looking beyond the manufacturing sector, it will be very interesting to use satellite-based data to examine the aggregate economic outcome associated with these upgrades.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India



ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

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ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

High Strenth Concrete with Varying Content of Micro Silica.

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Abstract :- **Concrete is the most important engineering material in construction industry because of its inherent strength properties. However, the addition of some other materials may change the properties of concrete. With increase in trend towards the wider use of concrete for pre-stressed concrete and high rise buildings there is a growing demand of concrete with higher compressive strength.. The mineral admixtures with pozzolanic properties such as fly ash (FA), silica fume (SF), ground blast-furnace slag (GGBS) and metakaolin (MK) are commonly used as a partial substitution of Portland cement during construction. These admixtures are often added to modify the physical and chemical properties of cementitious mixes. In comparison to ordinary Portland cement, the collection of flyash as a by-product requires less energy and it produces less greenhouse gases. Thus, flyash blended concrete is a more environmentally friendly concrete compared to OPC concrete. This paper presents the study of variation of contents of micro silica in the mix consisting of cement, Flyash, and micro silica. Micro silica is used in three percentages 0%, 7%, and 10% and the compressive strength test of cubes is being conducted.**

Keywords: **- compressive strength, cementitious content , flyash , Micro silica, pozzolanic.**

I. INTRODUCTION

Fly ash, ground granulated blast-furnace slag, silica fume, and natural pozzolans, such as calcined shale, calcined clay or metakaolin, are materials that when used in conjunction with Portland or blended cement, contribute to the properties of the hardened concrete through hydraulic or pozzolanic activity or both. Supplementary cementitious materials are added to concrete as part of the total cementitious system. They may be used in addition to or as a partial replacement of Portland cement or blended cement in concrete, depending on the properties of the materials and the desired effect on concrete. Traditionally, fly ash, slag, calcined clay, calcined shale, and silica fume were used in concrete individually. Today, due to improved access to these materials, concrete producers can combine two or more of these materials to optimize concrete properties. Mixtures using three cementitious materials, called ternary mixtures, are becoming more prominent.

II. MATERIAL

FLYASH is also known as "pulverized fuel ash" in the United Kingdom, is one of the residues generated by coalcombustion, and is composed of the fine particles that are driven out of the boiler with the flue gases. Ash that falls in the bottom of the boiler is called bottom ash. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably .The recycling of fly ash has become an increasing concern in recent years due to increasing landfill costs and current interest in sustainable development.

Silica fume, also known as microsilica, is an amorphous (non-crystalline) polymorph of silicon dioxide, silica. It is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy production and consists of spherical particles with an average particle diameter of 150 nm. The main field of application is as pozzolanic material for high performance concrete. Silica fume is an ultrafine material with spherical particles less than 1 μm in diameter, the average being about 0.15 μm.

Cement, type of cement is important mainly through its influence on the rate of development of compressive strength of concrete. The choice of the type of cement depends upon the requirements of performance at hand. The most commonly used cement is ordinary Portland cement. Variation in the cement quality will cause the compressive strength to vary more than any other single material.

2.1 Tests on material

The materials required and determining their various properties has been carried out in this phase. The Constituents of concrete viz. cement, fine aggregate, and coarse aggregate are procured and their various properties are determined.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Table -1: Properties of Cement

Property	Average value for OPC used in present investigation
Specific gravity	3.15 (standard)
Fineness(%)	4
Consistency (%)	30
Final setting time (min)	78
Initial setting time (min)	380

Table -2: Test results of physical Properties of Coarse Aggregate

Sr no	Property	Average value
1	Specific Gravity	2.88
2	Water absorption	0.97%
3	Moisture content	-
4	Type	Crushed
5	Maximum Size	20 mm

Table 3 : Test results of Physical Properties of Fine Aggregate

Sr no	Property	Average value
1.	Specific Gravity	2.67
2.	Water absorption	1.23%
3.	Moisture content	-
4.	Fineness Modulus	4.97
5.	Type	Natural Sand
6.	Grading Zone	III

