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4th National Level Construction Techies Conference on Advances in Infrastructure Development and Transportation Systems in Developing India



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MITCOM-Project & Construction Management

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Rajbaug, Loni Kalbhor, Pune, Maharashtra-412201

यंत्र - तंत्रादि विज्ञानम् । 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, Salt Lake 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.

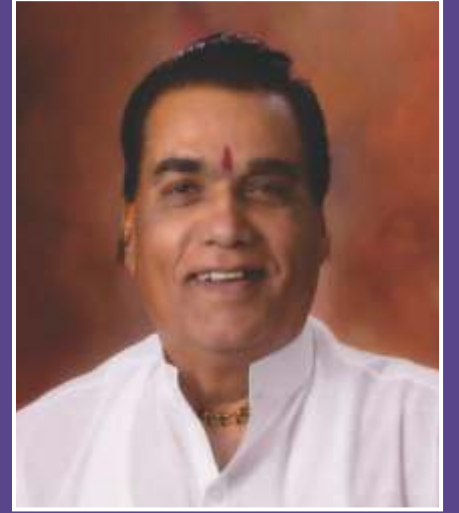
Under his valuable guidance MAEERS's MIT group of Institutions has reached 63 institutions with more than 50000 students on the campuses. His chain of "Vishwashanti Gurukul" schools initiated in 2007 has in a short span of time come up at more than 7 locations.

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

Vice President,

MIT Art, Design and 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





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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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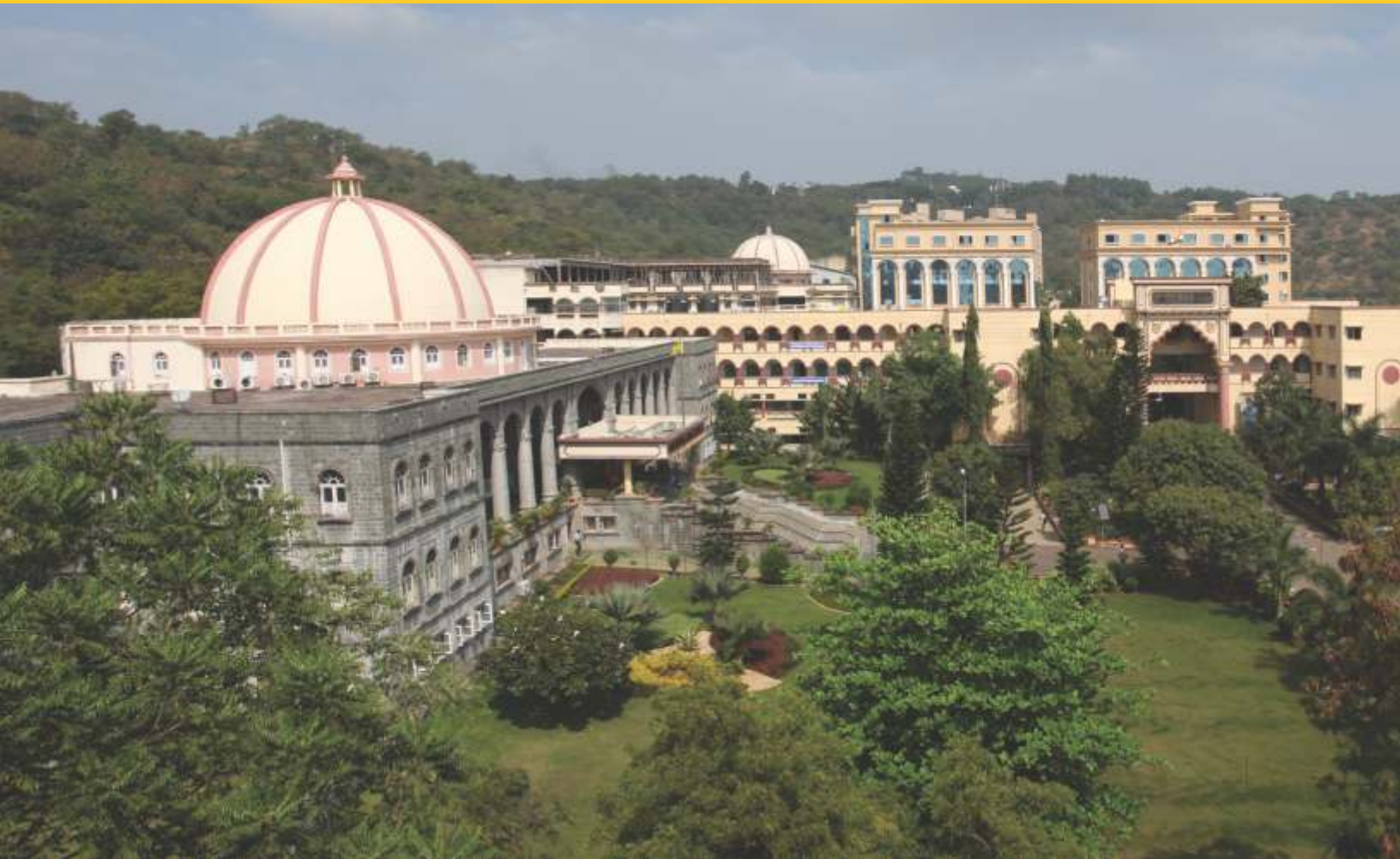


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About MITCOM

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 entrepreneurship 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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Latest Trends and Technologies for Railway Engineering Using Composite Sleepers

^[1] Abhishek Budhavant, ^[2] Priyanka Danane, ^[3] Shreyas Joshi, ^[4] Dr. Shantini Bokil
^{[1][2][3]} Research students, ^[4] Professor and Head
^{[1][2][3][4]} Dept. of Civil Engineering, MITCOE, Pune

Abstract— Railway sleepers are one of the most important elements of the railway track system. Timber is the most widely used material for railway sleeper. Although timber sleepers are the most common, use of pre-stressed concrete, steel materials are also increasing. Composite sleeper is becoming suitable alternative for replacing the existing concrete, steel and particularly timber sleeper. Use of composite sleepers not only reduces the land pollution from disposed waste plastics but also ensure less destruction to the forests. Composite sleeper technologies are already available in the last 20 years but they have limited acceptance by the railway industry. In recent years, reinforced polymer sleepers have emerged as a potential alternative but their implementation has been very slow. This paper reviews the use of composite sleeper which is a new initiative on focusing of alternative sleepers, their advantages and disadvantages over traditional sleeper. For the upcoming years every construction activity needs to focus on sustainable engineering and this research attempts to give the alternative smart solution for future infrastructure engineering sector.

Keywords— Infrastructure and Sustainable engineering, Railway sleepers, Composite sleeper, reinforced polymer sleepers.

I. INTRODUCTION

Railway sleeper are one of the most important element of railway track system. Their function is to transfer and distribute rail load to ballast and hence secure displacement of gauge, maintaining gauge-width. Sleepers also resist the lateral and the longitudinal movement of the rail system. Sleepers are exposed to large temperature variations, excessive amount of UV light, severe weather conditions, attack from microorganisms and insects. To prevent the occurrence of accidents, the materials used for manufacturing sleepers need to be stiff, strong and resistant to UV light, temperature fluctuations, and insect attack. Also, the material should be nonconductive to prohibit electrical flow between the rails.

Different kinds of materials are used in sleeper production. Hardwood timber is the most widely used sleeper material. Timber sleepers are declining and becoming less capable of meeting performance requirements. In order to maintain the track quality to a specified service level and ensure a safe track

operation, damaged and degraded sleepers are being replaced with new ones. Strength and durability of the sleepers is one of those ingredients that play an important role in track system. Failure to adequately serve these roles can lead to a derailment endangering both lives and property.

Beside timber wood, pre-stressed concrete and steel were widely applied in sleepers but the results were not satisfactory. This is because concrete and steel sleepers were not economical in comparison to timber sleepers. Steel's risk of corrosion, high electric conductivity, fatigue cracking, and difficulty of packing it with ballast has made it an inferior material to be used in sleepers. On the other hand, pre-stressed concrete sleeper, which offers a great durability than timber and steel sleepers, suffers due to heavy weight, high initial cost, low impact resistance, susceptibility to chemical attack consequently; have failed to satisfactorily meet the demands.

Several investigations have been carried out in an attempt to investigate the strongest, durable and cost

effective material for replacing traditional sleepers. Hence, the use of composite sleepers has emerged as a potential alternative. Composite sleepers are environment friendly, highest in performance in comparison to other sleepers and provide an outstanding value to its rail customers. Composite sleepers use decreases maintenance cost of track and increases its lifespan up to 50 years. Indian railways use composite sleepers for construction of rail road bridges. Use of timber sleepers were banned in 1998-1999 and trials were made on Channel Sleepers, FRP sleepers and Composite Sleepers in which composite sleepers are under trial, but got very limited acceptance from railway industry and their implementation has been very slow.

II. MATERIALS FOR RAILWAY SLEEPER

Timber sleepers are still the most common, however, use of pre-stressed concrete and steel sleepers is also increasing. The advantages and disadvantages of these railway materials will be discussed in the following sections.

1. Timber sleeper

Timber sleepers have effective and reliable performance in the railway environment. Timbers most commonly used for sleepers in India are Sal (hardwood), Chir and Deodar (softwood). Softwood sleepers are treated in a creosoting plant before putting them in service, where as hardwood sleepers are generally used untreated. Like the others, it has advantages and disadvantages. The main advantage of the timber is their adaptability as it can be fitted with all types of railway track. Timber sleepers are workable, easy to handle, easy to replace and needs no complicated assembly equipment. Their susceptibility to mechanical and biological degradation leading to failure is their major disadvantage. Cleaving of timber at the ends is also common as railway sleepers support very large transverse shear loadings. However, the most typical problem that the railway is now facing is the diminishing availability of quality timber for railway sleepers. Use of chemical preservatives to timber sleepers is affecting environment as well as causing health hazards. The majority of timber railway sleepers are soaked in coal tar creosote in order to protect them from environmental wear and insect infestation.

Creosote extends the life of wooden sleepers but is toxic hazard which creates an added cost for disposal and has damaged the environmental credibility of the industry's traditional railway sleeper material.

Reports worldwide suggest that the disposal to landfill of preservative-treated timber sleepers is at present an acceptable option.

Demerits

- Timber species available in India have relatively short life
- For modern LWR track, it is light sleeper
- Gets worn out faster under beater packing
- Need special treatment for fire protection
- Less scrap value

2. Concrete sleeper

Concrete, because of its natural weakness in tension is not used in sleeper's products. Pre-stressed concrete is a method for overcoming this matter. It can be used to produce beams, floors and bridges with longer span. Pre-stressed concrete sleepers have become widely and successfully accepted for railway sleeper usage especially in high speed lines. Mono-bloc pre-stressed concrete sleepers is the most commonly used. Twin-bloc, on the other hand, is gaining popularity because it weighs less compared to mono-bloc sleepers. Twin-bloc sleeper is made up of two concrete parts supported by steel reinforcements. However, handling and placing of twin-bloc sleepers can be difficult due to the tendency to twist when lifted.

Their economic and technical advantages are the results of longer life cycles and lower maintenance costs. The appearance of modern track in the form of long welded rail, wherein the heavy weight of sleeper become a positive asset. With their great weight, concrete sleepers assure optimal position permanence and stability even for traffic at high speeds. The higher structural stiffness of the concrete means a higher load is transfer to concrete sleeper which could lead to greater deterioration due to flexural cracks.

The problem because of heavy weight of concrete sleeper is that it requires specialised machinery and skilled labour during laying and installation. The initial cost of concrete sleeper is almost double that of hardwood timber sleeper. The main disadvantage of concrete sleeper is, the manufacturing of concrete

sleeper, their transport, laying and maintenance requires superior technology, which is not readily available in developing countries like India. The manufacturing plants generally have a heavy initial outlet. Also damage during derailment is excessive and no scrap value.

3. Steel sleeper

Steel sleepers are moderately used. Steel sleepers can be intermixed with the existing track but in a fixed intermixing pattern to reduce the variation in the track geometry and prevent the service failure of sleepers. A steel sleeper is lighter in weight than timber sleeper which makes it easy to handle as well as having a life span known to be in excess of 30-50 years. As steel sleepers stronger than wood and cheaper than concrete, they are usually considered as middle way between wooden sleeper and concrete sleeper. It is free from fire hazard and has good scrap value. However, steel sleepers are being used only on more lightly travelled tracks and are regarded as suitable only where speeds are 160 km/h or less.

A modern Y-shaped steel sleeper was developed to replace the traditional steel sleeper. From the name itself implies, the Y-steel-sleeper is shaped like a "Y" in its horizontal layout. Compared to the usual steel sleeper, the Y-steel-sleeper possesses much greater resistance against cross movements due to the greater amount of ballast contained between the two parts of the Y-fork. However, due to its form, laying of the Y-steel-sleepers should follow strict guidelines that require high output renewal trains. Practical experiences have proven that it is not possible to adjust or pull the sleepers in the ballast subsequently by means of a simple laying device.

Steel sleepers require extra care during installation and tamping due to their inverted through profile which makes them difficult to satisfactorily pack with ballast. Another concern is that manufacturing concrete and steel sleepers requires considerably more energy and is one of the largest producers of atmospheric carbon. The carbon dioxide emissions during the production of concrete and steel are 10–200 times higher than that of hardwood timber, respectively. Key type fastening subjected to high frequency vibrations under the influence of traffic get loose and need frequent

tightening. This results in enlarged holes, opening of the jaws and play between rail and the sleeper, affecting the track geometry quite adversely. Steel sleepers with their close spacing at the rail joints are difficult to pack.

III. NEED FOR ALTERNATIVE

Many railway infrastructure companies have long been trialling concrete and steel for replacing timber sleepers in existing railway tracks. However, this maintenance strategy has gained limited success. These materials did not prove to be a viable alternative to timber sleepers. Worldwide most of the maintenance and construction of railway tracks still utilised timber sleepers despite the increasing reliability and effectiveness of alternatives such as steel and concrete. It is often more financially viable or convenient in the short term to replace sleepers with new timber sleeper. Concrete sleepers have the ability to provide better line and gauge-holding characteristics than timber sleepers, but they are relatively expensive, quite heavy and are often incapable of providing a projected 30-50year service life. Sleepers made of steel, on the other hand, can offer superior strength over that of wood and concrete, but steel sleepers are being used in moderate quantities because of their high cost.

These problems have resulted in more premature failures and higher replacement rates of timber sleepers. Table I summarises the advantages and disadvantages of the currently used materials for railway sleepers. An alternative material for sleeper replacement to reduce maintenance cost and overcome problems encountered using traditional sleepers is therefore both desirable and necessary.

Properties	Timber	Concrete	Steel
Adaptability	Easy	Difficult	Difficult
Workability	Easy	Difficult	Difficult
Handling and installation	Easy	Difficult	Difficult
Durability	Low	High	Low
Maintenance	High	Low	High
Replacement	Easy	Difficult	Difficult
Availability	Low	High	High
Cost	High	Very high	Very high
Fasteners	Good	Very good	Poor
Tie ballast interaction	Very good	Very good	Poor
Electric conductivity	Low	High	Very high
Impact	High	Low	Medium
Weight (kg)	60-70	285	70-80
Service life (years)	20-30	60	50

IV. COMPOSITE SLEEPER

Plastic railway sleeper, also called composite sleeper, mainly refers to the railway sleeper made of the plastic composite. Plastic composite is a total modern material for making rail sleepers. It is the mixtures of plastic or waste rubber. Plastic sleeper combines the pliability of wood and durability of concrete. Composite material is made from two or more materials to obtain properties which are superior to the individual components. Each material combination will have different properties from one another. Plastic sleepers are a good alternative that can give solutions for specific problems in the track which are mentioned above. In recent years reinforced polymer sleepers have emerged as a potential alternative to traditional sleepers. Reinforced polymers can be designed to mimic traditional sleeper behaviour (an essential requirement for track maintenance) are almost maintenance free and are more sustainable from an environmental perspective. Despite this potential the implementation of these polymer sleepers in India has been extremely limited. The main reason for this is their price which has been approximately 5-10 times higher than that of a standard sleeper making them commercially unviable.

Three different types of polymer sleepers have been available in the market for some time. Both types of sleepers are conveniently referred to as “composite sleepers” however the composition and structural

behaviour of these sleepers are quite different.

Type:1– Polymer sleepers with short or no glass fibre reinforcement. These sleepers consist of recycled plastic or bitumen with fillers. The fillers often include sand, gravel, recycled glass or short glass fibres (shorter than 20mm) and they are generally included to increase the stiffness and/or crack resistance. Because of their short length these fillers do not have a major reinforcing effect and the failure behaviour of these sleepers is mainly polymer driven. Due to the lack of any long reinforcement fibres these sleepers are very flexible and expand and contract significantly with temperature, which can result in undesirable gauge widening.

Table II summaries the advantages and disadvantages of this type of polymer sleeper.

Advantages	Disadvantages
Easy to drill and cut	low strength
good durability	low stiffness
recycled material	limited design flexibility
reasonably priced	temperature sensitive
tough	creep sensitive
	low fire resistance

Type:2– Polymer Sleepers with long longitudinal glass fibres This type of sleeper has long continuous glass fibre reinforcement in the longitudinal direction and no or very short random fibre reinforcement in the transverse directions. The longitudinal flexural behaviour is mainly determined by the long glass fibres. The structural behaviour in the transverse directions (shear) is largely polymer based. This type of sleeper performs well in applications which are dominated by flexural loading (sleepers on ballast) but it is less than ideal in situations where they have to carry high shear forces (sleepers on bridges).

Table III summaries the advantages and disadvantages of this type of polymer sleeper.

Type:3 sleepers have long reinforcement fibres in both longitudinal and transverse directions and consequently both the flexural and shear behaviour are dominated by fibres. The structural performance of this sleeper can be engineered through the adjustment of the fibre reinforcements in each direction according to the specified performance requirements. In some cases, the disadvantage of a non-ductile behaviour of glass fibre reinforced polymer sleeper can be overcome by including some steel reinforcement bars. The ductile property is particularly important when the sleepers are installed in bridge, where sufficient warning before failure is expected. The excellent design flexibility, good flexural and shear strength, easy drilling and good fire performance are the key benefits of this sleeper. However, the production process of composite sleeper technologies under this category is quite slow which may increase the manufacturing cost. The sandwich polymer sleeper and the hybrid composite sleeper wherein fibres are oriented in the two directions to resist flexural stresses as well as shear forces falls under this category. A brief description of these sleeper technologies are provided in Table IV.

Table IV. Performance comparison of different types of composite sleeper.

Performance Measurement	Type:1	Type:2	Type:3
Density	850-1150	740	1040-2000
Modulus of Elasticity	1.5-1.8	8.1	1040-2000
Modulus of Rupture	17.2-20.6	142	1040-2000
Shear Strength	4	142	1040-2000
Rail seat compression	15.2-20.6	142	1040-2000
Screw withdrawal	31.6-35.6	142	1040-2000

Wahid Ferdous (2015) has worked on sleepers with

Item	Type of Bridge Sleepers		
	Wooden	Steel	Composite
Durability (years)	8-10	15-20	40-50
Weight (kg)	100-171	110	54
Replacement sleepers	Easy	Difficult	Easy
Handling	Not so easy	Difficult	Easy
Suitability for track circuited areas	Suitable	Problematic	Suitable
Cost per sleeper with fittings	Rs. 3500/-	Rs. 9500/-	Rs.19240/-
Life cycle cost (Rs./year)	402/-	575/-	385/-

short or no fibre reinforcements (Type:1) Sleepers that consist of recycled plastic (plastic bags, scrapped vehicle tires, plastic coffee cups, milk jugs, laundry detergent bottles etc.) or bitumen with fillers sand, gravel, recycled glass or short glass fibres (less than 20mm). The structural behaviour of these sleepers is mainly polymer driven. While some of these technologies introduced short glass fibre to increase the stiffness and/or resist crack, they do not have major reinforcing effect to improve the structural performance required for heavy duty railway sleeper application. The high demand for alternative sleeper

Table V. Comparison of some bridge sleepers

materials have resulted in. (Chattree R and Manoharan S, 2014) has highlighted on the aspect that Indian Railways have already adopted recycled High-density polyethylene (HDPE), crumbled rubber, glass reinforcement, mineral fillers, and some other patented items materials for use in bridge sleepers, and they also made a comparison of fibre reinforced plastic sleepers with wooden and steel ones (Table V). Their composites consisted of E-glass woven

fabric as the reinforcement and polyester as the resin. Polyester resin was also mixed with accelerator, hardener, fire retardant, and UV Stabiliser.

V. ENVIRONMENTAL BENEFITS

Recycled raw materials are used in manufacturing composite sleepers, diverting tonnes of would-be wastes from landfills to a productive, "clean" use. Composite sleepers are manufactured from recyclable materials and are 100% recyclable after production. Since composite sleepers incorporate readily available waste material in the manufacturing process, they have no harmful impact on environment. Because composite sleepers are recyclable themselves, there are no disposal issue. At about 118 kg each and about 1.2 million whole post-consumer tyres worth of recycled rubber granulate, using about 4 tyres-worth for each sleeper. Additionally, it has used about 22,000 tonnes of recycled HDPE, using about 70 kg per sleeper.

VI. CHALLENGES AND POSSIBLE SOLUTION

Despite many advantages of the newly developed composite sleepers, they have gained a very limited acceptance by railway industry. This section presents some of the common challenges encountered in using composite sleepers.

- **Price of composite sleeper-** The prohibitive costs of most composite sleeper technologies is one of the main reasons identified for their slow uptake in the market. The price of high fibre containing composite sleeper technologies (Type:2 and Type:3) is approximately 5–10 times higher than that of a standard timber sleeper. However, its lower life cycle cost is anticipated to offset its high initial cost, which to attract the attention of the railway industry, needs to be similar to, or insignificantly higher than, that of traditional ones. Similarly, optimising the manufacturing process and material usage would result in a more cost competitive sleeper product.
- **Low anchorage capability-** The low anchorage capacity of holding screw is another problem for Type:1 composite sleeper. It has been reported that the modified compound of a natural rubber composite sleeper (Type:1) showed a very stiff and inelastic

performance when holding the spike for a fastening system

- **Formation of material voids-** During the manufacturing process for a plastic composite sleeper there is a high possibility of voids being formed inside the materials. When in-service, voids can break and transfer stresses from one part to others which creates a stress concentration and later leads to local failure of a sleeper before the end of its design life.
- **Creep deformation-** The long-term performances of plastic sleepers (Type:1) are becoming a critical issue as their continuous service over time has a significant effect on their mechanical properties. It has been reported that, under sustained loads, a composite sleeper may be subjected to permanent deformation due to creep, the rate of which depends on the magnitude and duration of the stress and the temperature at which the load is applied. Because of the effect of creep and the subsequent stress relaxation, the fastening system tends to become loose, particularly in a curved track, which has an adverse effect on gauge holding. These effects may reduce the service life of a plastic sleeper.

Fibre composite sleepers are a relatively new technology compared to the more conventional hardwood, concrete or steel sleepers. Most of the fibre composite sleepers developed and trialled are very much in their formative stage. Thus, developments of specifications for this new material are intended to provide the necessary guidance in the design, manufacture and use of fibre composite railway sleepers. The specification should contain a minimum performance requirement for this innovative material. Performance testing should be continuously carried out on these new materials to ensure that they will carry the required loads and solve the maintenance issues in timber sleepers.

VII. CONCLUSION

This paper presents the comparison between the traditional sleepers and new plastic composite sleepers. Due to the use of a new innovative technology and a highly optimised shape, the new sleeper offers improved performance at a much more economical price. A number of composite sleeper technologies have

been developed in different parts of the world but their implementation in the market is extremely slow. The primary obstacles of their widespread application are their low anchorage capability, high price, low capacity of holding screw, formation of voids into the body of sleeper, and permanent deformation due to creep and temperature variations. Test results and performance of composite sleeper reveals that it can be an alternative of traditional sleepers. They require minimal labour for their installation, repair and maintenance. They release less amount of energy and produce minimum greenhouse gases. In composite sleepers recycled raw materials are used, hence waste in a large amount from landfill can be turned into a productive use. Adoption of composite sleeper proves to be less destructive to forests. Composite sleepers have comparable physical and chemical properties to traditional sleepers. The introduction of long fibre reinforcements will improve the strength and stiffness of recycled plastic sleepers. Continuous research and development are essential to develop the market and increase confidence in using this alternative material. Finally, development of national and international standards will encourage the adoption of fibre composites as an alternative railway sleeper material.

In the infrastructure sector, a new integrated approach is needed to sustain and satisfy the worldwide demand of natural resources. This research paper highlights the recycle and reuse of waste material can address the disposal problem and also create a resource for manufacturing economical units in transportation engineering.

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Feasibility to use of Fly Ash & Stone Dust as Partial Replacement with Cement & Sand in M30 Concrete

^[1] Aditya S. Dubewar, ^[2] Sumedh S. Shinde

^{[1][2]} Second Year Civil Engineering, MIT Academy of Engineering, Alandi(D), Pune

Abstract— Concrete has been used in various structures all over the world since last two decades. Recently a few infrastructure projects have also seen specific application of concrete. The development of concrete has brought about the essential need for additives both chemical and mineral to improve the performance of concrete. Most of the developments across the work have been supported by continuous improvement of these admixtures. Hence varieties of admixtures such as fly ash, stone dust have been used. An attempt has been made in the present investigation to study the behavior of concrete by Partial Replacement of Cement with Fly Ash and Sand with Stone Dust. To attain the setout objectives of the present investigation, Partial Replacement of Cement with Fly Ash and Sand with stone quarry dust Used in Concrete by 5, 10, 15, 20% and 30 % respectively to produce Concrete. Concrete is tested for Compression, split tension and flexural strengths. The results are quite encouraging for use of fly ash and stone quarry dust in producing Concrete.

Index Terms— Experimental, Investigation, Partial Replacement, Cement with Fly Ash, Sand with stone quarry dust.

I. INTRODUCTION

Concrete is a mixture of cement, sand, coarse, aggregate and water. River sand which is most commonly used as fine aggregate in the production of concrete. Many state Governments have imposed ban on sand mining from river beds. In such a situation quarry waste from crusher are being as an alternative to river sand.

Similarly, Indian thermal power stations are generating millions of tons of fly ash every year. Fly ash is a major product by waste material generated by the thermal power plants. Disposal of fly ash has become great problem and is aggravating day by day. Fly ash is characteristics to get heated very fast and cool down as well. Disposal and utilization of fly ash has become challenge all over the world. Engineers are continually pushing the limits to improve its performance with the help of innovative chemical admixtures and supplementary cementitious materials. The main benefit of fly ash are their ability to replace certain amount of cement and still able to display cementitious properties, thus reducing the cost of using Portland cement.

In India about 200 million tons of fly ash has been produced by 68 major thermal power station and

are likely to be double within a next 10 years. A partial replacement of cement with fly ash is desirable and indeed essential due to variety of technical, economic and ecological reasons. In the present work, primary aim is to study the feasibility of use of stone quarry dust, fly ash.

II. MATERIALS USED AND MATERIAL PROPERTY

A. Cement:

The cement used was Portland Pozzolana cement 53 (PPC 53). All properties of cement were determined by referring IS 12269 - 1987. The specific gravity of cement is 3.15. The initial and final setting times were found as 55 minutes and 258 minutes respectively. Standard consistency of cement was 30%.

B. Coarse Aggregate 20mm size aggregates:

The coarse aggregates with size of 20mm were tested and the specific gravity value of 2.78 and fineness modulus of 7 was found out. Aggregates were available from local sources.

C. Fine Aggregate:

The sand which was locally available and passing through 4.75mm IS sieve is used. The specific gravity

of fine aggregate was 2.60.

D. Stone Quarry Dust:

The particle size of crushed Fine Aggregate I.e. Stone Quarry Dust range from 4.75mm to 75micron and below. Presence of angular shape fractions give better interlocking properties since it binds each and every particle. The angular shape particles may impart improved qualities for split tensile strength & flexural strength of concrete.

E. Water:

The water used for experiments was potable water.

F. Fly Ash:

Fly Ash is one of the residue generated in the combustion of coal and transported by the flue gases and collected by electrostatics precipitator. Fly ash is generally captured from the chimneys of coal-fired power plants, and is the one of the two types of ash that jointly are known as coal ash; the other, bottom ash, is removed from the bottom of coal furnaces. Depending upon the sources and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide (SiO₂) and calcium oxide (CaO). Fly ash is varying in color from light to dark grey its depend on its carbon content.

•Advantages of Fly Ash in Concrete

- 1) It is a pozzolanic material.
- 2) It improves concrete workability and lowers water demand.
- 3) It generally exhibits less bleeding and segregation than plain concretes.
- 4) It is Sulfate and Alkali Aggregate Resistance.
- 5) It has a lower heat of hydration.
- 6) It is generally reducing the permeability and adsorption of concrete.
- 7) It is a raw material.

III. PROPERTIES OF CONCRETE

A. Fresh Concrete Properties

• Workability:

The property of fresh concrete which is indicated by the amount of useful internal work required to fully compact the concrete without bleeding or segregation in

the finished product. To serve this Slump Test is performed.

1. Slump Test

Fresh concrete when unsupported will flow to the sides and sinking in height will take place. This vertical settlement is known as slump. The workability of concrete depends on wetness of concrete i.e., water content as well as proportions of fine aggregate to coarse aggregate and aggregate to cement ratio. This test is performed by filling fresh concrete in the mould and measure the settlement i.e., slump.

2. Compaction Factor Test

The sample of concrete to be tested is placed in the upper hopper up to the brim. The trap door is opened and the concrete is allowed to fall into the cylinder. The is filled up to the top level of the cylinder. This weight is known as “weight of partially compacted concrete.” The cylinder is emptied and then refilled with the concrete from the same sample in layer approximately 5 cm deep. the layers are heavily rammed to obtain full compaction. this weight is known as “weight of fully compacted concrete.”

B. Hardened Concrete Properties:

1. Compression Test On Concrete

The concrete has been tested using nominal maximum size of aggregate 20mm test specimens of size 15cm x 15cm x 15cm are prepared and tested after 7 days, 14days, and 28days of curing.



Fig. Curing



Fig. Compression Test

2. Split Tensile Test

The concrete has been tested using nominal maximum size of aggregate 20mm test specimens of 15cm diameter and 30 cm height are prepared and tested after 7 days, 14days, and 28days of curing.



Fig. Split Tensile Test

3. Flexural Test On Beams

The concrete has been tested using nominal maximum size of aggregate 20mm test specimens of size 10cm x 10cm x 50cm are prepared and tested after 7 days, 14days, and 28days of curing.



Fig. Flexural Strength Test

IV. MIX DESIGN

Mix design is the process of selecting suitable ingredient of concrete and determines their relative proportions with the object of certain minimum strength and durability as economically as possible. Mix design has been carried out for M30 grade of concrete for conventional ingredients by I.S. Method (IS 10262-1982).

1. Mix Design for M30 Concrete as per Indian standard recommended method of concrete mix design (IS 10262-1982).

i. Characteristic compressive strength required in the field at 28 days.

$$f_{ck} = 30 \text{ Mpa}$$

ii. Target mean strength of concrete

$$F_t = f_{ck} + 1.65 S$$

$$F_t = \text{Target mean strength}$$

$$f_{ck} = \text{Characteristic strength}$$

$$S = \text{Standard deviation} = 5.00$$

$$F_t = 30 + 1.65 (5)$$

$$= 38.25 \text{ Mpa}$$

iii. Maximum size of aggregate = 20 mm

iv. Assume w/c ratio as 0.45

v. Selection of water & sand content

For 20 mm maximum size of aggregate, water content per cubic meter of

Concrete = 300 kg & sand content as % of total aggregate = 35 %

Select water content = 300 kg

vi. Determination of cement content

W/c ratio = 0.45

Cement = 186/0.45

= 413.33 kg/m³

vii. Determination of coarse & fine aggregate contents

$$V = [w + c/S_c + f_a/p \cdot S_{f_a}] / 1000$$

$$0.98 = [300 + (413.33 / 3.15) + \{(1/0.35) \times (F_a/2.66)\}] \times 1/1000$$

$$F_a = 510.918 \text{ kg/m}^3$$

$$C_a = [(1-p) / p] \times f_a \times (S_{c_a} / S_{f_a})$$

$$= (1-0.35/0.35) \times (510.918 \times 2.85/2.26)$$

$$C_a = 764.660 \text{ kg/m}^3$$

Where,

V = absolute volume of fresh concrete, which is equal to gross volume(m^3) Volume of entrapped air,

W = Mass of water (kg) per m^3 of concrete

C = Mass of cement (kg) per m^3 of concrete

S_c = Specific gravity of cement

P = Ratio of FA to total aggregate by absolute volume

F_a, C_a = Total masses of FA and CA (kg) per m^3 of concrete respectively and

$S_{fa} S_{ca}$ = Specific gravities of saturated, surface dry fine aggregate and coarse aggregate respectively.

Mix Proportion then becomes

Cement Fine Aggregate Coarse aggregate

413.33 510.918 764.660

1 1.23 1.84

Mix proportion for M30 grade of concrete is 1 : 1.23 : 1.84

2. Investigational work conducted on concrete by replacing cement with flyAsh and sand stone dust with 0.5 % super plasticizer.

• Preparation of Specimens

Constant parameters

Mix proportion of concrete selected : 1:1.23:1.84

Type of cement : PPC

Type of aggregate

i. Sand : <1.47mm

ii. Stone dust : 150u – 4.75 mm

iii. Coarse Aggregates for compressive Test and split tensile test : <25mm

Period of curing : 7, 28 days

Super plasticizer : 0.5 %

Water cement ratio : 0.45

• Variable Parameters

Cement replaced by fly ash from 0% to 15% at the increment of 5%

• Details of mix designation:

Sr. No.	Mix Designation	Binding materials		Fine aggregate		Coarse aggregate	Admixture Super Plasticizer
		Cement	Fly-ash	Sand	Stone dust		
1.	F05	95%	5%	70%	30%	100%	0.5%
2.	F10	90%	10%	70%	30%	100%	0.5%
3.	F15	85%	15%	70%	30%	100%	0.5%
4.	F20	80%	20%	70%	30%	100%	0.5%

V. TEST RESULT

A. Effect of fly ash on Compressive Strength of concrete (N/mm²)

Mix Designation	7 Day	14 Day	28 Day
F05	23.51	25.65	32.30
F10	22.23	24.69	31.20
F15	19.22	21.79	26.93
F20	14.80	17.88	19.42

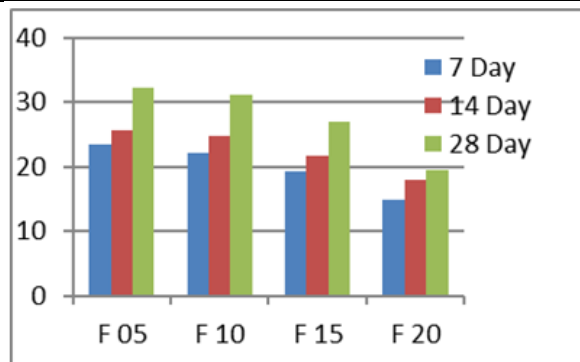


Fig. Variation in Compressive Strength

B. Effect of fly ash on split tensile Strength of concrete (N/mm²)

Mix Designation	7 Day	14 Day	28 Day
F05	2.33	3.32	3.79
F10	2.13	3.04	3.56
F15	1.88	2.75	3.23
F20	1.82	2.68	3.11

VI. DICISION

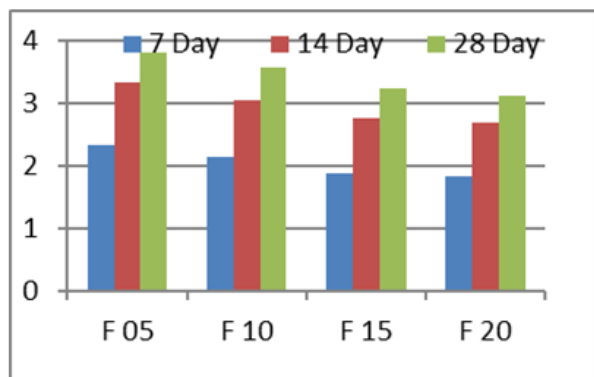


Fig. Variation in split tensile Strength.

C. Effect of fly ash on flexural Strength of concrete (N/mm²)

Mix Designation	7 Day	14 Day	28 Day
F05	2.22	4.08	6.68
F10	1.95	4.32	5.86
F15	1.81	3.90	5.43
F20	1.66	3.80	4.98

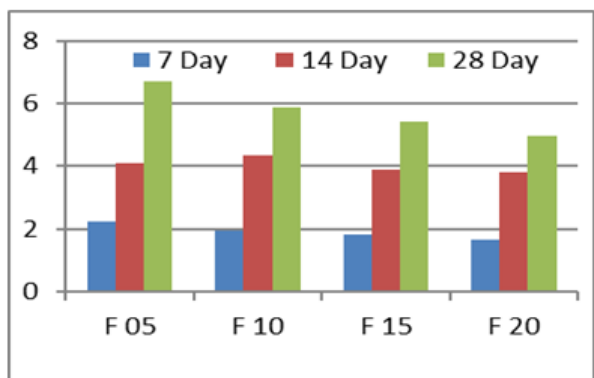


Fig. Variation in flexural Strength

Where,

F05 - 5% Replacement of Cement with Fly Ash & 30% of Sand with Stone Dust.

F10 - 10% Replacement of Cement with Fly Ash & 30% of Sand with Stone Dust.

F15 - 15% Replacement of Cement with Fly Ash & 30% of Sand with Stone Dust.

F20 - 20% Replacement of Cement with Fly Ash & 30% of Sand with Stone Dust.

- Due to addition of fly ash workability of concrete is reduced to vary low, hence there is need to super plasticizer.
- Compressive strength of concrete found within limit, up to 10% replacement, beyond which it reduces.
- Compressive strength of concrete is found to be good up to 30% replacement of sand with stone quarry dust.
- Split tensile strength and flexural strength of concrete goes on decreasing with the increase in percentage of added fly ash.

CONCLUSION

From the experimental investigation it can be concluded that,

- Concrete mix M30 (Design mix 1:1.2:1.8) gives satisfactory mechanical properties like compressive strength, split tensile strength and flexural strength up to 10% replacement of cement by fly ash and 30% replacement of sand by stone quarry dust with 0.5% super plasticizer.
- Concrete mix with above ingredient can be called as green concrete which should be promoted for its use which indirectly help to save environment and economy.

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Innovations in Transforming a Traditional Building into Green Building

^[1] Aishwarya Kodnikar, ^[2] Sneha Hajare, ^[3] Shubham Thorat, ^[4] Shantini Bokil

^[1] Research Students, ^[2] Professor and Head

^{[1][2][3][4]} Department of Civil Engineering, MIT, College of Engineering, Pune, Maharashtra, India.

Abstract— Implementation of sustainable practices in construction sector is not new; this concept has already gained tremendous importance worldwide. It includes many aspects such as environmental, social, economic etc. With the increasing awareness of sustainable development in the construction industry, today's market is full of innovative green building materials and technologies. The rating systems like LEED are becoming universal so as to measure and verify the sustainable practices employed in the design, construction, and operation of commercial real estate in the world. Despite the increasing adoption of the LEED Rating Systems, the knowledge of how to “green” existing buildings through the implementation of sustainable practices remains largely unfamiliar to the real estate industry. The driving force behind implementing green practices in existing buildings is knowledgeable and diligent. Unlike fulfilling green building requirements for new construction, converting existing buildings into green buildings requires an ongoing commitment to monitor building systems, train staff, and keep up to date with certification requirements. By doing so, we can save up to 30-40% of water, 40-50% energy and 20-40% of construction material. While this may seem like added work with added costs, the financial benefits of pursuing green practices are pronounced and long lasting.

Keywords: Sustainability, growing awareness, “green” existing buildings, financial benefits

I. INTRODUCTION

A green building uses less energy, water and other natural resources, creates less waste & Green House Gases and is healthy for people during living or working inside as compared to a standard building. Another meaning of Green Structure is clean environment, water and healthy living. Green building is not about a little more efficiency, it is about creating buildings that optimize on the local ecology, use of local materials and most importantly they are built to minimize power, water and material requirements. Thus, if these things are kept in mind, then we will realize that our traditional architecture was in fact, very green. Today, we have forgotten how to create a natural environment, instead we are copying it from developed countries. Buildings are a major energy consuming sector in the economy. About 35 to 40% of total energy is used by buildings during construction. The major consumption of Energy in buildings is during construction and later in lighting or air-conditioning systems. This consumption must be minimized. Possibly, this should be limited to about 80-100 watts per sqm.

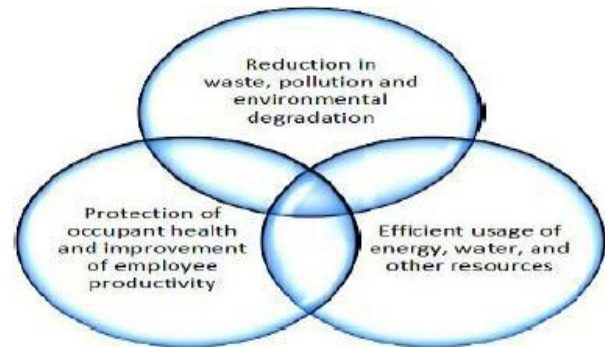


Fig-1: Parameters defining green building concept

Green building in India is experiencing major growth. According to the World Green Building Trends 2016 Smart Market Report, green construction in the country accounts for 37 percent of respondents' total work. What's more, those surveyed estimate that by 2018, it will be 57 percent, the second highest among all countries taking part in the survey.

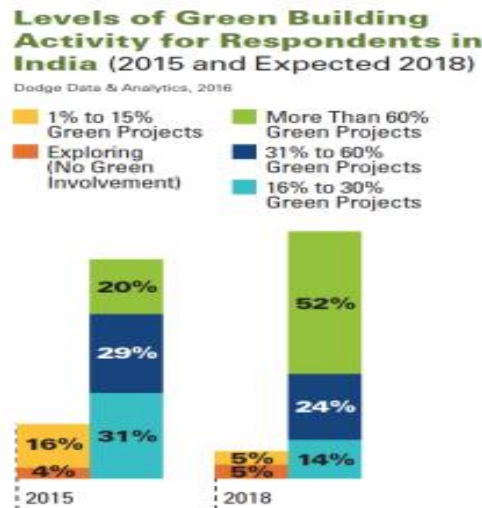


Fig 2: Level of Green Building Activity

Despite of the increasing demand of green building concept in India, the knowledge of how to convert existing buildings into green building through various sustainable practices remains largely unfamiliar to the real estate industry. The real estate industry lacks the data of how to “green” an existing building by implementing sustainable practices. While the LEED Rating System for New Construction was launched in 2000, the Rating System for Existing Buildings was only introduced to the market in late 2004. As of February 2007, there were a total of 715 LEED certifications, 550 of which represented new construction, while only 45 represented existing buildings. Of the existing buildings rated, almost all were single tenant buildings. Education, training, and experience remain barriers to implementing green practices in existing buildings. The USGBC now offers training and exams for LEED Accredited Professionals working with existing buildings.

Green practice in the existing buildings can help address national issues like water efficiency, energy efficiency, reduction in fossil fuel use in commuting, handling of waste and conserving natural resources. Most importantly, these concepts can enhance occupant health, happiness and well-being.

Against this background, the Indian Green Building Council (IGBC) has launched ‘IGBC Green Existing

Building O&M Rating System’ to address the National priorities. By applying IGBC Green Existing Building O&M criteria, existing buildings can be sustainable over the life cycle of the building. This rating program enables the building owner / developer to apply green concepts and criteria, so as to reduce the environmental impacts, which are measurable.

Green existing buildings can have tremendous benefits, both tangible and intangible. The most tangible benefits are the reduction in water & energy consumption. The operational savings through energy & water efficiency could range from 15 - 30 %. The consumer waste generated in the building can also be substantially reduced. Intangible benefits of green existing buildings include enhanced air quality, health & higher satisfaction levels of occupants.

II. LITERATURE REVIEW

1. IGBC Green Existing Buildings O&M Rating System-Pilot Version

IGBC Green Existing Building O&M is the first rating program developed in India, exclusively for existing building stock. It is based on accepted environmental principles and strikes a balance between known established practices and emerging concepts. The system is designed to be comprehensive in scope, yet simple in operation. Green existing buildings can have tremendous benefits, both tangible and intangible. The most tangible benefits are the reduction in water & energy consumption. The operational savings through energy & water efficiency could range from 15 - 30 %. The consumer waste generated in the building can also be substantially reduced. Intangible benefits of green existing buildings include enhanced air quality, health & higher satisfaction levels of occupants.

National Priorities Addressed-

- Water Conservation: Most of the Asian countries are water stressed and in countries like India, the water table has reduced drastically over the last decade. Green Existing Buildings O&M Rating System encourages use of water in a self-sustainable manner through reducing, recycling and reusing strategies. By adopting this rating program, green existing buildings can save potable water to an extent of 15 – 30%.

- Handling of Consumer Waste: Handling of waste in existing buildings is extremely difficult as most of the

waste generated is not segregated at source and has a high probability of going to land-fills. This continues to be a challenge to the municipalities which needs to be addressed. IGBC intends to address this by encouraging green existing buildings to segregate the building waste.

●**Energy Efficiency:** The building sector is a large consumer of electrical energy. Through IGBC Green Existing Building O&M rating system, buildings have scope to reduce energy consumption through energy efficient-lighting, air conditioning systems, motors, pumps etc. The operational energy savings that can be realized by adopting this rating program can be to the tune of 15 – 30%.