III. MIX PROPORTIONS

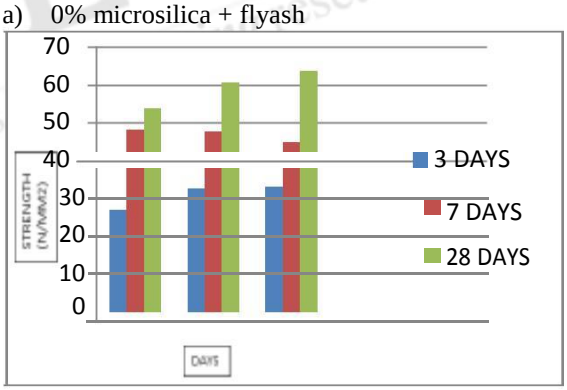
Mix proportions are determined for the proposed grade of concrete (M60) by partially replacing cement with flyash and micro silica.

Mix components	Mix 1 (micro silica 4%)	Mix 2 (micro silica 7%)	Mix 3 (micro silica 0%)
Cement	400	385	410
Fly ash	110	110	130
Micro silica	20	37	-
20mm	770	790	820
10mm	360	360	350
River sand	450	435	280
Artificial sand	300	288	420
Water content	140	140	135
Admixture	161 gm (9 cubes)	173gm (9 cubes)	226gm (9 cubes)

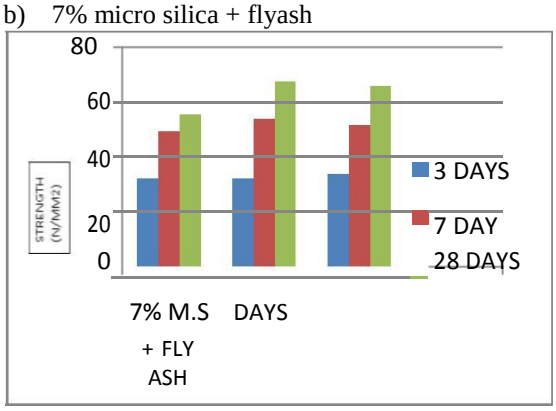
IV. RESULTS AND DISCUSSION

The test was carried out on number of specimens prepared by using different contents of the materials. In the mix cement was partially replaced by flyash and micro silica, where the percentage of micro silica is varying (0%, 7% and 10%). Test was carried out at 3, 7, 28 days and results were obtained.

a) 0% microsilica + flyash



b) 7% micro silica + flyash



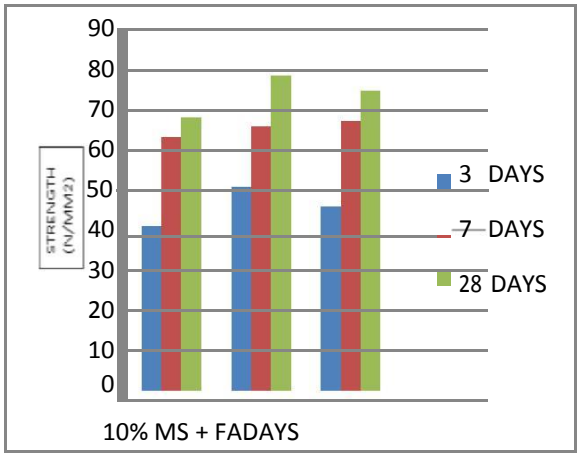
ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