●**Reduced Dependency on Virgin Materials:** The rating system encourages projects to use recycled materials, and discourages the use of virgin wood during renovation, thereby, addressing environmental impacts associated with extraction and processing of virgin materials.

●**Health and Well-being of Occupants:** Health and well-being of occupants is the most important aspect of Green Existing Buildings. IGBC Green Existing Buildings O&M Rating System ensures minimum ventilation aspects, occupant well-being facilities which are critical in a building. The rating system also recognizes measures to minimize the indoor air pollutants.

2. Jigneshkumr R. Chaudhari¹ and Prof.Keyur D. Tandel's paper "Energy saving of Green Building Using Solar Photovoltaic Systems" states the idea of green buildings promotes use of renewable energy, recyclable & recycled products Green building design reduces energy consumption over its lifetime. Green building has to save water 36-40%, save energy 30-40% and save material 25-40% compared to conventional building. Green building is which one high thermal insulations, Rain water harvesting, terrace gardening, ventilation and energy efficient appliances.

III. METHODOLOGY

We have carried out analysis of green retrofitting in existing residential building; and for that purpose we have selected a residential building- Swami Krupa, Pune, India. In this survey we have analyzed the existing energy and water consumption of the total 6 flats - 3 flats of 2BHK and 3 flats of 1BHK. With the

help of this data we calculated the energy and water consumption of the building by implementing the green concepts like solar photovoltaic panels, rain water harvesting and WTP. Also, we suggest some green concepts to convert the existing traditional building to green building. These are as follows:

ENERGY CONSERVATION:-

1. Energy conservation through lighting systems:

1. Use compact fluorescent lamp (CFL) in place of incandescent lamps.
2. Commonly T12 fluorescent tube is used which consumes 40W power by tube plus 10-18W power by electromagnetic ballast. Replace these lamps with more efficient T8 or T5 lamps.
3. Use of metal halide lamps in place of LPMV or HPSV lamps.
4. Use LED lighting.
5. Proper installation of luminaries.
6. Improving lighting control (Occupancy Sensors).
7. Use maximum daylight.
8. Proper maintenance.
9. Energy management systems.

(B) Solar photovoltaic system:

In solar photovoltaic system solar energy is directly converted to electric power. This makes the system far more convenient and compact compared to thermal methods of solar energy conservation. It uses the energy of visible and infrared regions of the solar radiations for conservation into electric power.

Items	Wattage	No s.	Approx. Working hours per day	Energy consumption (wh/day)
Incandescent lamps	60	21	7	8820
Fluorescent tubes in Flats	40	24	7	6720
Fluorescent tubes in common area	40	15	10	6000
Fan	70	21	5	7350
Computers	100-200	6	3	2700

Refrigerators	225-500	6	10	21750
T.V.	210-400	9	10	27450
Microwave	800-1000	5	1.5	6750
Heater/Geyser	1000-1500	5	1.5	9375
Mixer	150-450	6	0.5	900
Iron	40-60	6	0.5	150
Washing Machine	600-800	6	2	8400
Radio	50-200	4	2	1000
DVD	80-85	3	2	495

If in place of Incandescent lamps, we use CFL lamps of 15 watts then we can save up to 205.065 KWh per month and in place of Fluorescent tubes if we use LED tubes of 18 watts then we can save up to 216.876 KWh per month. That is a total of about 422 KWh/month and around 10-12% of total energy consumed in the building.

If we use a solar system of 5kW as a renewable source of electricity, we will need 20 solar panels (250W panel). The panel will be about 1.6m x 1m, so you'll need at least 32m² of roof space, to give you a feel for how big 32m² is, this picture may help (fig 1). This 5kW solar system will generate approximately 23kWh per day, depending on the location and a variety of other factors. This will further save approximately 18-20% of the building electricity consumption.

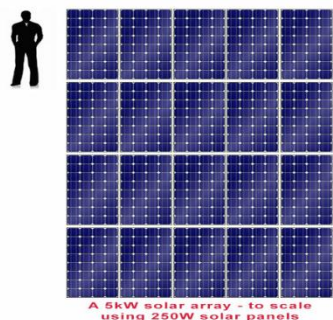


Fig 3: 5kW solar panel- using 250W panels

(C) Eco-friendly refrigerants and halons - To encourage the use of eco-friendly refrigerants and halons in the facility, thereby minimizing leakage in the atmosphere and the resultant impact on the ozone layer.

(D) On-site renewable technologies- Encourage the use of on-site renewable technologies to minimize the environmental impacts of generating energy through fossil fuels and demonstrate renewable energy generation for at least 2.5% of total annual energy consumption of the building.

(E) Energy metering and monitoring - Encourage continuous energy monitoring to identify improvement opportunities in energy performance of building

WATER CONSERVATION:-

Principles of Conservation: While talking about any conservation, we should remember the basic principles as shown below:

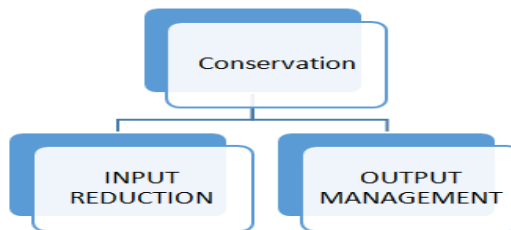
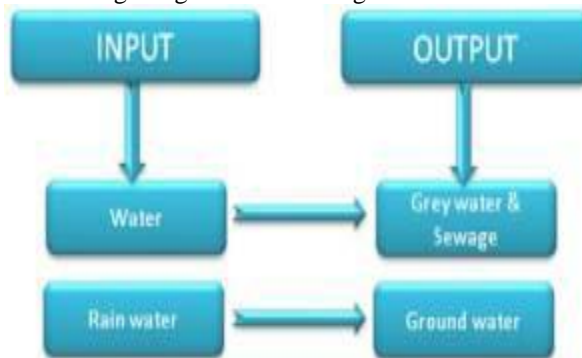


Fig 4: Basic principles of conservation

Methods for water conservation may reduce input, output, or both. Here it is shown how water changes its form after getting used in buildings.



**Fig 5: Input & output process of water in buildings
Reduce Consumption**

A cursory look at the statistics of water consumption in different types of buildings will reveal which areas need to be stressed upon so that we can make an effective reduction in the consumption of water at all levels.

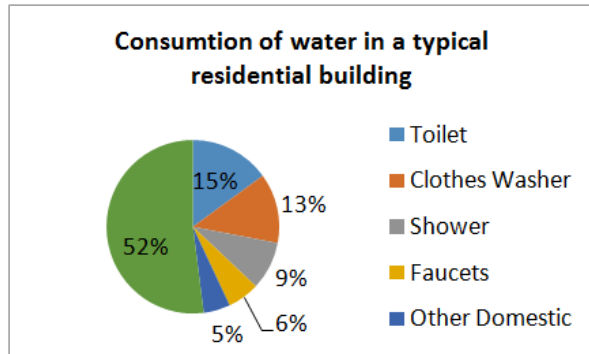


Fig 6: Consumption of water in a residential building

On an average we can see that the major portion of water goes in flushing and outdoor purposes in residential buildings and in commercial buildings, air conditioning and cooling also plays a significant role. This makes very clear what our major thrust areas should be. Few of the methods which can help are discussed below:

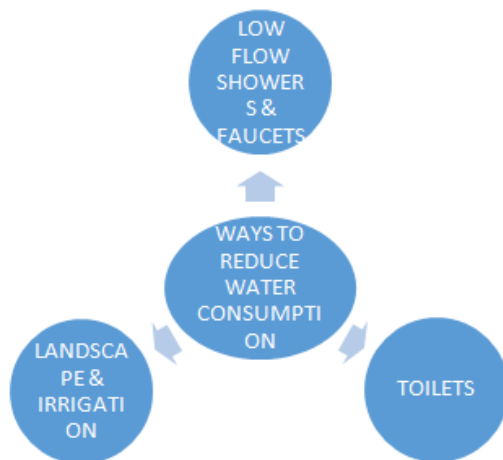


Fig 7: Methods to reduce the consumption of water

A. Reuse Water Onsite

Apart from planning for efficient consumption of water, the professionals should design plumbing systems so as to allow reuse of water onsite. Water consumed in

buildings can be classified as two types:

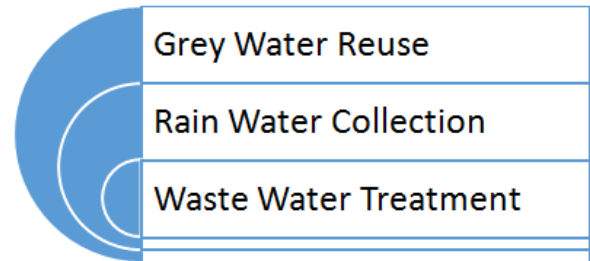


Fig 8: Methods that can be adopted to reuse water onsite

B. Grey Water reuse

“Gray water” is wastewater collected from clothes washers, bathtubs, showers, and laundry or bathroom sinks. If properly collected and stored, it can be safely re-used, thereby reducing fresh water consumption, along with reducing the load on septic tanks. Hence it can be recycled within a building, either to irrigate ornamental plants or flush toilets by separating grey water through well-planned plumbing systems.

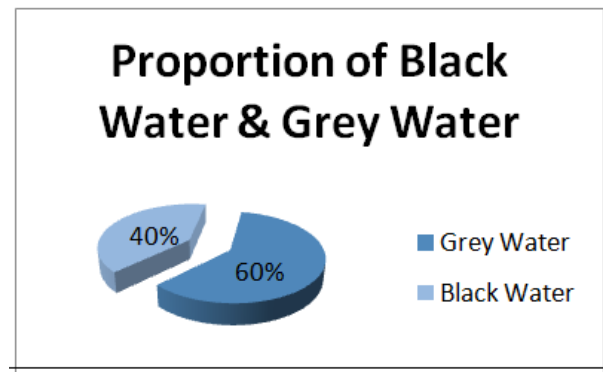


Fig 9: Proportion of Black water & Grey water in a typical building

C. Sewage / Black water treatment:

Perhaps the most significant difference between black water and grey water lies in the rate of decay of the pollutants in each. By separating black water we can utilize it as odor-free fertilizers and a valuable soil conditioner and even save the ground water from pollution. Since it is an expensive process, at small

scale, the black water is generally disposed into the main sewer and in buildings at large scale like commercial and industrial buildings, separate Sewage Treatment Plants are installed to treat the black water and recycle the soft water for air cooling and irrigation. Following is the process shown for that:

Rain Water collection:

1. By providing impermeable surfaces on the plot, such as bare ground or pavement, or roof with gutters and downspouts, some rain can be captured and directed to the landscaping.
2. Surface runoff can be directed to turfed areas or shallow basins around trees and shrubs by contouring the land surface. The goal is to collect the runoff, direct it to where it can be of use, and slow it down so it has time to soak into the ground.
3. Rain that falls onto roofs can not only be directed to landscape plants, it can be stored in tanks or rain barrels for later use in car wash, firefighting or toilet flush etc.

HEALTH & COMFORT

- A. Smoking is prohibited- Minimize exposure of non-smokers to the adverse health impacts arising due to passive smoking in the building.
- B. Fresh air ventilation- Provide adequate outdoor air ventilation so as to avoid pollutants affecting indoor air quality.
- C. Carbon dioxide Monitoring & Control- Continuously monitor and control carbon dioxide level in the building to provide occupant comfort and well being
- D. Eco-friendly Housekeeping Chemicals- To encourage the use of eco-friendly housekeeping chemicals so as to reduce adverse health impacts for building occupants
- E. Occupant Well-being Facilities- The project has at least 2 occupant well-being facilities (such as gymnasium, aerobics, yoga, meditation or any indoor / outdoor games) to cater to at least 10% of building occupants)

INNOVATION CATEGORY

- A. Accredited professionals- To involve green building accredited professionals in the project so as to facilitate design & implementation of environment friendly measures

B. Terrace Gardens- Terrace gardens help to maintain the internal temperature of the building. The vegetation on the roofs helps to create a healthier environment and also keeps the temperature cooler.

C. Insulated water tank- A water tank is installed which receives the hot water from the solar and it stores and supplies the hot water as per the requirements. This concept ensures equal distribution of hot water throughout the day.

CONCLUSION

In conclusion, we can say that, by implementing the above mentioned green concepts, we can transform an existing building into a green building which will save approximately 20-22% of energy consumption. Along with it the water is also conserved, recycled and reused for various purpose using green methods. By planting vegetation around the plot and on the roof, we can ensure healthy and cooler environment and thus improve the quality of living for the occupants. These concepts conform with the IGBC norms for existing green buildings and helps the building get a LEED recognition. Such initiatives will also encourage other engineers and builders to adopt green practices and promote sustainability not only in new construction but also in the existing structures.

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“Retrofitting Of Existing Building As Per IGBC Existing Building Norms – A Review” BY Vijay Katarial, Hemant Salunkhe in International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 4, Issue 1, pp: (250-253), Month: April 2016 - September 2016.

Nahar-E-Ambari a Case Study: Rebirth and Recommendation for Medieval Water Supply System (Part I)

^[1] Anand G. Pagare, ^[2] Ajay P. Sawant, ^[3] Kishor Y. Lokhande, ^[4] Mayuri K. Patil, ^[5] Sarna D. Girhe
^{[1][2][3][4][5]} UG Students, International Center Of Excellence In Engineering And Management, Aurangabad..

Abstract— This paper present on the ancient water management system (Nahar-E-Ambari) was one of the pure and preferable sources of water in Aurangabad city. And it's built by Malik Ambar in 1617 A.D. it is design for population of 7 Lakh. On the high land around the city from north, east and south wherever the circumstances allowed the engineers of the period brought down Nahar in Aurangabad city. In city of Aurangabad was having number of Nahars of pure minerals subterranean drinking water.

The inhabitants of Aurangabad where being benefitted by this water supply system since 300 years regularly without any tax. In over paper, the technical detail of Nahar system is discussed in depth. It is world 2nd number water management system based on symphonic action in working condition, but now days it was break down and with the age, the rupture and break down began and Destroy. In this report we will study and analyzing parameters like mapping of aqueduct and manholes by GPS water quality parameters (physical, chemical and biological) and we recommended various norms like renewal of Nahars, water filter plant for at specific station, replacement of old pipeline system, various repairing method improve water quality and utilization of water use for in public sector like drinking, gardening, street washing, public toilets.

Keywords: Nahar-E-Ambari, GPS, Siphon, Air Towers, Gaimukh Aqueduct, Google Earth, etc.

I. INTRODUCTION

In the history of Aurangabad Malik amber in 1617 A.D. introduced memorable system of water supply. Aurangabad city always faced scarcity of water and there were no big dams or water reservoirs in the vicinity. Owing to hard rock and dry land it was very difficult to construct the pillars to supply water to the town. So this was the great feat of medieval engineering achievement. Malik amber in 1617 ad discovered subterranean water table of mountainous elevated valleys in north of Aurangabad. He practically manipulated and procured a stable perennial water supply for a population of 50000 of people by constructing his unique wonderful aqueduct by name Khair – E- Jari. The old water supply system is the reminiscent of medieval period. When we enter the town, we find numerous buildings, palaces, tombs, mosque, fortifications around the town, but same time, we see high rectangular or round pillars erected on the roadsides. These high pillars are called “distribution chambers” which clearly indicate the medieval system

of supplying water.

The city of Aurangabad was having number of Nahars of pure mineral subterranean drinking water. This practice of construction of such aqueducts continued from the period of Malik Ambar (1617) up to the time of Aurangzeb and Asif Jan (1803) for a period of about two centuries. On the high lands around the city from north, east and south wherever the circumstances allowed the engineers of the period brought down Nahars in Aurangabad city.

Personalities like Malik amber, shah Mehmood of Panchakki and Shah Ali Nehri are founders, designers and planners of these three famous, wonderful easy and useful aqueduct system of Aurangabad. During the long period of three and half centuries this unique, god gifted old water supply system prevailed and lasted up till now, the inhabitants of Aurangabad were being benefitted by this water supply system since three hundred years regularly without any tax.

During the military activities, Malik Ambar discovered the Kham river valley and its large natural basin of about 150 sq. Miles over head of a well planned and

layout city. Malik amber has designed the construction of the aqueduct in a very simple appearance and natural way underneath the river bed of Sawangi and Kham River which has got number of man holes over head called Abgir Nali Upto Gaimukh. An earthen dam was constructed on the river Kham on the north of Aurangabad city.

NAHAR-E-AMBARI:

Nahar-E-Ambari is a living memorial of Malik Ambar. He constructed this canal in 1029 A.D and died in 1035. This is the biggest of all canals and still exists. In the Northern direction of Aurangabad there is a range of mountains, but the most famous mount is Ju-Ban. Adjacent to this mountain the Sangvi town is located. A mile away from this town is the origin of this canal. The total length of this canal is 4450 m. There was no distinct mark on this canal before 400m. But after 400m, Fateh Bhai, administrator of Aurangabad marked on this canal from beginning to the end. He also constructed in his supervision high & strong man holes. Due to these man-holes the cleaning & maintenance of the canal was easy. At the beginning of this site there is a man-hole & at the end of it is Gaimukh. The difference of height these sites are 140 feet from the highest point of the town its starting point is 48.8 m high. So the flow of this canal is based on the natural process of gravity modern engineers think, that it is underground streams of water. At the beginning man-hole was buff with porous bricks so that large quantity of water enter into it & the flow of natural underground streams of water also continues. At the complete length of this canal there are 100 man-holes through these the cleaning of the canal is performed. Sawangi River is almost parallel to this canal. On one side of the river is canal Ambri & on the other side which is comparatively higher is Nahar-e-Nasrullah. The floor of the canal is lower at many places the canal is dug in the porous layers of the ground so that large quantity of water may be supplied by the percolation. The peculiarity of this canal is that the water filters into it and the quantity of water also increases. At the beginning, they confined the natural underground flowing water and diverted into the canal subsequently so that the canal flows permanently.

The canal is in fact an underground stream of water. Its sectional area at the length of the canal is different,

sometimes it is broader & sometimes it is narrow. This difference is due to the slope of land. Its shape and cutting is normally rectangular but sometimes it is trapezoidal the average width is 0.75 m and height is from 0.75 m to 4.5 m. The canal is dug very deep under the ground but there is no masonry work on its two vertical sides. But above the vertical sides an arch of lime & brick is built. Bricks are red in colour and smaller in size. The rise of the arch is not more than 7 to 9 cm. The conduit of this canal is like a tunnel. Above this arch, earth filling is done so at some places the agriculture is also done. Man holes are strong and high rectangular tanks on which are stone coverings are fitted. So that the time needs it can be removed easily and the man could enter into it and clean it. There is a network of masonry pipe from Gaimukh. There is a particular reason because from that point, the land is uneven so it was not possible to supply water by the siphon system. There were two branches of the pipe lines one used to go Upto Bara Dari Khurd-E-Kallan and second used to supply water to the remaining population of the town. The clay pipes are circular and its radius is 20 cm at the ends of these pipes are sockets by which they were connected and then they become solid and also the size of the pipe becomes longer. On the line of pipe in the town there are some hollow pillars made up of bricks & lime & they are called air-tower.

The purpose of the construction of these air-towers was that the air of pipes should be passed because these pipes are weak and they cannot bear the pressure of water secondly each air tower created pressure in water and in order to create velocity in the forward line of pipes so that it could get head of water and maintain balance. These air towers are often circular or rectangular. Out of these some are higher and some are less high for the pressure and head of water. In the solid towers, at the proper distance, there are manholes for the distribution of water. Irrespective of weather, the water was distributed in the different streets through these holes to the taps. Whenever they wanted to close these holes, the lids of wood were fitted. Out of these towers, they are some main (principal) towers & some are branch tower. The branch towers were connected to the common tanks and houses. Each tower has two vertical lines of pipes & they are parallel from pipe the water comes up and falls down from the other pipes and

flows faster forward. For common people there were tanks in each street royal & rich people used the pipe connection and tap water stored water in the tanks of their garden.

The recent water supply system of Aurangabad is a link of this chain. In this recent system the whole length of the canal is kept like the past Upto Gaimukh but they some changes e.g. in the town instead of clay-pipe the new system pipes are laid down. This modern system of the net of taps is a part and parcel of Ambari system. Initially there were proposals of constructing a huge dam for the water supply of the town. But this scheme was very expensive and there were no huge sources of water like dam, river and wells in the town. So keeping in view the high expenditure required for this project the director of the water supply Mr. Ahmad Mirza continued Nahar-E-Ambari as a source of water which is completed in the supervision of the chief and asst. Engineer. After the cleaning and restoration of the Nahar-e-Ambari canal at some distance of Gaimukh a setting tank is constructed. First the water stores in this tank and accumulates into clear water chamber and then by the chemical action it is cleaned and then falls down into service reservoir. Distribution reservoir is made inside Delhi gate. In this reservoir filtered water is deposited and the from here it is distributed in the town cleaning of water is done either by the bleaching powder or chlorine. Although there is no heavy rains in the recent years and while cleaning the canal all the old principles were not followed, with which the ancestors were familiar. However, the Nahar-E-Ambari is being utilized for the supply of water except a few Hanes which are at the highest level. In older times the water was distributed permanently. But in recent times it is done intermittently and that is two hrs in the morning and two hrs in the evening. From Gaimukh to inside city instead of clay pipes the metallic pipes are put so that they could bear the pressure of water. In these pipes the main pipe of R.C.C. is put and others are metallic. Another small distribution of water supply was made little away from the Paithan gate at Kala Chabotra. From this centre the water was supplied to a number of lanes. This Kala Chabotra is constructed by Malik Ambar. He uses to check his military from here. This reservoir is at higher level so the pump was used to fill the reservoir. For common people in the various lanes common tap or public stand post were founded. In

the hours of rich needy the connection of water was given by the iron pipes.

When we compare our water supply system with the present system, we find a huge difference in indigenous system a single paisa was not spent abroad, but the whole amount was spent at the same place and if is utilized in the vicinity where there was no extra expenditure in filtering, depositing, cleaning or distributing the water. The water supply system of Aurangabad is on a very large scale but for the maintenance hardly little amount is spent and despite the meager spent on this old project, it continues to supply water over 300 years.

Planning Designing and Construction of Old Water Supply System:

The old system of water supply was dependent on the canals. If we try to find out the origin of these canals outside the town we will find only huge land fields. At the origin there is neither any construction work nor deposit of water. As the origin of these canals are either in the lap of mountain or in the vicinity of river. Under the principle of gravitational power these canals were dug in the porous levels of land and they flow in the natural way. Geographically the town is surrounded by the mountains from all sides. The town is located in the valley. Hence most of the canals start from the mountainous field and end in the town. The most interesting and absorbing thing is the simplicity and uniqueness of these canals. There is no technical complication but still it is running successfully. Each canal is divided into two parts. First is conduit (large pipe or water way) and the second part is a net of masonry pipes on which they erected rectangular or round pillars sometimes they are higher in a size and sometimes smaller. The cross sectional area of these conduits is based on the old engineering hydraulic & design system is an engineering marvel. In order to cope up with growing population despite Ambri- Nahar (canal) they dug several canals.

LIST OF NEHARS:

Nahar – E – Palsi, Nahar – E – Nasrullah, Nahar – E – Pan-Chakki, Nahar – E – Lal Mahal, Nahar – E – Kiradpura, Nahar – E – Garkheda, Nahar – E – Koila, Nahar – E – Darga – Shab Ali Nahri, Nahar – E –

Chausar, Nahar – E - Darga Hazrat Shab Noor Hashmi, Nahar – E – Begampura And Nahar – E – Chavni.

They utilize the local material and the peculiarity of these canals lies in the principle that the water stores and filters into it. Malik Ambar was the commander of the Nizam Shahi kings and subedar of Daultabad: he was dynamic commander and a great engineer his system of water supply is first of its kind and also the last. In the year 1604, Malik Ambar made ‘Khadki’ present Aurangabad as his head-quarter and named it as Fateh Nagar. He introduced the system of water-supply for the public utility and this well-Organized system is known as canal Ambari or Nahar-E-Ambari. In 1653, when Aurangzeb was appointed as the subedar of Deccan he made Fateh Nagar as his capital and named it as Aurangabad. When he became the emperor of the Mughal Empire he declared Aurangabad as the capital of the Mughal Empire. Owing to this reason the population of time grew faster and acuter scarcity of water was felt. In order to supply water to the growing population he extended the system of water supply of Ambari and new canals were also dug. It is described that at the peak of Aurangzeb’s reign the population of Aurangabad was about two Lakhs. Besides Nahar-e-Ambari there were 12 (twelve) canals which were sufficient to supply ample water to the town some of them are still functioning properly and rest of them can become permanent source of supplying water after the minor repairs.

LITERATURE REVIEW:

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Pradeep Purandaree [2] report no economic & political weekly June 22, 2013 vol xlvi no 25. Water governance and droughts in Marathwada- 2012. An attempt has been made here to review the 2012 drought in the Marathwada region of Maharashtra based on various issues as reported in the Aurangabad edition of the state’s newspapers.

Pratik V. Mane,[3] NICMAR, and Goa. International journal of science, engineering research & emerging technology, vol. 1, issue. 1, January 2017 engineering aspects of neher-e-Ambari and its necessity in Aurangabad (Maharashtra). study and analyze the hydraulic characteristics of Nahar-e-Ambari constructed in 1968, study the spread of the Nahar-e-Ambari aqueduct system over the Aurangabad city, to analyze a scope / feasibility regarding utility of the aqueduct in the existing water supply system of Aurangabad, Nahar-e-Ambari water course, construction of aqueduct, siphon system aqueduct, air towers, pioneer of a unique everlasting aqueduct of the world, underground water through aqueduct, advantages.

P.A.Sadgir and U.J.kahalekar.[4] national seminar on water & culture, Hampi, Bellary dist. 25-27, June 2007 dying wisdom of medieval water management of Aurangabad city-P.A.Sadgir and U.J.kahalekar. National seminar on water & culture, Hampi Bellary dist. 25-27, June 2007. Planning designing and construction of old water supply system the old system of water supply was dependent on the canals. If we try to find out the origin of these canals outside the town we will find only huge land fields. At the origin there is neither any construction work nor deposit of water. As the origin of these canals are either in the lap of mountain or in the vicinity of river.

Mr.Dr.Shaikh Ramzan[5] 400 years under ground living Aqueducts. This book written by Dr. Sheikh Ramzan in 2010 and his study of all nahar exist in Aurangabad and completed his Ph.D. on this subject. His conduct following points on this book, Nahar-e-Ambari aqueduct, Gaimukh, Nahar-e-panchakki, different types of aqueduct, manholes on Nahars, earthen pipelines in tunnels, siphon systems, air towers, junctions of towers, photos, maps, sketches.

Dr. Dilip B. Boralkar et al. [6] submitted to district planning & development council under the aegis of district magistrate & collector Aurangabad 2012. Project proposal on bioremediation of sewage disposal in the Kham River at Aurangabad (Maharashtra). Aurangabad is not blessed with unlimited water resources. The city has crossed population total of one million. There is tremendous pressure on limited drinking water availability and its distribution in the city. The city is generating sewage at about 100 million liters per day (MLD). Untreated sewage disposal is of concern as it is cause of water pollution.

W. James Marold, et al. [7] water storage, transport, and distribution-aqueducts, tunnels, canals, pipelines, siphons, and water distribution. Tunnels: lining, grouting, rock bolts, blasting, boring, And canals: lining, routing, control structures, siphons: inverted, head recovery, pump discharge, pipe materials, hydraulics, equalization storage, carrying capacity, cross connections.

Evan James Dempsey [8] report no-3116 522 2 the aqueducts of ancient Rome February 2009. This thesis will examine the eleven main aqueducts that fed the city of Rome; how they were made, what they were made of, when and how they were repaired, the tools that were used to make them, the skills needed to make them and how the prevailing political climate that existed at the time influenced the construction of each aqueduct. As far as possible, the distribution of water from each aqueduct will be examined, but this aspect may be considered an insoluble problem.

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quality index (WQI) for groundwater quality assessment, Anna Nagar, part of Chennai city, Tamil Nadu, India. Published with open access at springerlink.com 2014. Ground water contamination in urban environment is a major issue and is complicated by large number of potential source of contamination (Jayaprakash et al. 2008). India has wide spectral variations of meteorological, materials and methods, chemical of physico-chemical parameters, correlation matrix.

R. T. Sniegocki and J. E. Reed [11] report no- 1615-d principles of siphons with respect to the artificial-recharge studies in the Grand Prairie region Arkansas, geological survey water-supply paper 1963. In 1953 the Grand Prairie region of Arkansas was selected for an investigation of the principles or artificially recharger, Ground-water reservoirs in alluvial deposits through wells. This area in the coastal plain of east-central Arkansas provided a large natural laboratory in which studies of general interest could be made. The U.S. army, corps of engineers, and the University of Arkansas have actively participated with the U.S. geological survey in these studies.

Hubert Chanson [12] hydraulic engineering and roman aqueducts: modern perspectives *actas de las IV jornadas de ingeniería del agua* 2015. The roman engineering heritage encompasses a number of magnificent structures including bridges, roads, dams and aqueducts, with many still standing. Among these, the aqueducts constitute a fine example of water resource engineering and many aqueduct sections are still in use, in Tunisia, Spain and France for example. Surprisingly, relatively little is known on their engineering design nor the hydraulic knowledge of roman engineers (Hodge 1992, Fabre et al. 2000).

W. James Marold et al. [13] aqueducts, tunnels, canals, pipelines, siphons, and water distribution, USA 2009. Pipelines. These structures may be combined in any manner to carry water for long distances to holding reservoirs or water treatment plants for distribution to the water consumers. The largest aqueduct in the world supplies southern California with nearly 44 m³ s⁻¹ of water carried in open concrete-lined canals from the Colorado River. The aqueducts used to supply water to New York City are tunnels and vary from 53 to 148 km

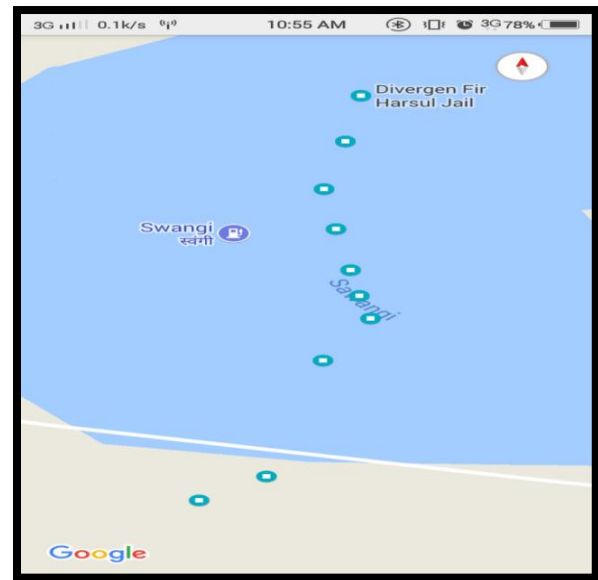
in length. Both systems withdraw water from storage reservoirs formed by large.

Kollipara parvathi manjusha, e.al [14] report no-volume 4, issue 2 | ISSN: 2321-9939, analysis and design of a siphon aqueduct, 2016 ijedr. An aqueduct structure is a complex structure as compared to bridge, as it takes canal water across stream and canal traffic over the trough. The water tightness and free expansions - contractions of trough, canal water load as well as traffic load on the trough involves complex load combinations, for which the superstructure and substructure of it is required to be planned and designed.

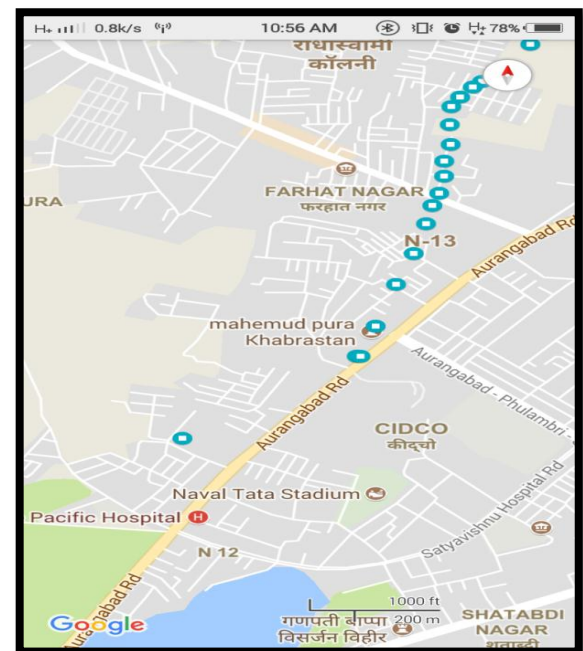
Yawar mushtaqrainae.al [15] [report no - EISSN: 2319-1163 | PISSN: 2321-7308, hydraulic design of an aqueduct and its necessity in rajouri town in Jammu and Kashmir, ijret: international journal of research in engineering and technology. Aqueduct is the cross drainage arrangement which make the route of water from one side of drain to the other. Most of therajouri town is hilly and semi-hilly belt. At rajouri about 9000 hectares areas of land remain deprived of irrigation facilities. The main aim of the paper is to present the hydraulic design of aqueduct proposed over Darhali River in rajouri town and explain as to why aqueduct was required in this area. To assist the growth of crops in areas adjoining to Darhali River construction of aqueduct from left bank to right bank of river was projected. Aqueduct of 6 x 9.5m span was proposed to be constructed.

APPROACH METHODOLOGY:

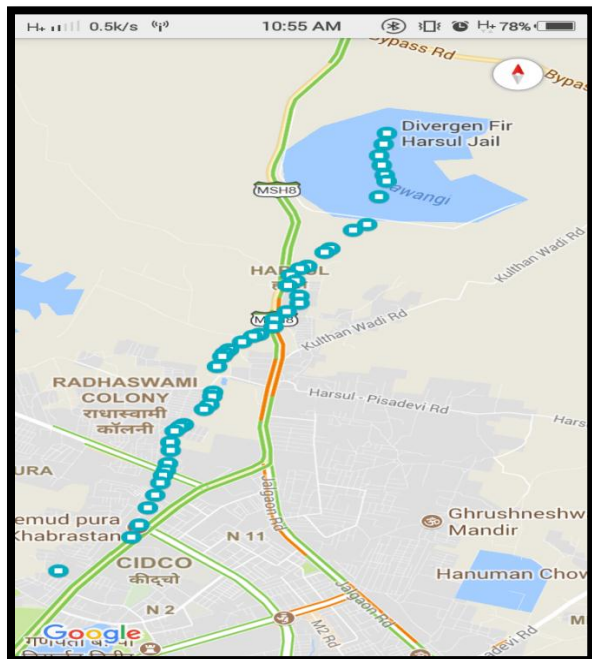
Mapping: Field survey is conducted in this project to locate water towers with the help of GPS: Then with the use of quantum GIS software prepare map for position of water towers & flow of water in aqueduct from start point (SawangiLake, harsool) to end point (Gaimukh, opp.taj hotel). Use GPS. Google map provide our location in x-direction and y-direction. You should also locate the point by fix distance and point step by step and it also give one of the fix distance average to your located point .Till up to located 86 manholes as well as air tower. Neher-e-Ambari proper map still not available up to. Create a rough map of Neher-E-Ambari and after that use QGIS software.



Pic.1 Screen shorts of mapping (GPS)



Pic.2 Screen shorts of mapping (GPS)



Pic.3 Full Screen shorts of mapping(GPS)



Pic.4.B Water /Air Towers



Pic.4.A Water /Air Towers

Water Sampling Testing:It is the very old system of drinking water near about 350 years. Upto now not conducted any type of water test on this Neher-e-Ambri. Collecting the water sample from Sawangi start point and end Gaimukh in 2 liters quantity within duration of 1 hr and conducting water test in water resource department lab class-2 Marathwada region, Aurangabad, water sample collecting on dated 1 February 2018. The water testing done in two session one is winter and second is summer because the parameter result changes with respect to session and atmospheric condition. After two tests in the rainy session third test can also be conducted. The test is conducted on the following parameters,

Table No.1 Water quality parameters

Sr. No	Parameters	Unit
1	Ph	Mg/l
2	Suspended solids	Mg/l
3	Total dissolved solids	Mg/l
4	Chlorides	Mg/l
5	Total hardness	Mg/l
6	Calcium hardness	Mg/l
7	Total alkalinity	Mg/l
8	Chemical oxygen demand (COD)	Mg/l
9	Biochemical oxygen demand (BOD)	Mg/l
10	Oil and grease	Mg/l
11	MPN	No. / 100 ml
12	Odour	No. / 100 ml
13	E-Coil	Col.
14	B-Coil	Col.

ADVANTAGES:

- 1.This water supply system is having low maintenance and few types of equipment for working.
- 2.No need of electricity hence does not produce any type of harmful gases like carbon.
- 3.It is unique and ideal water supply system which is collected percolated ground water as well as storm water in each place.
- 4.Construed in locally available material like bricks and lime, etc.
- 5.Useful for Green revolution to make green and healthy Aurangabad.

6.This is underground water system so it does not affect on valuable land.

7.This is useful for local minor projects.

Study:

1.In this System Three main sources are available,

i.Sawangi lake

ii.Percolated ground water

iii.Strom water(In rainy Session)

2.This system based on gravity and siphontechnique. An underground 2½ km. tunnel was dugout from the bottom of the elevated hills with providing gradual slope in the bottom tunnel towards town.

3.The complete Nahar Aqueduct is built in brick & limes and thousands of cavities are left to enter the sub terrain spring water in the tunnel.

4.At the top of each tower was an open tank of several cubic meters. The purposes of these towers were,
i.To supply water to the higher parts of the town without pressure loss.

ii.To function as an air relief valve to prevent a pressure surge resulting from sudden cessation of the water flow to allow a water outlet for public use and irrigation at several points along the aqueduct without loss of water pressure.

CONCLUSION:

The 350 year old water supply system is working effectively without anymaintenance, without silting and corrosion. The life of present water supply system is 30to 50 years and with maintenance. The methods and materials used for neher system isavailable locally and constructed by local skilled and unskilled labour. This will helpulto solve water problem in developing countries. Aurangabad is one of the fastest growing cities in theAsia with a population of almost 18 lakhs. The waterconsumptions from industries and civilians is a part andparcel of the city's economical growth. The existingaqueduct system including Nahar e Ambari could helpsolving the water scarcity problem, if properly worked.As the only source of the water supply for this growingtown us Jaikwadi (Nathsagar) dam, we cannot expect it toserve the catchment area for too long. This is where, Nahare Ambari comes into the picture.The natural benefits can be used efficiently as theaqueduct contains a fully gravitational flow, flawlessnetwork of the chambers, properly spaced

outlets, manholes for the maintenance purpose. Hence the system could serve the city without involving electricity and other traditional resources.

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Intelligent Transport System

^[1] AkshayGovindraoShelke, ^[2] Shaikh Samrin Shaikh Irfan, ^[3] Akanksha Rajesh Shirwat
^{[1][2][3]} Government Polytechnic, Aurangabad

Abstract— A broad range of diverse technologies, known collectively as intelligent transportation systems (ITS), holds the answer to many of our transportation problems. ITS is comprised of a number of technologies, including information processing, communications, controls and electronics. Joining these technologies to our transportation system will save lives, save time, and save money.

There are many technologies involved in intelligent transportation system,

- ❖ Wireless communications
- ❖ Computational technologies
- ❖ Floating car data/floating cellular data
- ❖ Sensing technologies
- ❖ Inductive loop detection
- ❖ Video vehicle detection

“ Intelligent transportation system i.e. ITS has wide range of applications as,

- ❖ Electronic toll collection
- ❖ Emergency vehicle notification systems
- ❖ Cordon zones with congestion pricing
- ❖ Automatic road enforcement
- ❖ Collision avoidance systems
- ❖ Dynamic Traffic Light Sequence
- ❖ Intelligent Vehicle

KEYWORDS: Automatic Number Plate Recognition System (ANPR), Reduce Fatal Accidents, Safety Rollers, Solar Cum Wind Mills, Protection from CO Emission.

I. INTRODUCTION

Background situations of promoting ITS:-

The future of ITS is promising. Yet, ITS itself, is anything but futuristic. Already, real systems, products and services are at work throughout the world. Still, the wide-scale development and deployment of these technologies represents a true revolution in the way we, as a nation, think about transportation. While many aspects of our lives have been made more pleasant and productive through the use of advanced technologies, we have somehow been content to endure a transportation system whose primary controlling technology is the four-way traffic signal, a technology that has changed little since it was first invented. It has taken transportation a long time to catch on, but now the industry is sprinting to catch up.

Fulfilling the need for a national system that is both economically sound and environmentally efficient requires a new way of looking at and solving our transportation problems. The decades-old panacea of simply pouring more and more concrete neither solves our transportation problems, nor meets the broad vision of an efficient transportation system.

Traffic accidents and congestion take a heavy toll on lives, productivity, and wastes energy. ITS enables people and goods to move more safely and efficiently through a state-of-the-art, intermodal transportation system.

Interest in ITS comes from the problems caused by traffic congestion and a synergy of new information technology for simulation, real-time control, and communications networks. Traffic congestion has been

increasing worldwide as a result of increased motorization, urbanization, population growth, and changes in population density. Congestion reduces efficiency of transportation infrastructure and increases travel time, air pollution, and fuel consumption.

- ❖ Problems in transportation :-
 - Fuel consumption
 - To reduce road accidents
 - Traffic congestion

Intelligent transportation technologies using ANPR:-

The Automatic number plate recognition (ANPR) is a mass surveillance method that uses optical character recognition on images to read the license plates on vehicles. They can use existing closed-circuit television or road-rule enforcement cameras, or ones specifically designed for the task. They are used by various police forces and as a method of electronic toll collection on pay-per-use roads and monitoring traffic activity, such as red light adherence in an intersection.

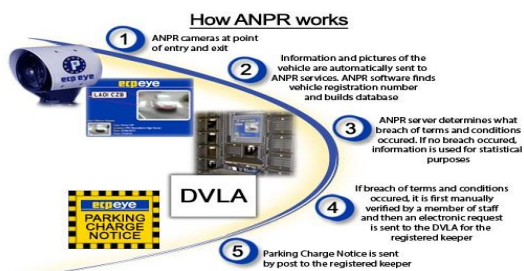


FIG NO.01 ANPR SYSTEM

ANPR can be used to store the images captured by the cameras as well as the text from the license plate, with some configurable to store a photograph of the driver. Systems commonly use infrared lighting to allow the camera to take the picture at any time of the day. A powerful flash is included in at least one version of the intersection monitoring cameras, serving both to illuminate the picture and to make the aware of his or her mistake. ANPR technology tends to be region-specific, owing to plate variation from place to place. Automatic recognition of car license plate number became a very important in our daily life because of the unlimited increase of cars and transportation systems which make it impossible to be fully managed and

monitored by humans, examples are so many like traffic monitoring, tracking stolen cars, managing parking toll, red-light violation enforcement, border and customs checkpoints. Yet it's a very challenging problem, due to the diversity of plate formats, different scales, rotations and non-uniform illumination conditions during image acquisition. This paper mainly introduces an Automatic Number Plate Recognition System (ANPR) using Morphological operations, Histogram manipulation and Edge Detection Techniques for plate localization and characters segmentation. Artificial Neural Networks are used for character classification and recognition.

- ❖ Benefits of intelligent transportation system (ITS)
 - Time savings
 - Better emergency response time and services
 - Reduce crashes and fatalities
 - Cost avoidance
 - Increased customer

Provision of collision resistant safety rollers:-

Safety rollers is a safety fixtures that prevents drivers and passengers from fatal accidents by not only absorbing shock energy but also converting shock energy into rotational energy. Safety roller needs to be installed at site where vehicles are exposed to frequent accidents. Safety rollers will safely lead a vehicle back to the road or stop the vehicle by absorbing shock energy. Safety roller will effectively function or drivers to control vehicles with its noticeable color – luminescence.



FIG NO.02



FIG NO.03 COLLISION RESISTANT ROLLERS

Hybrid solar cum wind millson highways:-

“Wind energy is available when the wind is blowing...solar energy is available when sun is shining”



FIG NO.04HYBRID MILLS

Hybrid mills is one of the renewable energy resources. it is made by integrating solar and wind energy. Street lights system on highways can be handle by this system properly.

OBJECTIVES:-

- ❖ Background situations of promoting ITS:-
- ❖ Intelligent transportation technologies using ANPR
- ❖ Intelligent transportation appliances
- ❖ Provision of collision resistant safety rollers
- ❖ Producing unconventional energy using hybrid mills (solar cum wind mills) on highways.

CONCLUSION:-

- ✓ The use of ITS in some developed countries like America, Japan, England, etc. has given them high progress in the field of transportation and helped them in their economic progress.
- ✓ The ratio of traffic congestions and accidents as well as wastage of fuel will definitely decreased to a larger extent.
- ✓ By utilizing maximum unconventional sources and eco-friendly technics in ITS will increase the power generation as well as increase the rate of productivity.
- ✓ Hence, with much more interest & advanced research in the field of ITS, it can be implemented in our country and it will be the solution for our traffic.