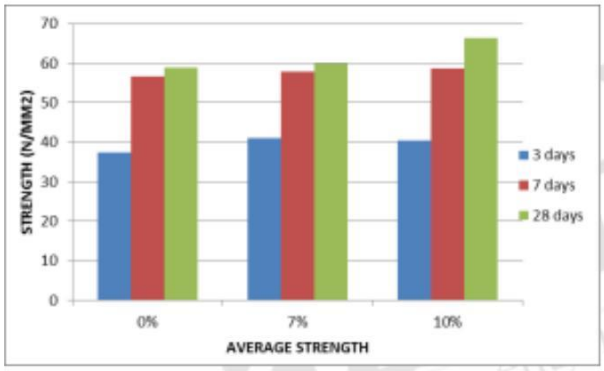
Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

c) 10% microsilica + flyash



d) average strength



This study gives the results for the mix tested by conducting compressive strength test on the cubes (150x150x150 mm). Silica fume has strong effects in compressive strength of concrete for 3, 7 and 28 days of age. Graph a, b, c shows the variation of strength for 0%,7%,10% micro silica for 3,7,28 days. The variation of compressive strength for different replacement levels of OPC by silica fume for 3, 7 and 28 days is shown in graph(d), which shows the average strength for variable proportions of micro silica. For 28 days concrete it was observed that maximum compressive strength (71.98 N/mm2) was exhibited which possess, 10% micro silica, 20% flyash and 70% cement.

V. CONCUSION

- Other materials than cement containing cementitious properties can be effectively used as a replacement of cement giving required results for the mix.
- Fly ash is more prominently used material with cement as it proves to be a good binding agent with cement, giving required specified designation of concrete.
- Micro silica can be added upto 10% of the total cement content to increase the strength of the mix effectively.
- These varying proportions of mixes proves as an better alternative to cement with environmental benefits and solves the problems of disposal of these other by products

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ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Construction of Flyover using Maccaferri MacRes® System

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Abstract :- **Maccaferri MacRes® system has been developed to create vertical concrete faced soil reinforcement structures, it is used extensively in infrastructure and anywhere that requires a vertical faced structure capable of resisting high loads. The system consists of a combination of geostrip soil reinforcements (ParaWeb) connected to large concrete facing panels. The ParaWeb polymer geopstrip linear reinforcement is placed between compacted layers of structural backfill and is intimately connected to the precast concrete fascia panels. The fascia panels are erected in progressive layers as the height of the reinforced compacted backfill rises behind. The concrete panels are designed and detailed according to the requirement of the project. The panels can be supplied with specific face finishes depending on the aesthetic demands of the client. The following paper discusses the details of the same system.**

Keywords: **- Boundary walls, Bridge Abutments, Construction of Flyover, Crusher walls, Maccaferri MacRes System, Reinforced Soil walls.**

I. INTRODUCTION

Maccaferri MacRes® is a cost effective engineered solution through vertical walls with concrete panels which can be used where only narrow construction corridors are available or a reinforced soil structure with a vertical face in urban areas is required.

The basic principle of MacRes® is Reinforced soil. *Soil is strong in compression (when confined) but weak in tension. Resistance to tensile strain can be provided by reinforcements.* Interaction between reinforcement and soil is provided by friction and/or mechanical interlock depending on the condition of the soil and site.

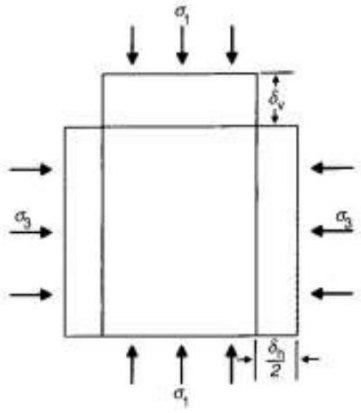

Fig 1:- Soil without reinforcement

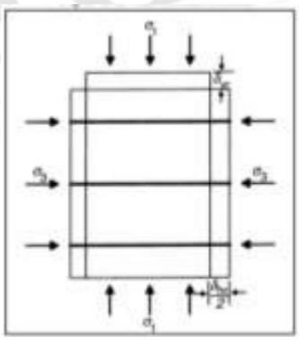

Fig 2:- Soil with reinforcement

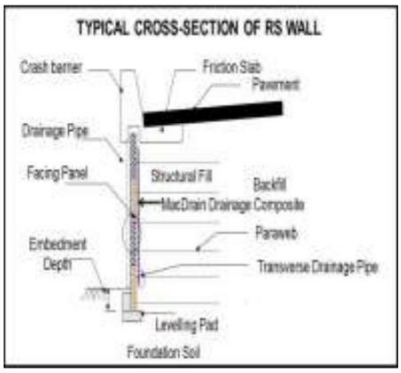

Fig 3: Typical Cross Section of RS Wall

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Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