Boutique Hotel, Jaipur - Resurrecting the Bygone Era

^[1] Ankisha Mehta

^[1] MBA In Project & Construction Management

Abstract— The ‘past’ is very much a part of the here and now in India. What makes Indian civilization special, is that it has continued in an unbroken continuum from the early ancient times right up till the present day. History, tradition and cultural heritage are not mothballed relics consigned to museums and inner recesses of the people’s collectively memory, they are an integral and organic part of people’s everyday life. Our Heritage is a legacy from our past. It is something we live with today and, hopefully, something that we can pass on to future generations. Heritage is both a record of life and history and also an irreplaceable source of creativity and inspiration. It’s like our DNA, determines who we are, giving us both identity and the values that will guide our lives in a changing world. Which is why the concept of heritage hotels has been steadily gaining popularity worldwide. And India, which is fast emerging as a popular tourist destination internationally, has many charming heritage properties. These mostly consist of old palaces, hilltop forts, lodges and etc.- some dating back centuries- which not only showcase India’s traditions and customs, but also bring alive the flavour, ambience and feel of her rich past.

“Athithi devo bhavha” has been one of the central tenets of Indian culture since times immemorial...

This project is a Boutique Hotel, with the Heritage style of Rajasthan, of the Bygone Era, bringing back the royalty in service and in one’s experience. A platform to rejuvenate with the past and present, with the main objective as to provide the visitors with “Feel-good-effect”.

Index Terms—Boutique Hotel, Heritage, Culture, Bygone Era, History, civilization

I. INTRODUCTION

The link between culture and tourism is the most visible aspect of the contribution of culture to local development. 37% of the global tourism has a cultural motivation. When tourism is identified as a part of an overall development strategy, the identification, protection and enhancement of historic resources is vital for any sustainable effort.

The tourism sector is the ‘industry’ that uses Cultural Heritage to the greatest extent as support for its backbone activities like hotel accommodation, transport and catering. The impact of heritage driving the tourism industry is obvious in our cities. Due to exploitation of heritage, many new jobs were generated in the tourism sector and as a result the figures are even more impressive. When the heritage tourism is done right, the biggest beneficiaries are not the visitors but the local residents who experience a renewed appreciation for and pride in their local city and its history.

The tourism industry of India is economically important and grows rapidly. The World Travel and Tourism Council calculated that tourism generated \$121 billion or 6.4% of the nation’s GDP in 2011. It was responsible for 39.3 million jobs. 7.9% of its total employment. The World Travel and Tourism Council predicted the annual growth to be 8.8% between 2011 and 2021. This gave India the fifth rank among countries with the fastest growing tourism industry.

A boutique hotel is a small hotel which typically has between 10 and 100 rooms in unique settings with upscale accommodations. Many boutique hotels are furnished in a themed, stylish and/or aspirational manner. A Boutique Hotel Is Small...But Has a Big Personality!!!

Aim of the project is to design a 5-star Boutique hotel (in Heritage style) for 25 or more numbers of rooms, with the sufficient services required and to make the best use of the existing structures on the site.

II. SITE

Site is located on the outskirts of Jaipur city, near AMER town. The history of site goes from the time of Meena community ruled at certain places in Rajasthan till they were overpowered by invading Rajput's. Once their palace was residing on this site, which is now all demolished. The lake beside the site was the place where Meena's would give tribute to their forefathers on the day of Amavasya. Site also has a ruined bawdi (stepwell) and a sunken structure.

The site is located in the eastern side of Rajasthan and it is surrounded by Aravalli Hill at its three sides. It is located at the average height of 1417 ft from sea base.



Sunken structure Step-well (bawdi)



View 1

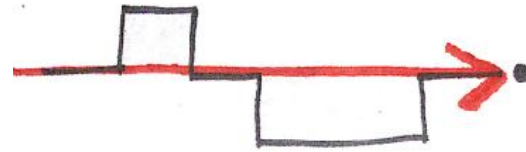


View 2

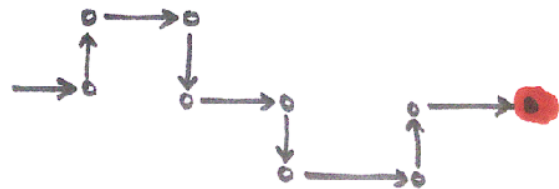


View 3

III. IDEAS AND CONCEPT



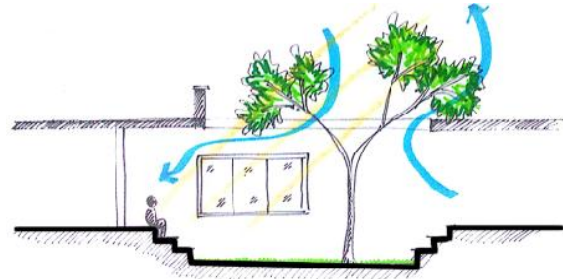
Visual reference on axis while physical movement path is shifted from axis.



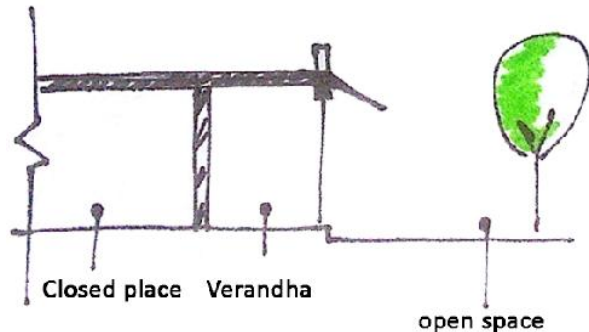
Non-linear organization-

Shifting axes of movement - unfolding the vista.

Each barrier makes a pause- Reorient & discover new facets

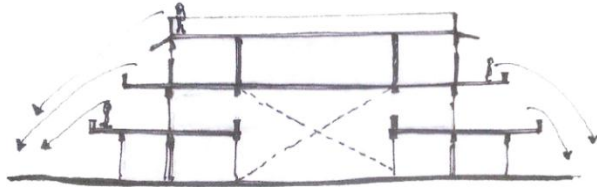


Courtyard + Tree = Filtered light and cold breeze

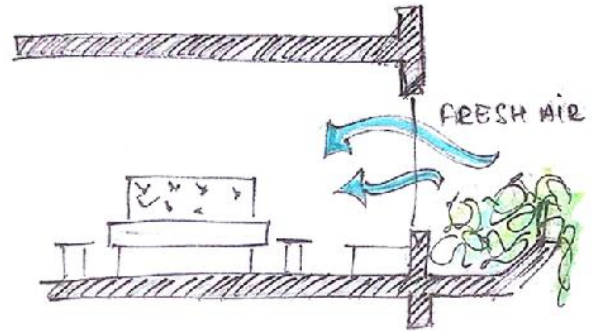


Layer of the building- from the closed place, it opens into semi - covered area and then finally to the open

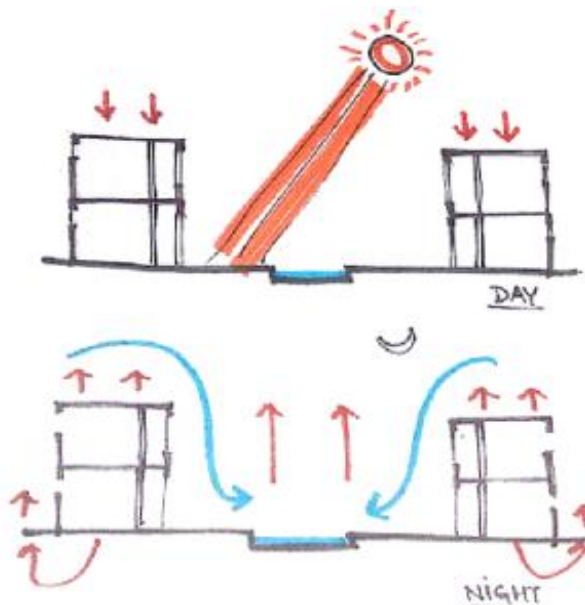
area/Courtyard.



Double Heighted space in the center of the building with overlooking spaces

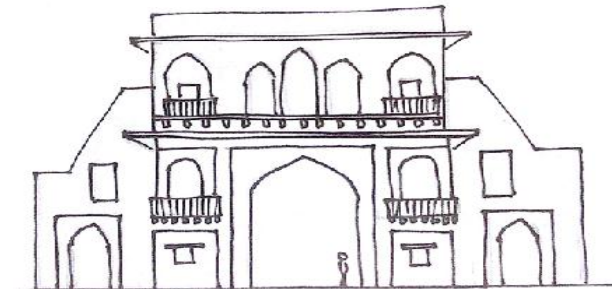


Plantation in the room provides the fresh air in the bedroom. with it a pleasant atmosphere for the visitors to stay (feeling like a home).

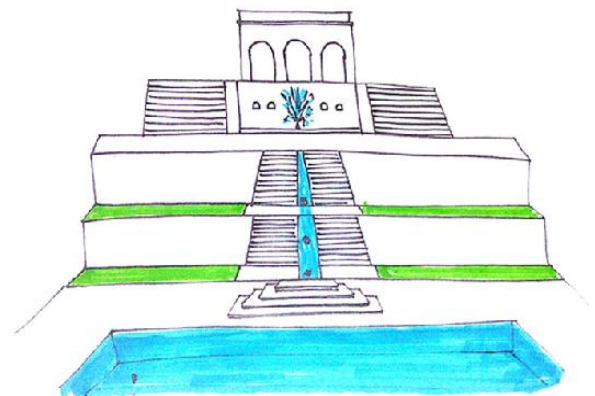
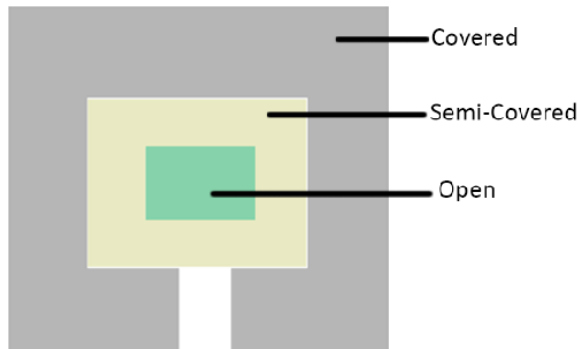
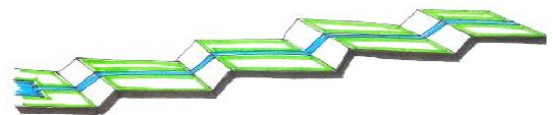


Courtyards & Pavilions- Response to harsh and hot climate & high sense of privacy.

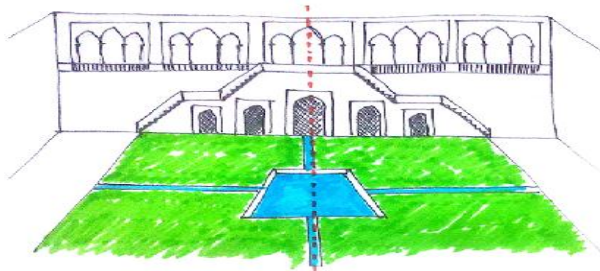
IV. GESTURES



Gateway - gesture of Grandness



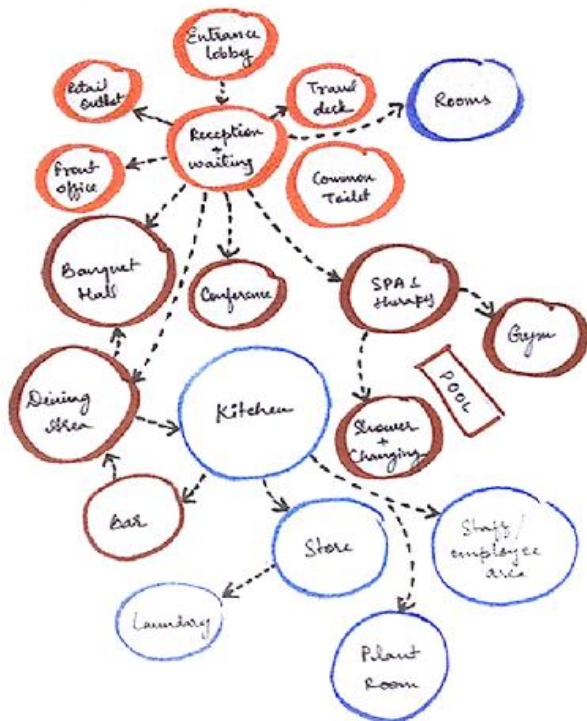
Concept of Step garden combined with the landscaping; with the hardscape and soft scape. As water forms the main element in the heritage forms of building, the water has been taken in the forms of water cascade, fountains, water bodies etc.



AXIAL- SYMMETRY

Charbagh garden - with stairway leading up to portico- Sense of entrance gesture. Visually connected, movement shifted from linearity

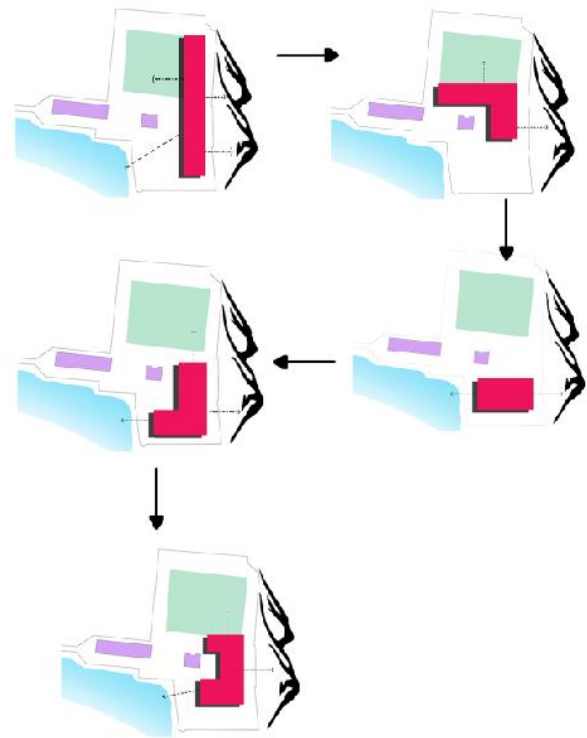
V. BUBBLE DIAGRAM



The bubble diagram has been derived after the understanding of how the hotels work, what are the services needed, the vertical and the horizontal segregation of the work.

Accordingly, the areas are divided into Public zones, Semi-public zones and Private zones. The recreational activities found in the Boutique hotels and how well they can co-operate with the other services.

VI. GRAPHICAL CONCEPT

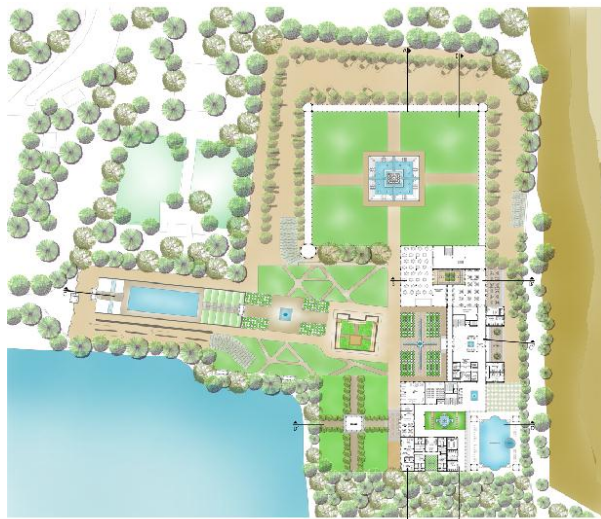


Different placements of the building with the building shape has been tried, to respond best with the contextual environment; the mountains, the lake and the Amer Fort view also the the existing heritage present on the site such as, sunken structure and step well.

Some would respond with the context, but some remain aloof with others. At last, the the C-Shaped building is finalized, as it has connectivity both with the natural and heritage elements acting efficiently.

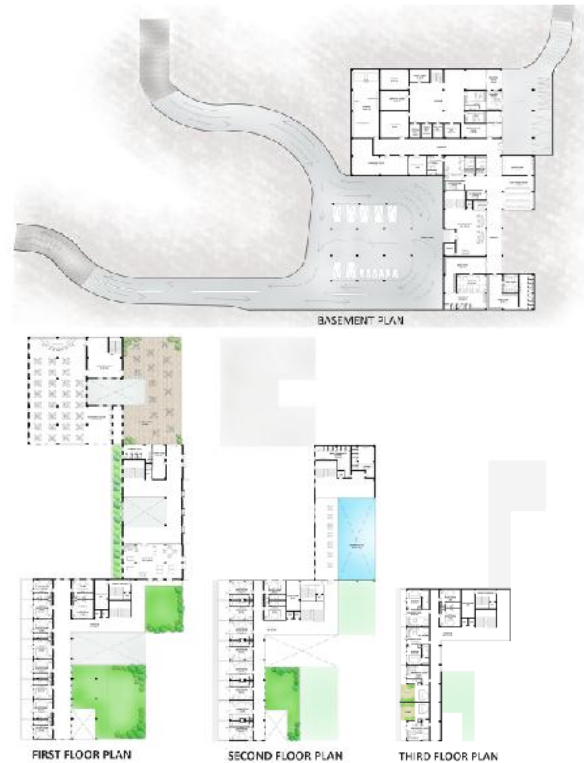
ground floor. All the main amenities have been placed in a such a way that they either face the waterbody in front or mountains at back. The floors are dividing according to the categories of the rooms, with the terrace pool on the second floor.

VII. DRAWINGS: PLAN

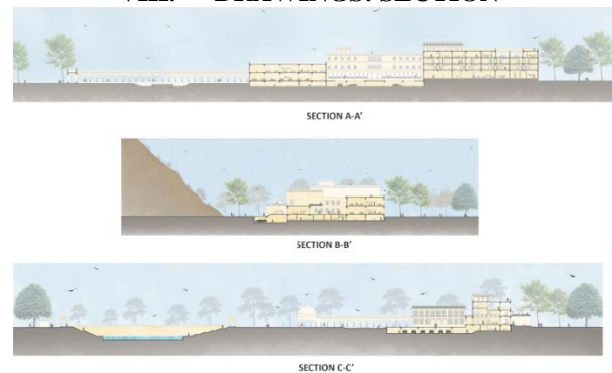


Ground Floor Plan

The building is a 'C-shaped' structure which is placed in a such a way this the front court of the building, reminding the past of char Bagh concept, with the fountain in between. The zoning of the areas has been kept in such a way that the courtyards are formed on both the wings of the building. There are the extended spaces in the east side, facing the mountains, gives the pleasant environment as well as privacy. Swimming pool, extended space for the fine dining even on the terraces open towards the east side with the climatic point of view, giving the making it more comfortable and enjoyable experience. The concept of Charbagh has been tried to put in every court. The garden area is a biggest court, for the purpose of the Marriages/function, with the provision of the Mandaps in between, with the beautiful combination of water body and steps. The connection between the heritage structure (baowli) has been maintained by the pathway leading from the main front courtyard to the step well experiencing the blend of past and present. The parking has been kept underground, so has to get the pedestrian area on the



VIII. DRAWINGS: SECTION



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SECTION D-D'

IX. DRAWINGS: ELEVATION



WEST ELEVATION (FRONT)



NORTH ELEVATION

X. 3DS & MODELS



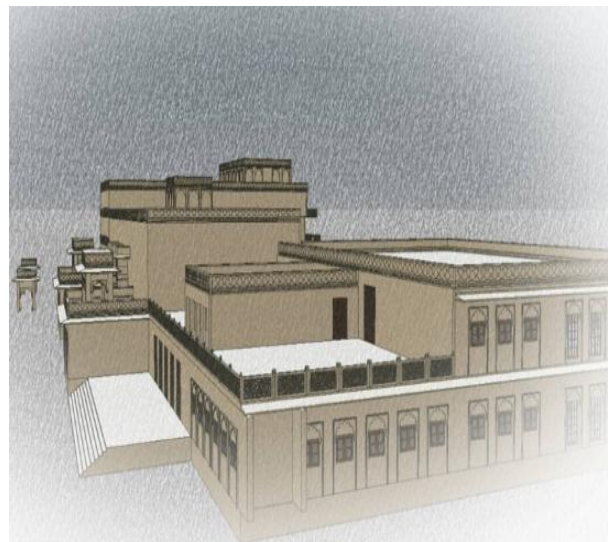
Pathway from sunken structure to step well



Chattri



Front Elevation & Back Elevation respectively

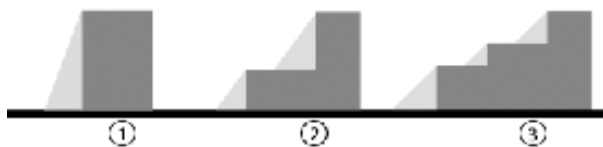


Back side view of terrace



Model

XI. POST DESIGN ANALYSIS



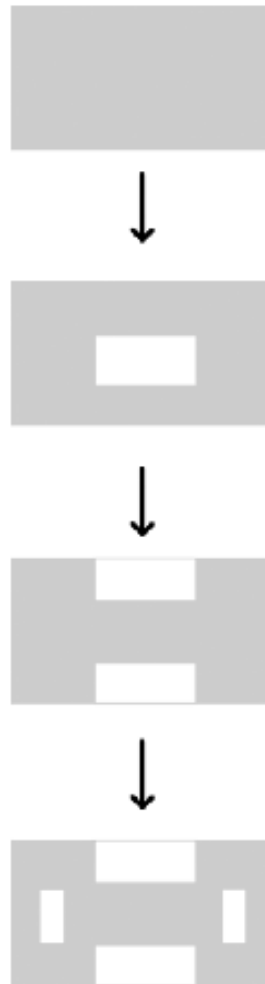
Transformation of the Building Mass

With the single structure building, the one side of the building is then breaking down to form the shaded part. Further the breaking down of building mass took place, which ultimately formed the stepped like elevation, over-shadowing the lower terraces.

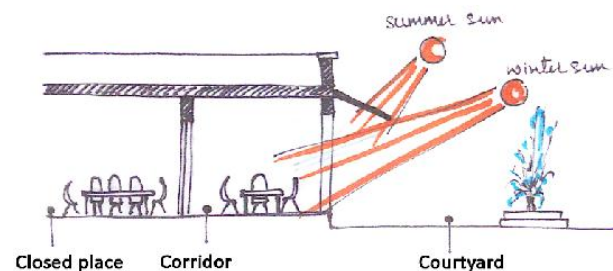


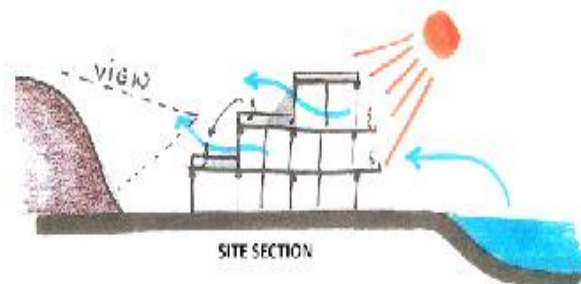
The zoning of the building is in such a way that, there is a public area in the center of the building, and then it gets bifurcated into two wings; one side is the food zone, with the fine dining, banquet hall, multi cuisine and bar (on the first floor). On the other side, it is recreational areas, with the amenities like spa, saloon, coffee shop, swimming pool, conference and meeting

rooms. The rooms are located category-wise on different floors.



Transformation of the Court





With one side lake and Amer View, and other side marvelous mountains, the building is designed in such a way that the enjoyment of both the natural scenic beauty can be possible. The terraces are all opening on the east side (mountain side), which also forms the overlooking spaces, which helps in having the connectivity with the hotel and the nature, whereas almost all the rooms are facing the west side with the view of Amer fort, individual balconies with comes out of the bedrooms, provides the privacy. Cold breeze from the lake, helps in mitigate the hot and humid environment of Rajasthan.

XII. IMPACT ON SOCIETY

Hotels are considered an important economic component to any community. In some cases, cities and municipalities will offer incentives in order to stimulate hotel development. These incentives can be in the form of tax breaks, favorable land leases, or assistance with financing. All federal, state, and local taxes that will be collected from the development and operations of the new hotel. Taxes include all sales taxes collected in association with the hotel generated revenues, as well as all payroll related taxes collected from full-time hotel employees and temporary construction workers. Local governments will also collect new property taxes from the operation of the hotel. Many local governments will also collect revenues through lodging taxes.

India is a country known for its lavish treatment to all visitors, no matter where they come from. Its visitor-friendly traditions, varied life styles and cultural heritage and colorful fairs and festivals held abiding attractions for the tourists. The other attractions include beautiful beaches, forests and wild life and landscapes

for Eco-tourism, snow, river and mountain peaks for adventure tourism, technological parks and science museums for science tourism; centers of pilgrimage for spiritual tourism; heritage trains and hotels for heritage tourism. Yoga, Ayurveda and natural health resorts also attract tourists.

Growth

Domestic tourism is as old as the Indian society. According to available statistics, domestic tourism has grown substantially during the last one decade. It increased to 167 million in 1998 from just 64 million in 1990, thus registering a compound annual growth of 12.8 per cent.

The growth of inbound tourism since Independence has been quite impressive. It was just around 17 thousand in 1951. From this level it rose to 2.36 million in 1998. Tourism receipts on the other hand have grown at a phenomenal rate of 17 per cent to Rs. 11,540 crores in 1998 from Rs.7.7 crore in 1951.

Economic Impact

Tourism has emerged as an instrument of employment generation, poverty alleviation and sustainable human development. During 1998-99, employment generation through tourism was estimated at 14.79 million.

Tourism also contributed Rs. 24,241 crores during 1998-99 towards the country's Gross Domestic Product (GDP).

It is also seen that in the heritage hotels, the employment generation is quite well. According to the survey, the staff of the hotel consists of the 46% of Rural people and 44% of people within the 5km of vicinity of Hotel, among which 39% are skilled workers and 61% are unskilled.

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A Review on the Application of Carbon Dioxide Gas as a Curing Compound

^[1] Ann M Biju, ^[2] Aarthi .M, ^[3] Sneha Vinod Naik

^[1] MBA in Construction Project Management, RICS-SBE, Amity University, Panvel, Mumbai

Abstract— The rising level of carbon dioxide in the atmosphere is one of the main concerns of researchers of all the time. The high level of CO₂ concentration in the atmosphere has serious effects on environment as it can make the earth warmer than it would be. Recently, there was a warning from UN weather agency's annual flagship report about the increasing level of CO₂ concentration in the atmosphere. According to the report, the CO₂ concentration has risen from 400 parts per million in 2015 to 403.3 parts per million in 2016, which was found to be the highest rate in past three million years. This paper discusses about reduction of CO₂ emission by utilizing it in the curing process of precast concrete elements. The comparison of effect of different curing conditions on carbonation reaction was reviewed. The effect of initial curing in the water loss and carbon uptake of concrete was also discussed.

Index Terms - Carbon Dioxide, Precast Concrete, Carbon Uptake, Initial Curing.

I. INTRODUCTION

The increasing level of carbon dioxide concentration in the atmosphere is becoming a major issue nowadays. The high level of CO₂ in the atmosphere would result in an increased surface temperature and unstable climatic conditions. The main sources of human induced CO₂ emissions are burning of fossil fuels, deforestation, industrial emissions and so on. It should also be noted that 5% of global CO₂ emission is due to the manufacturing of cement. Construction industry is producing more than 1.6 billion tons of cement a year, which will emit about 1 ton of CO₂ to the atmosphere. There would be also emission of CO₂ from heavy machineries used in construction industry. The transport of materials would also result in a CO₂ emission of about 6-8%. The commercial and residential sector together is contributing a CO₂ emission of around 39%. The reduction of CO₂ level in the atmosphere is thus the responsibility of construction industry as well. [1]

Carbonation, the process of absorption of carbon dioxide to concrete surface, is well known for the improvement of the surface hardness, strength and durability of concrete. Concrete structures absorb CO₂ in its calcium bearing phases and produces calcium carbonate as shown in the equation 1.



The absorption of CO₂ in the concrete surface will lower the pH of the absorbed concrete portion. Carbonation in concrete seems to be advantageous in non-reinforcement structure as the reinforcements would be more vulnerable to corrosion as the pH of concrete gets lowered. Many studies have been conducted for accelerating the carbonation process in concrete structures.[2]

The implementation of carbon dioxide as a curing compound would not only help in reducing its level in atmosphere, but will also eliminate the use of large amount of water for curing process. The CO₂ curing can be done using an experimental setup as shown in Figure 1. An air tight vessel is used as CO₂ chamber. The vacuum pressure before CO₂ injection was made to be -0.5 bars. Also, the pressure of CO₂ in the chamber was kept constant at 0.1 bars with the help of a regulator. Anhydrous silica gel was used inside the chamber to absorb water from the specimen during carbonation, which will help in maintaining the required humidity.[4][5]

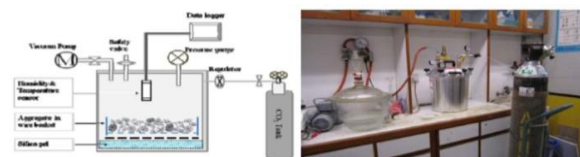


Fig 1. Experimental Setup of CO₂ curing[4]

II. CARBONATION IN DIFFERENT CURING CONDITION

The hardened properties of concrete specimen were compared under different curing conditions. The curing conditions used were moist curing room with 100% relative humidity and 0.15% CO₂, drying room with 50% relative humidity and 0.15% CO₂ and CO₂ chamber with 50% relative humidity and 5% CO₂. The Portland cement used was ASTM type 1. The fine aggregate used was river sand with specific gravity 2.6, bulk density 1790 kg/m³ and absorption 1.4%. The coarse aggregate used was of specific gravity 2.66 and bulk density 1550kg/m³. [6]

Figure 2 shows the compression strength of 100x200mm cylindrical specimen under three conditions at 3,7,28 and 91 days of curing. The specimen cured in dry room developed lowest compressive strength. Also, the specimen showed no or less strength gain after 28days. The CO₂ chamber cured specimens showed same compressive strength as that of moist cured specimens.

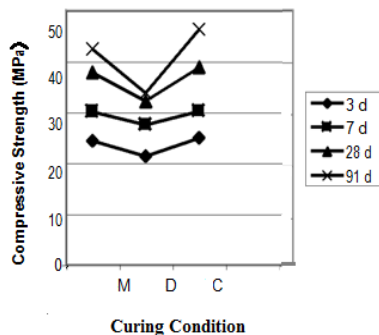


Fig 2. Compressive strength of specimens under different curing conditions.[6]

Figure 3 shows split tensile strength developed by 100x200mm cylindrical specimen at 3,7,28 and 91 days. The specimen cured in dry room showed less split tensile strength than moist and CO₂ cured specimens except in the 3 day split tensile strength. The CO₂ cured specimens showed approximately the same strength as that of moist cured specimens.

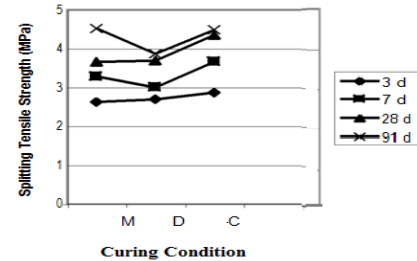


Fig 3. Split tensile strength under different curing conditions[6]

Figure 4 shows the flexural strength of 100x75x300mm concrete specimen after 7, 28 and 91 days. The specimen cured in dry room condition showed more strength initially than other conditions, but showed lower strength at 91days of curing. The CO₂ cured specimen showed higher flexural strength than specimens cured under moist and dry condition.

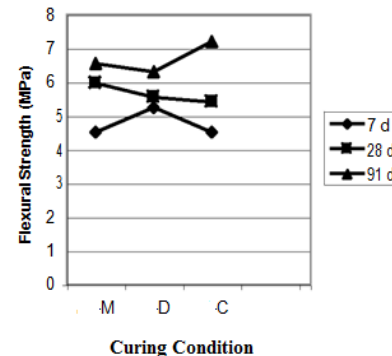


Fig 4. Flexural strength under different curing conditions[6]

A pH indicator solution of 1% phenolphthalein and 70% ethyl alcohol solution was used to measure depth of carbonation in specimens. The area which turned pink after spraying the solution was considered as non-carbonated and area which showed discoloration was considered as carbonated. Table A show the depth of carbonation in concrete at 3,7,28 and 91 days under these conditions of curing. Specimen cured under moist condition showed up carbonation. Concrete used in co₂ chamber showed higher carbonation than the concrete cured in drying room. [6]

Table A. Depth of carbonation of concrete(mm) under different curing conditions.[6]

Curing Condition	Age(days)			
	3	7	28	91
Moist curing	0	0	0	0
Dry room curing	0	0	3	6
Chamber curing (CO ₂)	3.5	7.5	12	22

Table B. Mass loss due to abrasion of specimen (grams)[6]

Curing Conditions	Age (days)	
	28	91
Moist curing	3.1	3
Dry room curing	15.7	17.5
Chamber curing (CO ₂)	11.7	9.9

The top surface of specimen was abraded using rotating cutters for 6 minutes under a load of 197N. Table B shows the loss of mass in grams of specimen, due to abrasion. The specimen cured in moist condition showed more abrasion resistance than specimen in CO₂ curing. The specimen cured in dry room showed more mass loss and resistance developed with age. But for CO₂ and moist curing, abrasion resistance increased with age.[6][7]

III. EFFECT OF INITIAL CURING ON CARBONATION

The curing process was performed on rectangular slab. An initial air curing of 0,4,6,8 and 18 hours respectively was performed on each specimen at a relative humidity of 50% and temperature of 250 C. Carbonation was

performed to the initially cured concrete for duration of 2 to 4 hours. A carbonation period of 96 hours was also given to study for the effect of extreme exposure time.

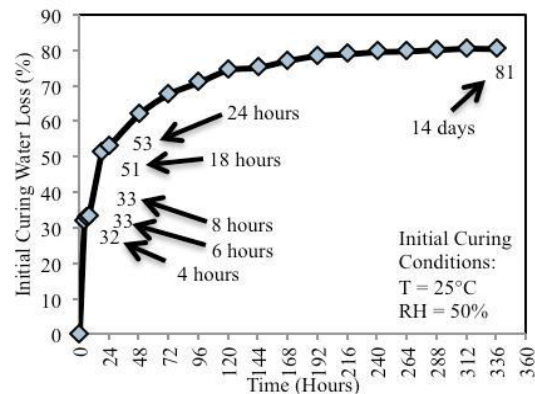


Fig 5. Water loss due to initial curing[8]

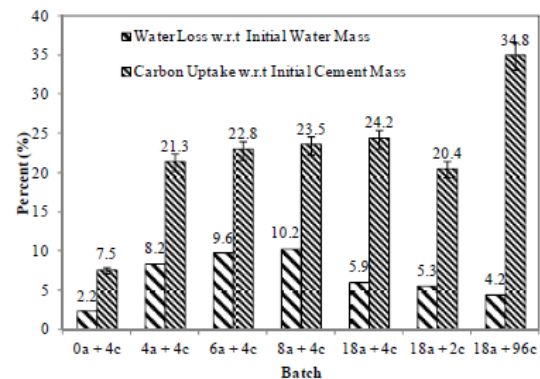


Fig 6. Water loss and carbon uptake due to carbonation[8]

Figure 5 shows the water loss due to initial curing and figure 6 shows the water loss and carbon uptake due to carbonation. For 4 hours carbonation without initial curing, the specimen resulted in a water loss of 22% and carbon uptake of 7.5%. An initial air curing of 4,6 and 8 hours resulted in a water loss of about 32-33%. The water losses due to 4 hour carbonation for these specimens were 8.02%, 9.6% and 10.2% respectively. The carbon uptake was 21.3%, 22.8% and 23.5% respectively.

It is obvious that initial curing helps to reduce water and aids in gas diffusion and calcium carbonate precipitation. But water loss due to carbonation

decreased for 18 hours of initial curing which indicates that prolonged initial curing would not increase the reaction efficiency.

For 8 hours initial curing, 4 hours of carbonation showed more water loss and carbon uptake than 2 hours of carbonation. Carbon uptake increased by 44% for 96 hours carbonation than 4 hours carbonation. But water loss was less for 96 hour carbonation and it might be due to the reabsorption of water during the curing period.

IV.CONCLUSION

The comparison of hardened properties of concrete in moist dry room and CO₂ chamber curing were studied.

- The specimens cured in CO₂ chamber showed approximately the same compressive, split tensile and flexural strength as that cured in moist condition and showed an increased strength when compared to dry room curing condition.
- The abrasion resistance of specimen cured in CO₂ chamber was less than that of moist cured specimen and was higher when compared with dry room curing. But the abrasion resistance of CO₂ cured specimen improved with age. The abrasion resistance could be improved using proper preconditioning of the specimen.
- The depth of carbonation was higher for CO₂ chamber curing and was least for moist curing. This is because of the high relative humidity in moist curing condition. The high carbonation depth of CO₂ chamber cured can be attributed to the integration of more amount of carbon dioxide.

The effect of initial curing on the carbonation reaction was reviewed.

- It was observed that the efficiency of carbonation reaction increased with increase in initial curing but it was less for prolonged period of initial curing.
- The carbon uptake of concrete increased with increase in carbonation period. And it would also help in increasing the carbon storage capacity of concrete.

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Smart Decision Making Technique in Construction Supply Chain Management for Infrastructure Engineering Projects

^[1] Atharva Shirude, ^[2] Krishna Shelake, ^[3] Parth Mahavarkar, ^[4] Dr. Shantini Bokil

^{[1][2][3]} Undergraduate Students, ^[4] Professor & Head

^{[1][2][3][4]} Dept. of Civil Engineering, Maharashtra Institute of Technology College of Engineering, Pune, India

Abstract— In this competitive era, the infrastructure sector has shown its promising side and has reached new heights. Companies execute multiple projects at various locations. In this fierce competition, the Indian infrastructure industry is facing tough competition from its counterparts. Also, in this everchanging demanding era of globalization, the project manager needs to equip himself with latest trends and technologies in infrastructure sector. Thus, to thrive in this era the companies need to enhance its criteria's and management methodology, also strive for customer satisfaction and delight. To improve this scenario, the decision making process for the infrastructure sector has to be revamped. First it is important to know the factors (parameters) affecting the decision making in infrastructure projects. This paper explains the various decision criteria's in construction supply chain process and factors affecting each decision criteria. The study is carried out using questionnaire survey conducted across different companies in Pune and Nasik and also using face to face interview with managers and engineers and then subsequent analysis of the response from companies. The analysis of the study is the application of AHP to construction supply chain process and its utilization as an effective means for the formalization of knowledge possessed by competent, experienced practitioners. On the practical side, it guides them in making logical, consistent decisions, and provides a facility for all necessary calculations.

Index Terms - Analytical Hierarchy Process (AHP)

I. INTRODUCTION

In today's aggressive sourcing environment, organisations must select suppliers based on their value-added capabilities and not purely on competitive process of quality and price. Therefore, in order to select supplier who continually outperform the competition, suppliers must be carefully analysed and evaluated. When making these critical material and service decisions, the key issues that a supply manager faces can be classified as either mistakes or success factors. Infrastructure engineering companies know that it is important to improve the decision-making process in supply chain process. However, they do not know exactly how to improve the decision making in supply chain process in relation to the needs of the organization. One reason is that a lot of companies do not have knowledge of factors and performance measure, which can support decisions in this area. To improve the decision making in supply chain

process, first it is important to know the factors (parameters) affecting the decision making in construction supply chain process. Studies show that the poor material management is due to the inaccurate decision making during material management process. Hence for the effective material management system, it is vital to have accurate decision making during the process.

II. LITERATURE REVIEW

Review of literature on the material management process in the construction industry is discussed in these research papers. The investigation considered the entire range of activities necessary for procuring the needed material, starting with the estimating process and ending with site delivery, distribution and storage logistics. To improve the material management process on fast track projects, there needs to be an integrated material handling process from the design stage to the

usage of materials. The materials management of manufacturing can assist in formalizing that of construction and some of the developed detailed techniques can be adapted or readily applied.

S. Vignesh and S. Shanmugapriyain their paper explained the need of the improved technique in decision making in the construction industry. Construction lacks the proper assessment while decision making, so by using AHP various parameters have been studied and evaluation has been done and proper ranking and weightage has been calculated for various parameters.

Syama Krishnakumar and Linu T. Kuriakose in their paper explained various parameters which play an important role in decision making have been enlisted. Along, with the parameters various methods for decision making like Analytical Hierarchy Process, Analytical Network Process, TOPSIS method have been explained.

Akshay Patil and Prof. Madhav Kumthekar in their paper explained that there is no best way to evaluate or select a supplier. Thus, this paper, supplier evaluation system is explored, this paper studies various supplier selection methods. The methods enlisted are AHP, Linear Programming, Multi Objective Programming. AHP process is selected for evaluation and supplier selection.

Linda F. McHenry and W.C. Benton in their paper explained mistakes made by the organizations while making decisions have been pointed out and how these mistakes can be rectified are stated. It also suggests, realistic assessment of capabilities, expertise of the suppliers and the alternative strategies have been proposed.

Sangeetha S and Anila PV in their paper explained 39 criteria's which affect the supplier selection process were identified and the effects and relative importance of these criteria's on the supplier selection process were studied by interviewing the organizations with the help of a predefined questionnaire. Thus, it was found AHP integrated with TOPSIS method was the best method to select the supplier.

III.METHODOLOGY OF WORK

The research is intended to improve the decision-making process for the supply chain management in the construction industry. After the research was conducted various criteria's were deduced. These criteria's were then enlisted to form a questionnaire. Preparing a questionnaire containing all the aspects that play vital role in decision making. Interviews were conducted in various companies to evaluate their ideology of decision making. The preferences for projects at different stages i.e. Initial stage, middle stage and finishing stage were categorized with the help of a mathematical analytical method. Analytical Hierarchy Process (AHP) was found out to be the best mathematical analytical method. Thus AHP was used as the mathematical analytical method. The parameters were evaluated by their weightages and ranking by using AHP. Suggestion of modifications in the preferences will be provided to the participating companies. The entire research data was gathered through questionnaire survey carried out across different construction companies in Pune and Nasik. The questionnaire was sent to nearly 12 different construction firms out of which 5 people replied their responses, meaning that success ratio of survey was 41.6%. Face to face interview of 2 people were carried out keeping in view the main objectives of the study. Also, there were some limitations to the collection of data like availability of people for interview due to their busy schedule and work load they bear.

IV.GENERALFACTORS USED FOR SUPPLIER SELECTION, CONTRACT ALLOCATION

4.1 Cost:

The basic and one of the most important criteria for selecting a supplier or allocation of the contract. Companies often give order to the vendor who supplies material and services at the cheapest rate.

4.2 Quality:

This factor which is at the top most priority irrespective of the cost. The durability and customer satisfaction is decided by the quality of the raw material and make of the product.

4.3 Availability:

The stage of the project affects the priority for availability of the material. Ex. If the project is in initial stage then the availability of the product which is required at later stage is not a concern/priority.

4.4 Financial Position:

This parameter affects the majority of the project. Project delivery is totally dependent on this parameter. Also, the quality and grade of the project is dependent on this.

4.5 Availability of the labours / Work force:

The contract allocation depends on the work force that the contractor has. This allocation also depends on the delivery time and stage of the project.

V .DATA PRESENTATION AND ANALYSIS

The data collected is analysed and presented in this section. This section is intended to represent graphically the decision making process. Using AHP rankings and weightages of various parameters for different stages of infrastructure project of multiple companies were mathematically evaluated. For this evaluation, AHP excel sheet developed by Prof. Goepel is used. Thus bar graphs are made to enhance the data analysis for proper and easy understanding.

QUESTIONNAIRE

Project:
Developer:
Stage of the project:

Please rate the preferences according to the company policy and project stage.

Serial No.	Decision Node	Scale (1-10)
1. Selection of Supplier	Location of Supplier	
	Availability of Material	
	Business relations with supplier	
	Credit capacity	
2. Contract Allocation	Experience	
	Cost Effectiveness	
	Grade of Equipment	
	Work force	
	Reputation	
	Credit capacity	
3. When to order material	Availability of funds	
	Ordering material in advance	
	Availability of material at best cost	
4. How much to order	Availability of funds	
	Availability of material at best cost	
5. Material Selection	Ordering as per the requirement of the current stage of work	
	Cost	
	Quality	
	Availability	

*Scale of 10 being most important and 1 being the least important.