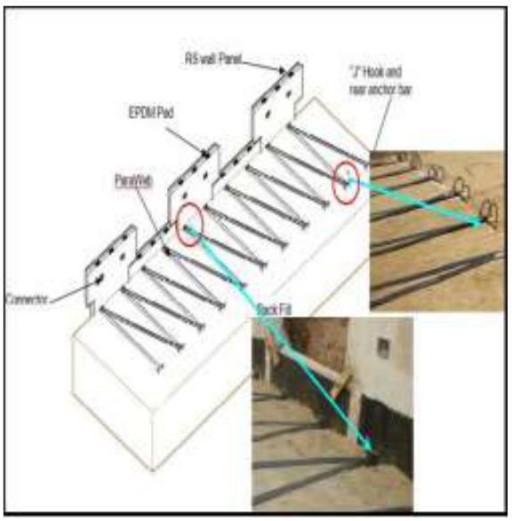


Fig 3: Laying of ParaWeb™

II. APPLICATIONS OF RS WALLS

Road Sector (Flypvers, Underpasses, Rail over Bridge(ROB), etc)

Bridge Abutments

Crusher Plant (Crusher walls)

Building Sector (Boundary walls)

Water Front Structures

III. INSTALLATION OF RS WALLS

A. Casting of Panels:

The panels shall be cast at the casting area using moulds.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

Mould

Casting Process

Panel after De-shuttering

Curing Process

Stacking of Panels

B. Panel Erection:

The Panels are transported from the casting yard to the site on trailers. The panels are then erected on site using a Hydra Crane. Alignment of the panels is checked.

Erection of Panels

Alignment of Panels

Timber supports to prevent over-turning

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

C. Filling and Compacting:

For filling material, it is advisable to use granular fill materials with fines less than 15%. Minimum angle of internal friction should be 30 degrees and plasticity index should be less than 6.

Care should be exercised when placing, spreading and compacting fill to ensure that heavy plant is not used within 2.0m of the panels. Light or Baby roller must be used in this area. Fill should be spread in a direction parallel to the facing panels.

Filter media must be provided behind the panels to allow excess water to flow out.

Dumping of Fill Material

Grading of Fill Material

Rolling and compaction of soil

Compaction with 1 ton roller immediately behind the panels.

D. Tests on Backfill:

After proper rolling and compaction is completed, the density of the compacted soil is checked. This is done by using the Modified Proctor Test and the Field Dry Density test by sand replacement. The Density achieved must be 97% of the Maximum Dry Density(MDD)

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

E. Laying of ParaWeb:

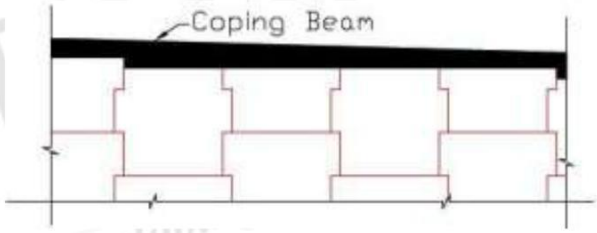
Laying of ParaWeb

Laying of ParaWeb

F. Coping Beam:

In case of highway projects, crash barrier friction slab is provided on the Reinforced soil wall to avoid any vehicle accidentally jumping off the RS Wall retained embankment. To negotiate the slope of the approach, panels are stepped by 200mm