Fig 1: Sample Questionnaire

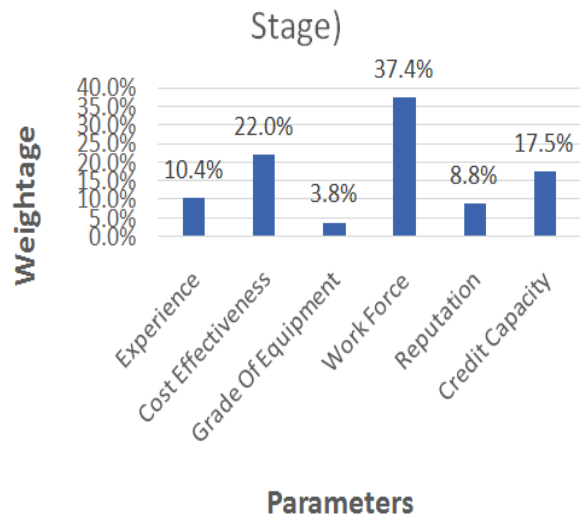


Fig 2: Graph for Initial Stage of Construction Project

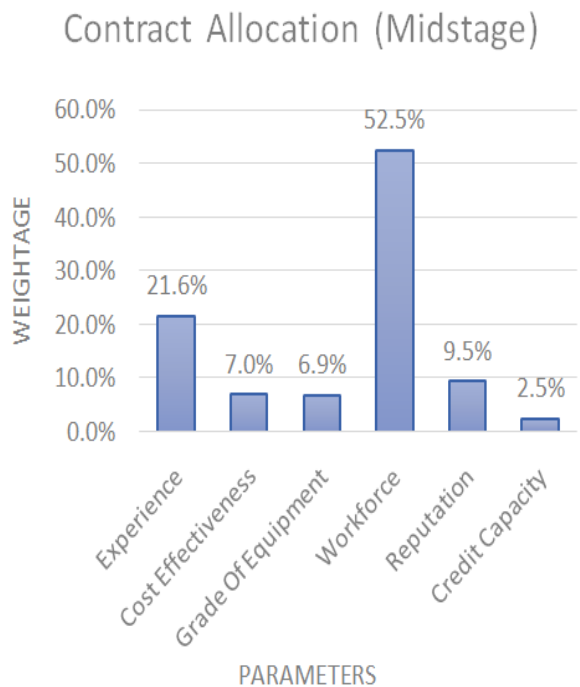


Fig 3: Graph for Middle Stage of Construction Project

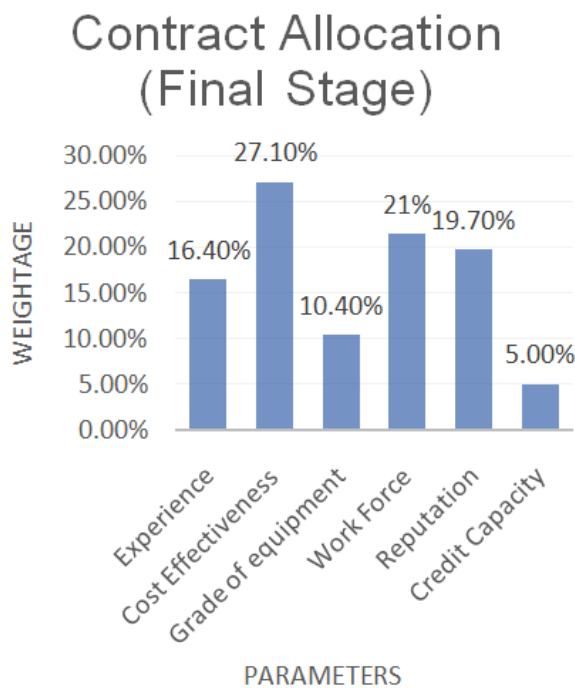


Fig 4: Graph for Final Stage of Construction Project

From the above graphs it can be seen the preferences of the companies for the projects differ according to the stages of projects. From Fig2, it can be seen that for the initial stage project, weightage is given to 'Work Force' by the infrastructure companies. From Fig 3, it can be seen that for projects in mid-stage, weightage is given to 'Work Force' and from Fig 4, it can be seen that for the project in completion stage the weightage is given to 'Cost Effectiveness' while allocating the contract for infrastructure project.

The various other parameters and its evaluation is being currently done and its output will presented soon.

CONCLUSION

The results found can give a practical approach to developers to optimise and reschedule a total inventory control and management on infrastructure projects. The research paper gives summary of various parameters and their method to prioritise and vary the decisions. This innovative concept of streamlining decisions can lead to effective and precise execution of a project. This

research is an attempt to highlight total quality management required for large scale infrastructure companies. The method suggested can be effectively implemented on multinational large scale projects.

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Ultra-high Strength Concrete with Reduced Carbon Footprints

^[1] Aziz J. Jesawada, ^[2] Shreya Joshi, ^[3] Dimple Ahuja

^{[1][2][3]} M.Tech Student, MIT-ADT, Pune, ^[2] MASc. Student, Carleton University, Canada, ^[3] B.E. Civil

Abstract— In today's scenario, the availability of land is much less than its requirement, so there is need of constructing massive structures but demands high cement usage. This paper aims to achieve ultra-high strength of concrete by replacing cement with waste materials like alccofine and iron dust. This will reduce usage of cement, which can save energy and reduce pollution. The ultra-high strength is achieved by partial replacement of cement with micro-silica and alccofine. Further, if cement is partially replaced by micro silica and sand is replaced by iron dust, ultra-high strength is achieved, but not appreciable.

Keywords: Alccofine, Iron-dust, Micro Silica, Supercon-100.

I. INTRODUCTION

In the past several years, improvements have been occurring in Concrete Technology. revolutionary developments in super-plasticizing admixtures and sustainable use of supplementary materials have facilitated improvements in the mechanical properties and durability of concrete. For example, researchers are using micro silica and high range water reducing admixtures to produce high density concrete. Along with micro silica, various environmental friendly materials can also be used as a replacement of cement and sand to fill the voids and increase the compressive strength of concrete. Production of Ultra-High Strength Concrete has been carried out since years. The project is focused on strength as well as on reducing the use of natural materials. We are aware that production of cement generates large amount of carbon-dioxide which leads to pollution in the environment. The amount of carbon-dioxide emitted in the atmosphere can be decreased by reducing the usage of cement in concrete. So, instead of using cement, it has been partially replaced by the eco-friendly materials like micro-silica and alccofine. On the other hand for the improvement of compression and flexural strength, sand has been partially replaced by iron-dust in small quantity. A great effort has been made on reducing water-cement ratio and achieving good workability by using a melamine based superplasticizer i.e.supercon100.

II. BACKGROUND

The Ultra- High Strength Concrete (UHSC) is composed of cement, coarse aggregate, fine aggregate, grit, micro silica and water reducing admixture. When used in optimum dosages, this admixture reduces the water-cement ratio while improving the workability of concrete. The mechanical properties of paste are enhanced by addition of micro silica which contributes in filling voids, producing secondary hydrates and enhancing rheology. The porosity of cement paste is reduced by lowering water-cement ratio and improves durability.

Saurabh Gupta, Dr.Sanjay Sharma, Er. Devinder Sharma [1] studied "A Study on Alccofine a supplementary cementitious material" Due to its ultra-fine size and high content of calcium oxide (CaO), Alccofine 1203 can be used as SCM. It is essential in terms of reducing heat of hydration and strength at all stages. Alccofine 1101 can be used as a grouting purpose. To determine the effect of Alccofine 1203 on workability water requirement and HRWR dosages, 3 trials of concrete mixes were prepared, based on following mix designs methodology- Results are taken from study carried out by Counto Micro fine Products PVT. LTD.

From the research it was concluded that as Alccofine is a mineral admixture in a concrete mix, it can increase the initial strength of concrete than the ordinary concrete. It has property which helps the concrete to possess and retain workability for sufficient time. Alccofine can be added directly with cement which makes it easy to use. The Ultrafine Particles of Alccofine provides smooth and better surface finish. For High Strength Concrete the cost of concrete mix with Alccofine is lesser than the concrete without Alccofine.

Dr. Prema Kumar W. P., Mr. Ananthayya M. B., Mr. Vijay K. [2] Studied “Effect of replacing sand by Iron Ore Tailings on the compressive strength of concrete and flexural strength of reinforced concrete beams. In their experimental work, they studied the effect of replacing sand partially or completely in cement concrete by Iron Ore tailing. Iron Ore Tailing is a waste material from the Iron Ore industry. They have investigated the disposal problem of iron ore tailing leading to environmental pollution. Compressive strength and flexural strength of cement concrete cubes and reinforced concrete beams respectively were tested by varying percentages of sand replacement by Iron Ore tailing. From the results, it was concluded that the compressive strength of cement concrete and flexural strength of reinforced concrete beams were not impaired by sand replacement. On the contrary, there was an enhancement in the strength for all the percentages of sand replacement.

Richard P and Cheyrey M. (1995) [3] studied “Composition of Reactive Powder Concrete” recommended the following principles to develop UHSC:

- Concrete can be made homogenous by removal of coarse aggregate.
- To carry out pozzolanic reaction in concrete, micro silica should be used.
- Optimization of the granular mixture for enhancement of compacted density.
- Application of presetting pressure for better compaction.
- Post-setting heat treatment to enhance the mechanical properties of the microstructure.
- Ductility can be achieved by adding steel fibers to the concrete.

III. MATERIALS

A. ALCCOFINE:

Alccofine is a new generation ultrafine product whose basic raw material is slag of high glass content with high reactivity obtained through the process of controlled granulation. Its particle size much finer than other hydraulic materials like cement, fly ash, silica etc. being manufactured in India. Alccofine has unique characteristics to enhance, performance of concrete in fresh and hardened stages due to its optimized particle size distribution.

I. Benefits of Alccofine-1101:

Alccofine penetrates better in tight joints, fissures & pore spaces. This penetration imparts greater water tightness. Ultrafine particle size allows the grout to penetrate fine sands and finely cracked rock. By using Alccofine 1101 initial and final setting time faster than normal grade cements which increases the productivity in tunnel grouting operation and reduce the waiting time for the next activity to start. It has no hazardous components, better working environment and excellent durability. Alccofine 1101-s is a hydraulic binder which can be used as an additive for complex mix design. It is also cost effective.

The Physical and Chemical Properties of Alccofine-1101 is as follows:

Table 1: Chemical Properties of Alccofine-1101

Chemical Analysis	S	IR	SO ₃	MgO	CL	LOI
Mass(%)	1.5	5	4	3	8	0.1

Table 2: Physical Properties of Alccofine-1101

Physical Analysis	Range
Bulk Density	600-700 kg/m ³
Surface Area	>8000 cm ² /gm
Specific Gravity	2.9-3.0
Particle Size, d ₁₀	<2.5 μ
d ₅₀	<6 μ
d ₉₀	<12μ
Initial Setting Time (min)	1 hr
Final Setting Time (max)	10 hr

II. Compressive Strength

As per IS 4031 (Part 6):1988

Table 3: Compressive Strength

DAY	MPa
7	>20
14	>30
28	>40

B. IRON-DUST

Iron-Dust is an industrial by product generated from milling industry in powdered form. It is left largely unused and is hazardous to human health because it is airborne and can be inhaled. The chemical properties of the iron- dust used in the study is as follows:

Table 4: Chemical Composition of Iron-Dust

Chemical Compound	Weight (%)
SiO ₂	2.41
TiO ₂	0.72
Al ₂ O ₃	1.81
Fe ₂ O ₃	89.0
MgO	0.23
MnO	2.16
CaO	0.45
Na ₂ O	0.66
K ₂ O	1.64
P ₂ O ₅	0.34
Ni	0.002
Cu	0.003

C. MICRO SILICA

Micro Silica (MS), also called condensed silica fume (CSF), is mineral admixture, mostly composed of submicron particles of amorphous silicon dioxide. When added to concrete, micro silica acts in two ways. As filler it improves the physical structure, occupying the space between hydrated cement particles, and as a pozzolan, it reacts chemically with the calcium hydroxide released during the hydration on cement, forming strength giving compounds to impart greater strength and durability to concrete. Bridge construction, marine structures, parking structure, water supply and sewage facilities, all benefit from the use of micro silica. MS is always used with a chemical admixture in concrete.

Physical Characteristics:

MS is essentially amorphous silicon dioxide and is dark grey in color. Besides its amorphous nature, the reactivity of MS in concrete depends upon the size of particles, size distribution and how well the particle gets dispersed in concrete after mixing. The sand present in concrete is also silicon dioxide, chemical similar to MS but crystalline in nature, hence does not react with hydrated cement. The physical characteristics of MS are given below:

Table 5: Physical characteristics of Micro-Silica

Particle Size (typical):	Bulk Density: (as-produced): (densified):	Specific Gravity:	Specific Surface
<1 μm	130 to 430 kg/m ³ 480 to 720 kg/m ³	2.2	15,000 to 30,000 m ² /kg

Chemical Characteristics:

The typical chemical composition of Micro Silica obtained from various sources is as follows:

Table 6: Chemical Composition of Micro-Silica

CONSTITUENT	SOURCE AND COMPOSITION (%)		
	SILICON	FERRO-SILICON	SILICON QUARRY
SiO ₂	97.5	96	92.48
C	0.40	0.50	-
Fe ₂ O ₃	0.03	0.50	0.09
Al ₂ O ₃	0.29	0.20	2.60
CaO	0.20	0.20	0.31
MgO	0.10	0.50	0.00
K ₂ O	0.20	0.50	0.04
Na ₂ O	0.10	0.20	1.08
Cl	0.01	0.01	-
SO ₃	0.10	0.15	0.09
Moisture	0.20	0.50	-
Loss of ignition	0.70	0.70	1.85

IV. MIX DESIGN

Mix design 1:0.62:1.64

(Cementitious material: Fine aggregate: Coarse aggregate)

Replacement of Micro-silica with varying percentages by cement:

Table 7: Materials for 1m³ of concrete (Keeping 20% constant of micro-silica rest 80% of cement was again partially replaced by Alccofine.)

Cement (kg)	Water (kg)	Sand (kg)	Coarse aggregate (kg)	Grit (kg)	Micro-silica (kg)	Replacement (%)
940.7	234.6	580.2	619.8	928.4	0.0	0%
846.9	234.6	580.2	619.8	928.4	93.8	10%
753.1	234.6	580.2	619.8	928.4	187.7	20%
659.3	234.6	580.2	619.8	928.4	281.5	30%

Keeping 20% constant of micro-silica rest 80% of cement was again partially replaced by Alccofine.

Table 8: Results of compression test.

N/m ²	7 th day cubes	Average Strength of 7days	28 th day cubes	Average Strength of 28days	90 th day cubes	Average Strength of 90days
0%	67.00	70.77	88.88	89.63	95.88	95.59
	71.14		86.67		97.90	
	74.22		93.33		95.59	
10%	67.11	67.19	75.55	73.33	93.63	89.49
	67.33		73.33		87.33	
	67.12		71.11		87.51	
20%	65.33	66.56	80.00	79.11	79.51	80.80
	65.44		73.77		82.67	
	68.88		83.55		80.22	
30%	64.44	65.97	65.44	68.33	76.00	74.55
	67.82		69.33		74.98	
	65.66		70.23		72.66	

Table 9: Materials for 1m³ of concrete (Keeping 20% constant of micro-silica, sand was partially replaced by waste material Alccofine).

Cement (kg)	738.45	729.04	719.63	710.23
Water (liter)	235.17	235.17	235.17	235.17
Sand (kg)	580.20	580.20	580.20	580.20
Coarse Aggregate (kg)	619.80	619.80	619.80	619.80
Grit (kg)	928.40	928.40	928.40	928.40
Micro-silica (kg)	188.14	188.14	188.14	188.14
Alccofine (kg)	14.11	23.52	32.92	42.33
Superplasticizer (liter)	4.70	4.70	4.70	4.70
Replacement (%)	1.5%	2.5%	3.5%	4.5%

Table 10: Result of Compression Test

N/mm ²	7 th day cubes	Average strength of 7 th day	28 th day cubes	Average strength of 28 th day
1.5%	51.11	52.31	77.78	77.96
	52.89		77.78	
	52.92		78.32	
2.5%	48.00	51.04	76.55	77.01
	54.22		76.69	
	52.67		77.78	
3.5%	55.55	57.43	82.00	56.48
	57.78		83.90	
	58.97		84.78	
4.5%	55.56	83.56	86.45	89.07
	56.89		88.56	

Table 11: Materials for 1m³ of concrete (Keeping 20% constant of micro-silica, sand was partially replaced by waste material Alccofine).

Cement (kg)	940.70	940.70	940.70	940.70
Water (litre)	282.21	282.21	282.21	282.21
Sand (kg)	557.00	533.78	510.58	487.37
Iron-dust (kg)	23.21	46.42	69.62	92.83
Coarse Aggregate (kg)	619.80	619.80	619.80	619.80
Grit (kg)	928.40	928.40	928.40	928.40
Micro-silica (kg)	188.14	188.14	188.14	188.14
Super-plasticizer (liter)	5.64	5.64	5.64	5.64
Replacement (%)	4%	8%	12%	16%

	76.32	79.33	81.02	87.97
Average strength of 28days	75.79	77.44	78.63	85.73

Table 12: Result of Compression Test

N/mm²	4%	8%	12%	16%
7th day cubes	47.56	52.44	49.78	56.89
	48.48	52.54	52.44	56.92
	48.68	52.98	52.57	57.00
Average strength of 7days	48.24	52.65	51.59	56.93
28th day cubes	75.08	75.0	77.22	82.45
	75.98	77.98	77.65	86.78

Comparison Graph of Materials:

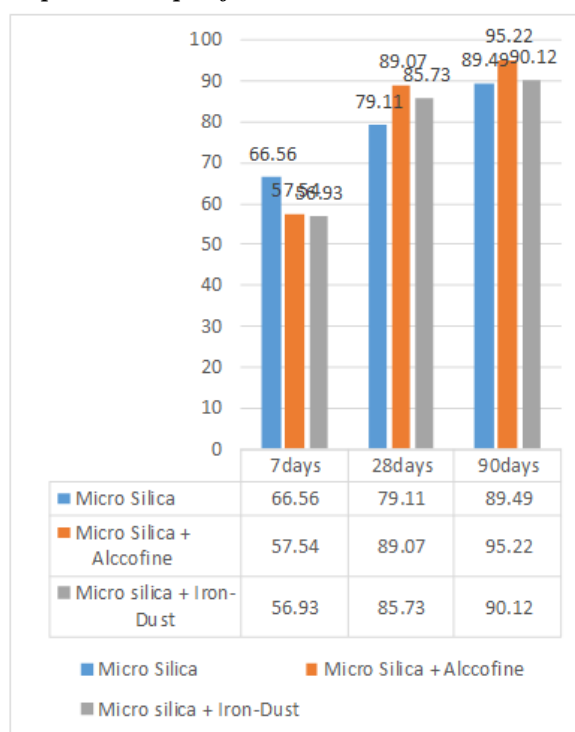


Figure 1. Comparison

V. CONCLUSION

This project was conducted to obtain ultra-high strength concrete with reduction in usage of cement and partially replacing it with eco-friendly and waste materials. Thus, the eco-friendly material alccofine and micro silica are partially replaced with 4.5% and 20% of cement respectively. The waste material iron-dust is replaced by 16% of sand. Further, to obtain true slump and proper workability, 1.5% melamine based super plasticizer supercon-100 is used. Thus, partial replacement of natural materials can result in member

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size reduction which decreases the dead load of the building. Further application of this can be extended as a shock absorbing material due to less voids. Moreover, it can be used as a construction material for barracks.

ACKNOWLEDGMENT

We express a deep sense of gratitude to our guide and Head of Department, Dr. LALIT S. THAKUR for his constructive support, constant encouragement, guidance and challenging our efforts in the right direction.

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Analysis of Water Quality Parameter of Kachna Area, Raipur, Chhattisgarh

^[1] Archana Thakur, ^[2] Chirag Atha
^{[1][2]} MBA(PCM) student

Abstract— Water is essential natural resources for all activities of human being. The study was carried out evaluate the current status of contamination in ground water collected from various different water bodies of Kachna area of Raipur district center of Chhattisgarh state. The study was carried out by collecting groundwater and municipal water samples during December 2015 – Feb 2016. The result was compared with various parameters in drinking water as per bureau of Indian Standard (BIS) specification for portable water (BIS 10500-1991) and World Health Organization (WHO).

The water quality parameters such as , electrical conductivity(EC),total dissolved solid(TDS), alkalinity, pH, total alkalinity(TA), total hardness(TH) calcium hardness and magnesium hardness were analyzed. It was found that underground water was contaminated at few sampling site and few sampling shows the physiochemical parameter below the water quality standard and is not favorable for drinking purpose.

The solution for the same problems are herewith mentioned in this research report.

I. INTRODUCTION

Natural resources are the important wealth of our country, water is one of them. Water is extremely essential for survival of all living organisms. The quality of water is of vital concern for mankind since it is directly linked with human health, protection of the environment and sustainable development. The modern civilization, industrialization, urbanization and increase in population have led to fast degradation of our ground water quality. Ground water is the major source of drinking water in both urban and rural areas. The domestic sewage and industrial waste are the leading causes of ground water pollution [1, 2].

The significance of environmental water quality monitoring has been increasingly recognized over the last few decades. Presently, drinking water quality has become a serious issue of concern for human, mainly in developed and developing countries worldwide [3].

1.1 Drinking Water Quality Standards

Drinking water quality standards describes the quality parameters set for drinking water. Despite the truism that every human on this planet needs drinking water to survive and that water may contain many harmful constituents, there are no universally recognized and accepted international standards for drinking water. Even where standards do exist, and are applied, the

permitted concentration of individual constituents may vary by as much as ten times from one set of standards to another.

Many developed countries specify standards to be applied in their own country. In Europe, this includes the European Drinking Water Directive and, in the USA, the United States Environmental Protection Agency (EPA) establishes standards as required by the Safe Drinking Water Act [4]. For countries without a legislative or administrative framework for such standards, the water quality standards do exist, most are expressed as guidelines or targets rather than requirements, and very few water standards have any legal basis or, are subject to enforcement. Two exceptions are the European Drinking Water Directive and the Safe Drinking Water Act in the USA, which require legal compliance with specific standards.

1.2 Indian Standard for Drinking Water as per BIS (IS 10500-1991)

This is a presentation which gives details of the permissible and desirable limits of various parameters in drinking water as per the BIS standard specifications for potable water.

Arghyam has compiled a brief presentation which gives details of the permissible and desirable limits of various

parameters in drinking water as per Bureau of Indian Standards (BIS) standard specifications for potable water (BIS-10500-1991). The BIS drinking water specification (IS 10500:1991) was drawn up in 1983 and its most recent revision dates back to July 2010 (Amendment No. 3).

The standard was adopted by the Bureau of Indian Standards with the following objectives -

- ✓ To assess the quality of water resources, and
- ✓ To check the effectiveness of water treatment and supply by the concerned authorities.

They apply to drinking water supplied by different Authorities/ Agencies/ Departments of State Governments and Central Government, wherever applicable in the country. They also apply to water supplied by Non-Government or Private Agencies for human consumption in any place of the country.

The various parameters covered include color, odor, pH, total dissolved solids, hardness, alkalinity, elemental compounds such as iron, manganese, sulphate, nitrate, chloride, fluoride, arsenic, chromium, copper, cyanide, lead, mercury, zinc and coliform bacteria.

The standard categorizes various characteristics as essential or desirable. It mentions the desirable limit and indicates its background so that the implementing authorities may exercise their discretion, keeping in view the health of the people, adequacy of treatment etc. All essential characteristics should be examined in routine. Besides, all desirable characteristics should be examined either when a doubt arises or the potability of water from a new source is to be established.

The standard has categorically made relaxation in the specification when no alternate resources are available and therefore, to enable the Water Supply Agencies to exercise their discretion a maximum permissible limit has also been given to certain parameters.

In formulation of the standard for drinking water BIS has taken into consideration the following publications: International Standards for Drinking Water issued by World Health Organization, 1984.

Manual of Standards of Quality for Drinking Water Supplies. Indian Council of Medical Research 1971.

Manual on Water Supply and Treatment (third revision) CPHEEO, Ministry of Urban Development, 1989.

The Central Water Commission has recently come up with a document to present the tolerance limits for inland surface waters for the various classes of water use. As per ISI-IS: 2296-1982, the tolerance limits of parameters are specified as per classified use of water depending on various uses of water. The following classifications have been adopted in India

Class A: Drinking water source without conventional treatment but after disinfection

Class B: Outdoor bathing

Class C: Drinking water source with conventional treatment followed by disinfection.