Coping Beam



IV. ADVANTAGES OVER CONVENTIONAL SYSTEMS

- Economical:- Lower cost of system in general (considering polymeric reinforcement & thin concrete fascia), simple and efficient means of erection. Cost saving in the range of 30% to 50% due to less execution time.
- Speed:- Much faster than a reinforced concrete structure. The rate of output may vary. In Situations where conditions permit, 75 m2 to 100 m2 of work can be done per day.
- No Specialized labour required
- Appearance:- The concrete panels are designed and detailed according to the requirement of the project. The panels can be supplied with specific face finishes depending on the aesthetic demands of the client.
- Flexibility:- it can allow differential movement of 1 in 100. Which means it has good earthquake resistance Design.
- Resistance against corrosion
- Indian Production.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

V. CONCLUSION

Maccaferri MacRes® system is ideal for the construction of vertical walls subject to high loads, or where architectural requirements demand a specific finish to the exposed wall face. The development of innovative solutions for retention works is one of Maccaferri's main research areas.

Installation instructions are provided with the construction components (Concrete facing panels, soil reinforcement and connectors) for the MacRes system which, together with preliminary design based on the characteristics of the reinforced soil, offer:

- High load bearing capacity
- Durability
- Overall cost effectiveness for implementation over a large area due to its simplicity and speed of installation
- Flexibility to meet layout requirements
- Ease of inclusion within various architectural contexts (Different types of finish)
- It has been possible to achieve this result by combining the geotechnical skills, structural engineering and know-how and materials knowledge which has been acquired by Maccaferri over many years.

VI. ACKNOWLEDGEMENT

I would like to thank Maccaferri Environmental Solutions Pvt Ltd for giving me an opportunity to do my internship at their MacRes vertical wall site.

I would like to thank Mr Thomas Cherien, Head of quality, and Mr Ratnakar Mahajan. Head of Technical (Core), who directed me and gave me insights of the projects. They also guided and supported me and imparted in-depth knowledge throughout my period of internship.

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Special Issue

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Reduction in Cost of Construction of Infrastructure by using Self Compacting Concrete with Glycerin as VMA & Fly Ash as Filler Material

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Abstract :- **Self Compacting Concrete was a concept introduced in late 1988 by Professor Ozawa with the sole intention of overcoming/eliminating the ever rising issue of insufficient compaction by a workforce, thus creating uniformity in the quality of concrete. SCC as its name suggests is a concrete that can easily flow into reinforcements without the need of compaction due to its own weights. In recent year, SCC has gained wide use for placement in congested reinforced concrete structure with difficult casting condition. For such applications the fresh concrete must possess high fluidity & good cohesion. However wide spread application of SCC has been restricted due to its high manufacturing cost; which is again due to the high cost of the superplasticizers, retarders & VMA'S used in manufacturing of SCC. The paper aims at developing SCC using glycerin as VMA and flyash as filler material, which would make it economical imparting comparatively more strength at the same time. The results of the experimental program are presented in the paper representing the strength of concrete at the end of 7days, 14 days & 28 days; which ranged from 28.7Mpa to 38Mpa at the end of 28days. Various proportions of glycerin were tried and it was found that glycerin can replace both the superplasticizers and the retarders imparting comparatively more flowability and strength as compared to SCC with superplasticizers and retarders & has proved to be more economic at the same time. The test results for acceptance characteristics of SCC such as slump flow; V-funnel & L-box are presented.**

Keywords: **- Self-Compacting Concrete, Glycerin, Fly Ash, VMA'S, Compersive Strength and Fresh Properties.**

I. INTRODUCTION

Self-Compacting Concrete (SCC) was first researched by Professor Ozawa in 1988 at Japan with the intention of creating concrete of uniform quality by eliminating or controlling the ever rising issue of insufficient compaction by a workforce. Professor Hagime Okamura was the first one who gave the concept of SCC in 1986.

SCC is a fluid mixture which is suitable for easy placement in case of congested reinforcements without applying vibration. The SCC in hardened state is homogeneous and dense and shows similar engineering properties like traditional concrete.

In recent year, SCC has gained wide use for placement in congested reinforced concrete structure with difficult casting condition. For such applications the fresh concrete must possess high fluidity & good cohesion. However wide spread application of SCC has been restricted due to its high manufacturing cost; which is due to the high cost of the superplasticizers, retarders & VMA'S used in manufacturing SCC.

Table 1: History of SCC

Year	Event	Place
March 1986	Proposal for developing self-compacting concrete by Okamura	Japan
August 1988	Completion of a prototype by Okamura	Japan
July 1989	An open experiment	University of Tokyo, Japan
May 1992	Presentation on SCC by Ozawa at ACI & CANMET international conference	Istanbul
September 1993	A text book on self-compacting HPC in Japanese	Japan
November 1994	ACI Workshop on High Performance Concrete sponsored by Prof. Paul Zia	Bangkok
January 1997	RILEM Committee found SCC	Bangkok

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International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Special Issue

INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

EFNARC in the year 2002 published their "Specification & Guidelines for Self Compacting Concrete" which at that particular time; provided significant information regarding the procedure of preparing SCC, which proved for producers and users to be a state of art information, since then much work has been carried out in the field and much technical information has been published.

Self Compacting Concrete development should ensure remarkable balance between stability and deformability. Compatibility of SCC is affected by characteristics of material, mix proportion, viscosity agents/super-plasticizers. Researchers mentioned some guideline for mixture proportioning of SCC. Which suggests the following: -

- Reducing the ratio of volume of aggregate to cementitious material.
- Increasing the water cement ratio & paste volume.
- Carefully controlling total volume & the maximum coarse aggregate particle size &
- Using various admixtures which enhance viscosity.

Whilst following above mentioned guidelines the process of preparing the mix becomes complex as well as costly at times. Specially adding super-plasticizers like retarders, PCE based chemicals add up to the overall cost of SCC.

If some locally available or regularly used viscous material is used as a super-plasticizer then they we might be able to replace the costly super-plasticizers.

In recent year, SCC has gained wide use for placement in congested reinforced concrete structure with difficult casting condition. For such applications the fresh concrete must possess high fluidity & good cohesion. However wide spread application of SCC has been restricted due to its high manufacturing cost; which is again due to the high cost of the superplasticizers, retarders & VMA'S used in manufacturing of SCC.

II. MIX DESIGN PRINCIPLES

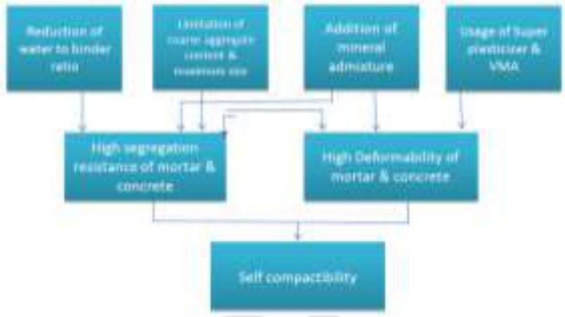
The viscosity and flow-ability of the paste can be attained/modified initially by proportioning water (including additives) to powder ratio and cement content and then after by adding super plasticizers (like PCE based chemical, retarder etc.) & Viscosity Modifying Agent.

The paste acts as vehicle for transport of aggregates, and so the volume of the paste should be greater than the volume of voids in aggregates.

In order to control rise of temperature & strength, as well as thermal shrinkage cracking, filler material (like fly ash, mineral filler, silica fume etc.) must be added in order to keep the cement content at an acceptable level.

Self Compacting Concrete should have:

- Low coarse aggregate content
- Increased paste content
- Low water powder ratio
- Increased super plasticizer dosage
- Viscosity modifying agents



Mix design principal elements

III. METHODOLOGY

Properties of Materials used

Table: 2 Properties of Cement

Properties	Results Achieved
Setting Time: Initial Final	 30 minutes 600 minutes
Compressive Strength(Mpa): 1 Days 7 Days 28 Days	 27 37 53
Air Contain of water (%) by volume	10%
Fineness (Specific Surface)	342 m^2/kg

Table:3 Properties of Aggregate

Properties	Coarse aggregate 10mm	Zone 2 Sand
Bulk Specific Gravity (Oven Dry Basis)	2.50	2.54
Apparent Specific Gravity	2.70	2.71
Unit Weight(kg/m^3)	1542	1591
Absorption (%)	1.50	1.1

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Special Issue

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Table:4 Properties of Fly-Ash

Sr. No	Physical Properties	Test Result
1	Color	Grey(blackish)
2	Specific Gravity	2.13
3	Average Strength after 28 days of mixture	4.90Mpa

IV. LABORATORY TESTS

Slump-Flow Test

Slump flow test is carried out in order to measure horizontal flow of concrete when there is no obstruction to the flow. It gives good assessment of filling ability. Slump cone is of 300mm height, 100mm upper diameter and 200mm bottom diameter. The diameter of spread should lie between 450mm to700mm.

Procedure

1. To carry out the test about 6 liter of concrete is needed, sampled normally.
2. Now the base plate and inside of slump cone is to be moistened.
3. The base plate is to be placed on level stable ground and the slump cone is placed centrally on the base plate; it has to be hold down firmly.
4. Now the cone is filled with the scoop. Be careful do not tamp, the concrete level is simply to be striked off with the top of the cone using the trowel.
5. Any surplus concrete is to be removed from and around the base of the cone.
6. The cone is to be raised vertically and concrete is allowed to flow out freely.
7. Simultaneously, start the stopwatch has to be started and the time taken for the concrete to reach the 500mm spread circle is recorded. (This is the T50 time).
8. Now the final diameter of the concrete in two perpendicular directions is to be measured.
9. Now the average of the two measured diameters is calculated. (This is the slump flow in mm).
10. Any border of mortar or cement paste without coarse aggregate at the edge of the pool of concrete is to be noted down.

If the value of flow is high the workability of concrete will be high.

L-Box Test

L-box test is used for measuring the passing ability of SCC that is its ability to flow through obstructions without blocking or segregation.

Procedure:

1. To carry out the test about 14 liter of concrete is needed, sampled normally.
2. The apparatus should be set at a level on firm ground, ensuring that the sliding gate can be opened freely and then close sliding gate.
3. The inside surfaces of the apparatus should be moistened, and any surplus water is removed.
4. The vertical section of the apparatus is filled with the concrete sample.
5. Now it is left to stand for 1 minute.
6. Now the sliding gate is to be lifted and the concrete is allowed to flow out into the horizontal section.
7. Simultaneously, the stopwatch is to be started and the times taken for the concrete to reach the 200 and 400 mm marks are recorded.
8. As and when the concrete stops flowing, the distances "H1 (depth at vertical end)" and "H2 (depth at horizontal end)" are measured.
9. Now the blocking ratio H2/H1 is calculated. Passing ability ratio (PL) is given as the ratio of depth at the end of horizontal by depth at the end of vertical=H2/H1.

V-Funnel Test

The V-funnel test is used for determining the filling ability of SCC and viscosity of SCC.

Procedure

1. To carry out the test about 12 liter of concrete is needed, sampled normally.
2. V-funnel should be set on firm ground.
3. The inside surfaces of the funnel is moistened.
4. Now the trap door should be opened; so as to allow any surplus water to drain.
5. Now close the trap door and place a bucket underneath.
6. Now the apparatus is filled completely with concrete without applying any compaction or tamping, having done that now simply strike off the concrete level with the top with the trowel.
7. After filling the trap door within 10 sec, allow the concrete to flow out under gravity.
8. Now start the stopwatch as soon as the trap door is opened, and time is recorded for the discharge to complete (the flow time). It is considered when light is seen from above through the funnel.

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V. LABORATORY PERFORMANCE

STUDY *Table:5 Mix Proportion*

Trials	T1	T2	T3	T4	T5	T6
Cement (Kg/m^3)	408	432	396	420	444	450
Fly ash (Kg/m^3)	192	168	204	180	156	150
Water (Kg/m^3)	210	210	210	210	210	210
Coarse aggregate (Kg/m^3)	802	802	802	802	802	802
Sand (Kg/m^3)	802	802	802	802	802	802
Super plasticizer ($Liters/m^3$)	0.90	1.5	-	-	-	-
Retarder ($Liters/m^3$)	3.00	-	4	-	-	-
Glycerin ($Liters/m^3$)	-	-	-	3.15	4.2	5.25

Table:6 Results Obtained

Trials	T1	T2	T3	T4	T5	T6
Initial Slump Flow(mm)	589	542	600	650	695	730
Slump Flow at end of 30 mins(mm)	500	450	530	600	620	676.7
L-Box Blocking ratio (H2/H1)[d]	0.2	0.3	0.4	0.1	0.2	0.1
V-Funnel T_f (Sec)	6	5	4	5	5	4
7-Days Strength (Mpa)	15	17	14	16	18	20
14-Days Strength (Mpa)	26.5	28.5	22.5	25	28	30
28-Days Strength (Mpa)	30	33.5	28.70	32	34	38

VI. COST ANALYSIS

A comparative cost analysis was carried out showing the cost of the traditional concrete with the cost of standard SCC mix to SCC mix using only Glycerin. The analysis does also include the manpower as well as the equipment cost. It also includes there comparative compressive strengths at various level. In the table:

SCC MIX 1: demonstrates the standard SCC mix using super plasticizer and retarder.

SCC MIX 2: represents the SCC mix with only glycerin as admixture without using super plasticizer or retarder.

Table: 7 Cost Analysis

	Ordinary Concrete(Rs)	SCC MIX 1	SCC MIX 2
Cement	2340	2340	2340
Aggregate 20mm	665	0	0
Aggregate 10mm	220	722	722
Sand	548	518	518
Fly Ash	450	450	330
Chemical Admixture	200	792	0
Super plasticizer	0	100	0
Glycerin	0	0	800
Initial Cost	**4423**	**4922**	**4710**
Manpower Cost	1300	650	650
Equipment Cost	1900	1500	1500
Total Cost	**7623 Rs**	**7072 Rs**	**6860 Rs**
Compressive Strength(Mpa)	**30**	**33.5**	**38**

VII. CONCLUSIONS

- By increasing the amount of glycerin at a rate of 1.5% to 2.5% of water; the mix yielded comparatively more strength as well as the flowability of the concrete.
- By varying the content of fly ash, it was observed that upto an extent; it added to the strength and contributed to the concrete being economic.
- Trial-4 shows that notable amount of flow as well as strength can be obtained by replacing fly ash by 30% of cement; although maximum amount of flow and strength can be obtained at 25% of replacement as replicated by Trial-6.
- The cost analysis above shows that SCC produced by using only glycerin as admixture yields more strength and flowability at a comparative low cost.

VIII. FUTURE SCOPE OF STUDY

- Durability test can be carried out on SCC containing glycerin as VMA.
- Further the effect on SCC by increasing the amount of glycerin more than 2.5% can be checked.
- Silica Fume may be added as filler material and results can be checked.

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INSIGHT'17 - Advanced Transportation Systems And Infrastructure Development in Developing India

IX. ACKNOWLEDGMENT

Presenting the Project report today remains an unparalleled event for us as it recapitulates all our toils and efforts. It is a great pleasure to acknowledge everyone who made it possible for us to achieve something, which appeared like a herculean task. Firstly, we would like to thank our faculties of Project & Construction Management Department College of Mangement, MITADTUniversity,Pune, for imparting their valuable time for guiding us.They gave us their expertguidance,valuable suggestions, provided reference materials, and continuous encouragement throughout the course of our Project work.

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