Class D: Fish culture and wild life propagation

Class E: Irrigation, industrial cooling or controlled waste disposal

Table 1.1

The test characteristics for drinking water as per IS - 10500:1991 (amended).

S. No.	Characteristic/Parameter	BIS	WHO
1	Temperature (°C)	28-30	28-30
2	pH	6.5-8.5	7.0-8.5
3	Electrical conductivity (S/cm)	1500	1500
4	Total dissolved solid (ppm)	500	500
5	Total alkalinity (ppm)	200	200
6	Total hardness (ppm)	300	300
7	Calcium hardness (ppm)	200	200
8	Mg hardness (ppm)	200	200

BIS- Beaurau of Indian Standards.

WHO- World Health Organization.

Table 1.2

Different analytical water quality parameters used for testing of quality of water and their source of occurrence and potential health effects with USEPA guidelines.

S. No.	Parameter	Source of occurrence	Potential health effect
1	pH	pH is changed due to different dissolved gases and solids.	Affects mucous membrane; bitter taste corrosion
2	Electrical conductivity (EC)	Due to different dissolved solids.	Conductivity due to ionizable ions. High conductivity increases corrosive nature of water.
3	Total dissolved solid (TDS)	Presence all dissolved salts	Undesirable taste gastro-intestinal irritation; corrosion or incrustation
4	Total alkalinity (TA)	Due to dissolved gases (CO ₂)	Embrittlement of boiler steel. Boiled rice turns yellowish
5	Total hardness (TH)	Presence of calcium (Ca ²⁺) and magnesium (Mg ²⁺) ions in a water supply. It is expressed. Hardness minerals exist to some degree in every water supply.	Poor lathering with soap; deterioration of the quality of clothes; scale forming
6	Calcium hardness (CaH)	Precipitate soaps anionic	Interference in dyeing textile,
7	Mg hardness (MgH)	surfactants, emulsifiers, anionic	paper industry etc.

The above facts motivated to undertake the present study is to analyse the water quality parameters of ground water collected from various different location of kachna area, Raipur Chhattisgarh state. The ground water quality parameters such as pH, Electrical conductivity (EC), Total dissolved solid (TDS), Total alkalinity (TA), Total hardness (TH), Calcium hardness and Magnesium hardness are analysed in accordance to standard analytical method.

2. Literature Review

A literature review surveys scholarly articles, books, dissertations, conference proceedings and other resources which are relevant to a particular issue, area of research, or theory and provides context for a dissertation by identifying past research.

Analysis of Water Quality in Different Location of BALCO Industrial Area of Korba, Chhattisgarh, India, Chirag Pandey and Ram Prakash Rajwade, International Journal of Research in Engineering, science and Technologies (2015)

Water is essential natural resources for all activities of human beings. The presents study was carried out to evaluate the current status of contamination in surface and ground water samples collected from different location of BALCO industrial area korba on the month of April 2015. The water quality parameters such as pH, Electrical conductivity (EC), Total dissolved solid (TDS), Total alkalinity (TA) and Total hardness (TH) of water samples are determined by standard method. Iron in water samples was determined by 1, 10 phenanthroline method using colorimeter at 510nm. The study reveals that Iron concentration is in the range of 0.02 to 0.59mg/L.

The physico-chemical characteristics of surface and ground water of Balco Industrial area of Korba city Chirag Pandey and Ram Prakash Rajwade, Journal of Civil Engineering and Environmental Technologies pp 23-24 (2015)

An investigation was carried out to examine the physical and chemical properties of surface and ground water quality of BALCO industrial area in Korba City. Ten different locations were selected for the study and water sample were collected in 2litres capacity of

polyethylene bottles (Jan 2015) from various sampling point viz. Budhawaribasti, ITI chowk, Irrigation colony, Parasabhata, Duggupara, Bhdrapara, Mungda, Sitamani, Risda, and Daihanpara. The parameters studied were pH, Total Alkalinity, Total Hardness, Total Acidity, Calcium and Magnesium Hardness, Total Dissolved solids and Conductivity. Result lies between viz. pH 5.55-8.46, TDS 100-390ppm, total hardness 82-238ppm, total alkalinity 20-130ppm, total acidity 10-80ppm.

Water quality analysis of River Yamuna using water quality index in the national capital territory, India (2000–2009)

Deepshikha Sharma and ArunKansal

River Yamuna, in the national capital territory (NCT), commonly called Delhi (India), has been subjected to immense degradation and pollution due to the huge amount of domestic wastewater entering the river. Despite the persistent efforts in the form of the Yamuna Action Plan phase I and II (YAP) (since 1993 to date), the river quality in NCT has not improved. The restoration of river water quality has been a major challenge to the environmental managers. In the present paper, water quality index (WQI) was estimated for the River Yamuna within the NCT to study the aftereffects of the projects implemented during YAP I and II. The study was directed toward the use of WQI to describe the level of pollution in the river for a period of 10 years (2000–2009). The study also identifies the critical pollutants affecting the river water quality during its course through the city. The indices have been computed for pre-monsoon, monsoon and post-monsoon season at four locations, namely Palla, ODRB, Nizamuddin and Okhla in the river. It was found that the water quality ranged from good to marginal category at Palla and fell under poor category at all other locations. BOD, DO, total and fecal coliforms and free ammonia were found to be critical parameters for the stretch.

Analytical study and microorganisms present in rain water of different areas

Reddy, Kondal Y; Maddirala, Priyanka; Vamshigoud, Raghu; Reddy, SaireddyNarender; Krishna, Sai; et al.

International Journal of Environmental Sciences 2.1(2011): 194-200.

Rainwater serves as a source of many essential nutrients in terrestrial and aquatic ecosystems. Rainwater harvesting is the process of storing water in sub surface so that it can be used later.

Global Market for Water Treatment Products January 2005

The global demand for water treatment products should rise at 6.6 percent per year between 2002 and 2007 and reach almost \$35 billion by the end of that period. China will record the highest rate of growth among major markets with a 17 percent annual rise through 2007. Gains in the developing world will reflect ongoing efforts to deliver safe drinking water to the more than one billion people who currently lack access.

Microbiological quality and metal levels in wells and boreholes water in some peri-urban communities in Kumasi, Ghana.

Obiri-Danso, K. S. and Adjei, B. and Stanley, K. and Jones, Keith (2009) Microbiological quality and metal levels in wells and boreholes water in some peri-urban communities in Kumasi, Ghana. African Journal of Environmental Science and Technology, 3 (3). pp. 59-66. ISSN 1996-0786

Many communities in Kumasi, Ghana, are increasingly dependent on boreholes and hand dug wells. The aim of this study was to examine the drinking water suitability of 6 wells and 3 boreholes in periurban communities in Kumasi, between December 2003 and January 2005. Total coliforms, faecal coliforms and enterococci were enumerated using the standard most probable number method and membrane filtration methods. The heavy metals in the water samples were determined using the atomic absorption spectrometry method. Overall, significantly higher bacterial counts were recorded during the wet (rainy) season compared to the dry (harmattan) season. Faecal coliforms counts (FCC) in 3 borehole samples ranged between 3×10^1 and 3.5×10^7 per 100 ml (geometric means 1.82, 1.75 and 2.8×10^4) while mean numbers of enterococci were 103-105 times

lower. The range and geometric means of FCC was similar in samples from wells but levels of enterococci were 8 times higher than in boreholes. Manganese and iron levels were well within the WHO standards for all 9 sites but lead levels except for one site (Boadi) were all higher than the WHO standard. A brief sanitation survey at each site suggested that wells and boreholes were frequently cited near latrines, refuse tips and other social amenities, and in the vicinity of domestic or grazing animals.

3.STUDY AREA

Water is essential natural resources for all activities of human beings. The study was carried out to evaluate the current status of contamination in ground water collected from various different location of kachnaarea , Raipur , Chhattisgarh on the month of December 2015. The water quality parameters such as pH, Electrical conductivity (EC), Total dissolved solid (TDS), Total alkalinity (TA) and Total hardness (TH), Calcium hardness and Magnesium hardness.

3.1 Study Area

The Kachana Area of Raipur district (21006|N 81002|E) is located in the centre of the Chhattisgarh state. The headquarters of Raipur, Chhattisgarh located on the Mumbai-Hawda line of south-eastern railways and the national highway (NH-6) is passing through the Raipur town..



3.2 Water Sample Collection

The ground water were collected from ten bore wells from different parts of the kachna, Raipur chhattisgarh on the month of December 2015 are summarized in the Table 1. The ground water samples are stored in pre-cleaned and rinsed polythene bottles of three litre capacity.

Table 3.2

Sample collection summary

S. No.	Sample Identification No	Number of Samples	Water Source
1	Kachna- 1	3	Bore Well
2	Kachna- 2	3	Bore Well
3	Kachna- 3	3	Bore Well
4	Kachna- 4	3	Bore Well
5	Kachna -5	3	Bore Well
6	Kachna -6	3	Bore Well
7	Kachna -7	3	Bore Well
8	Kachna -8	3	Bore Well
9	Kachna -9	3	Bore Well
10	Kachna - 10	3	Bore Well

RESULTS

pH and Electrical conductivity of groundwater in Kachna area, Raipur

Sample No.	pH	Electrical conductivity (mhos/cm)
Kachna- 1	6.40	800
Kachna- 2	6.55	550
Kachna- 3	6.48	670
Kachna- 4	6.87	810
Kachna-5	6.65	450
Kachna-6	6.45	630
Kachna-7	6.89	720
Kachna-8	6.45	680
Kachna-9	6.40	560
Kachna-10	6.72	600

Total Dissolved Solid and Total Alkalinity of groundwater in Kachna area, Raipur

Sample No.	Total Dissolved Solid (ppm)	Total Alkalinity (ppm)
Kachna- 1	440	296
Kachna- 2	300	281
Kachna- 3	330	265
Kachna- 4	410	250
Kachna-5	300	234
Kachna-6	390	234
Kachna-7	420	296
Kachna-8	380	312
Kachna-9	440	265
Kachna-10	350	296

Total Hardness, Calcium and Magnesium Hardness of groundwater in Kachna area, Raipur

Conclusion

Sample No.	Total Hardness (ppm)	Calcium Hardness (ppm)	Magnesium Hardness (ppm)
Kachna- 1	440	180	260
Kachna- 2	440	180	260
Kachna- 3	420	180	240
Kachna- 4	400	180	220
Kachna-5	390	190	200
Kachna-6	390	180	210
Kachna-7	390	180	210
Kachna-8	390	180	210
Kachna-9	380	190	190
Kachna-10	390	190	200

The present study deals with the analysis of ground water samples collected from blocks of Kachna, Raipur, Chhattisgarh. The pH values are in range between 6.40 to 6.89, which are within the permissible limit prescribed by BIS [7] and WHO[6].

The electrical conductivity values of samples are in range between 450 to 810 mhos/cm. The result indicates that almost all the water samples are within the permissible limit of 1400 mhos/cm. The TDS of the water samples are varies from 300 to 440 ppm, which are within the permissible limit of 500ppm. The Total alkalinity of the samples is found to range from 234 to 312ppm. The results reveals that all the samples are not within the permissible limit of 200ppm by BIS and WHO. Total hardness of water samples is varying from 380 to 440 mg/L. The values of total hardness of all the samples are not within the permissible limit of 300ppm.

FUTURE SCOPE

According to the case studied for the water quality parameter of kachna area, Raipur, Chhattisgarh, Total alkalinity (TA) and Total hardness (TH) all the ground water samples are not within the permissible limit of 200ppm by BIS and WHO. The bore well attached to the study area should be filter based on activated alumina adsorption might be solution for filtering drinking water. In general this ground water may be boiling, cooled, filtered and used for drinking purpose

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Review on Camera Technology and Digital Image Processing in Construction Industry

^[1] Krushna Raut, ^[2] Pavankumar Chandratike, ^[3] Nisha Shingare, ^[4] Ashwini Shinde, ^[5] Minal balki
^{[1][2][3][4]} UG Student, ^[5] Asst. Prof., International Centre of Excellence in Engineering and Management
^{[1][2][3][4]} MIDC Waluj Water Treatment Plant, CIDCO Mahanagar Aurangabad – Pune National Highway, Waluj,
Aurangabad -431 136 (MS) India

Abstract— This paper reviews of application of camera technology through digital image processing for monitoring construction project. On construction site cameras have been around for many years but the application of digital image processing will be helpful for incredible, efficient and economical construction projects. The control of construction project management is a very difficult task to handle in proper manner. So, application of digital image processing on construction site it will be helpful. Application of digital image processing reduces the chances of accidents on construction site.

Keywords— Image processing, Monitoring, Incredible, Efficient, Camera Technology, Etc.

I. INTRODUCTION

Digital image processing is a rapidly evolving field with growing application in science and engineering. The fundamentals of major topics of digital image processing are Representation, Processing, Techniques and Communication. The term 'Digital image processing' generally refers to the processing of two dimensional pictures by a digital computer. A digital image is an array of real or complex numbers represented by a finite number of bits. An image given in the form of a transparency slide, photograph, and chart is first digitized and stored as a matrix of binary digits in computer memory. This digitized image can then be processed and/ displayed on high resolution television monitor. Digital image processing has a broad spectrum of applications such as remote sensing via satellite and other spacecrafts, image transmission and storage for business application, medical processing, Robotics and automated inspection of industrial parts like civil engineering. Image processing is successfully used in many sub-areas of civil engineering like pavement distress assessment, site evaluation via satellite imagery, engineering document scanning studies of crack propagation and microstructure in cement based material, and evaluation of soil fabric etc. Traditionally, site superintendents walk the construction site to verify the progress report

and understand the current state of construction progress. Construction –site control in the majority of the construction industry is still mostly a manual task using visual inspection and paper based checklists, project participants such as owners, architects, contractors, and subcontractors increasingly rely on using technologies to update data when collecting site performance information. Another way for moderating construction site is by taking photos of construction site daily at the end of work and comparing every day work with previous day work. Construction Progress Monitoring is a critical task for construction manager. To go on site is time consuming process. In Nowadays due to ineffective construction management the project gets become costlier and may pitfall. In nowadays construction projects are increasing and the rates of construction material, equipment and labor charges are also increase because of demand of large construction project. In this if any proposed work like excavation can done in 2 days and the excavator operator does not do it correctly or in time then that increasing time after proposed time it counts big charge of money and it will not affordable.

II. LITERATURE SURVEY:-

Y. Wu and H. Kim researched on Digital Imaging in Assessment of Construction Project Progress (Dept. of

civil and environmental engineering, university of Alberta, Edmonton, Canada). Jeffery S. Bohn and Jochen Teizer present Benefits and Barriers of Construction Project Monitoring Using High Resolution Automated Cameras. (ASCE June 2010). Timothy C. Lukins and Emanuele Trucco researched on Towards Automated Visual Assessment of Progress in Construction Projects (UK). Junhao Zou and Hyoungkwan Kim worked on Image Processing for Construction Equipment Idle Time Analysis (Dept. of civil and environmental engineering, university of Alberta, Edmonton, Canada). Jorge Abeid Neto, David Arditi and Martha W. Evens researched on Using Color to Detect Structural Component in Digital Picture (Civil and Computer Science Dept. Illinois Inst. Of Technology, Chicago, and USA 2002). C.A. Quinones-Rozo worked on Digital Image Reasoning for Tracking Excavation Activities (Dept. of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign, United states, 22 Oct. 2007). Changyoon Kim, H. kim and Yeonjong Ju represented Bridge Construction Progress Monitoring Using Image Analysis (ISARC 2009). Seokho Chi and Carlos H. Caldas Researched on Image-Based Safety Assessment: Automated Spatial Safety Risk Identification of Earthmoving and Surface Mining Activities (ASCE March 2012). Seunghyun Lee and Min Hong Researched on Implementation of Man-Hours Measurement System for Construction Work Crews by Image Processing Technology (Hongik University, Korea, 1 may 2014).

CAMERA TECHNOLOGY IN CONSTRUCTION INDUSTRY:-

Whenever the word camera heard on our ear the first thing comes in our mind that the a scientific equipment which captured the number of images and which it converts into video that process carry out a equipment named as a Camera. Generally camera is used for capturing images and videos for safety and security of commercial shops, banks, industries and high secure zones. In digital image processing the camera with application in construction management mainly focus on controlling the measurement environment that cameras operating and processing its visual contest provided. Now in our project we take application of camera technology for digital image processing in construction industry. The movement of equipment

captured by camera technology in the form of video and after that it processed in MATLAB software in the manner of digital image processing.

BACKGROUND:-

Digital image processing develops hardware and software processing and to analysis provides promising opportunities in construction management and site investigation application. It is the different structure components and equipment from the background. It is the very potential for a resultant digitized, two dimensional about the size, shape and location of object. It is extensively for quantitative analysis and observation of the geometry of the region extraction for modeling and identification purposes. The geotechnical and transportation engineering sub-areas of civil engineering are to lead in applying image processing techniques to solve practical problems.

APPLICATION:-

• *Image processing for construction equipment idle time analysis :-*

Accurate analysis of equipment idle time is more useful for the utilization of construction equipment in a large construction project. Less idle time gives us higher efficiency of construction progress. It is not practically possible to calculate idle time by human visualization. Digital image processing method gives automatically the idle time of construction equipment during progress of project management.

• *Bridge construction progress monitoring using image analysis:*

This digital image processing presents the whole process of monitoring of a cable stayed bridge construction from the automated data acquisition to the data analysis by digital image processing.

• *Digital image processing for tracking excavation activities:-*

Digital image processing is used to field records of excavation time to time. If sufficient number of targets are selected from excavation site then 3 dimensional geometry of site is easily obtain. For specific reason observed measurements of ground deformation can be stored in the form of images.

• *Safety:-*

Safety is very important issue at construction site, for which camera is used. Any hazard is occurring at site then staff on duty informed for removes that hazard. On site thieves catch by using cameras. In case of

earthmoving and surface mining activities more possibility of accident happening in that case safety is measurable factor. In such case digital image processing gives safety risk factor.

•Automation on construction site:-

On construction site is not practically possible to use automation system but by using digital image processing it so easy to apply automation on construction site. Because of not applying automation on site large errors occur on construction site to minimize this errors digital image processing help.

BENEFITS:-

Digital image processing progress monitoring prevents construction projects from falling into the pit fall of ineffective management. It provides less rework than the general methods because of automatic and increase measurement accuracy and also provide large amount of saving. Well project control and management is to minimize the unnecessary cost of project construction. Data collected at random interval and non standard format is not helpful for project management as compared to data collected by camera at regular interval. When meetings are held, meeting participants can instantly learn about the project status and minimizing waiting periods. Digital image processing minimizes telephone calls and email answer and thus reduces the site visits for the progress of project. Camera is mounted in single spot and it is most advantages for reducing confusion that may arise from multiple perspectives. Camera taking images at standard time and it is more advantageous for accurately gauge progress. For post project analysis or marketing purposes the standard images allows for time-lapse photography. Camera use for monitoring work force, materials, inventory and equipments of important imbalance for a project management. Time wasting, task completion timing and inefficiency can be reduced for good project progress digital image processing. Digital image processing reduces the frequency of trips, saves gas expense and wear and tear on company vehicles and traveler should be informing site condition before visiting. Camera helps us for safety and security. Camera becomes beneficial to some user when used as safety inforcement tool for long projects. More detailed studies saving due to material tracking can be quantified also.

BARRIERS:-

Due to changing project site and environment it

is very difficult and complicated task of monitoring construction progress by digital image processing. Tracking the location and performance of site sources like material, labor equipment may not feasible because of several problems like ethical problem etc. due to poor communication and documentation resulting more problems generating in managing construction progress by digital image processing. Camera catch thieves but due to interval between pictures it is less likely to occur. Digital image processing is not suitable for small scale construction industry. In case for interior and finishing of building the user remount camera to other location and it gives wrong data analysis and in that case digital image processing is not applicable. In many project site due to corruption the engineers do not gives the CCTV footage for the digital image processing. Some peoples having no more knowledge of camera technology. They are in misunderstanding of camera technology.

III. CONCLUSION

This paper represented the application with benefits and barriers of use of high resolution camera & image processing in civil industry. It is found that this technology has great importance as well as potential in civil industry for better management and improvement. It may help in proper resource management. For the quantitative determination of difficult jobs, data collection, In- depth analysis this study will proved helpful.

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Importance of Material Management on Construction Sites

^[1] Pratik P. Sarowar, ^[2] Komal S. Surdkar, ^[3] Chetana K. Chaudhari
^{[1][2][3]} Students of Civil Engineering, Government Polytechnic, Aurangabad

Abstract— Materials management is an important element in project planning and control. Materials represent a major expense in construction projects. It is reported that materials and required equipments make 70% of the total project cost. Improper handling and management of material on the site adversely affects the cost of the project. Materials management is an important function in order to improve productivity in construction projects. This makes it necessary to implement material management practices on large projects. India is a developing country and bringing it in the line of developed countries, main focus is paid on infrastructure development. Numerous large projects such as metro rail, tunneling, construction of big malls are in progress. Hence it becomes necessary to study and implement material management practices. A properly implemented materials management program can achieve the timely flow of materials and equipment to the jobsite, and thus facilitate improved planning, increased labor productivity, better schedules, and lower project costs. This paper focuses on different material management practices adopted on sites and discusses their advantages and disadvantages affecting the economy of the project.

Keywords—, Construction, , economy, management, planning.

I. INTRODUCTION

Materials management is an important element in project planning and control. Materials represent a major expense in construction, so minimizing procurement or purchase costs presents important opportunities for reducing costs. The materials management system attempts to insure that the right quality and quantity of materials are appropriately selected, purchased, delivered and handled on site in a timely manner and at a reasonable cost. Poor materials management can also result in large and avoidable costs during construction. Good material management in construction must vigorously pursue the efficient utilization of la material and equipment. Material handling, which includes procurement, inventory, shop fabrication and field servicing, requires special attention for cost reduction. The use of new equipment and innovative methods has made possible wholesale changes in construction technologies in recent decades.

Literature Review

Material management can be defined as a process that coordinates planning, assessing the requirement, sourcing, purchasing, transporting, storing and controlling of materials, minimizing the wastage and optimizing the profitability by reducing cost of

material. Building materials

account for 60 to 70 percent of direct cost of a project or a facility, the remaining 30 to 40 percent being the labour cost.

Components of material management are:

- Material estimation, budgeting, planning and programming.
- Scheduling , purchasing and procurement
- Receiving and inspection.
- Inventory control, storage and warehousing
- Material handling and transport
- Waste management

OBJECTIVES OF MATERIALS MANAGEMENT

- Efficient materials planning
- Buying or Purchasing
- Procuring and receiving
- Storing and inventory control
- Supply and distribution of materials
- Quality assurance
- Good supplier and customer relationship
- Improved departmental efficiency

To fulfill all these objectives, it is necessary to establish harmony and good co-ordination between all the employees of material management department and this department should have good co-ordination with the

other departments of the organization to serve all production centers.

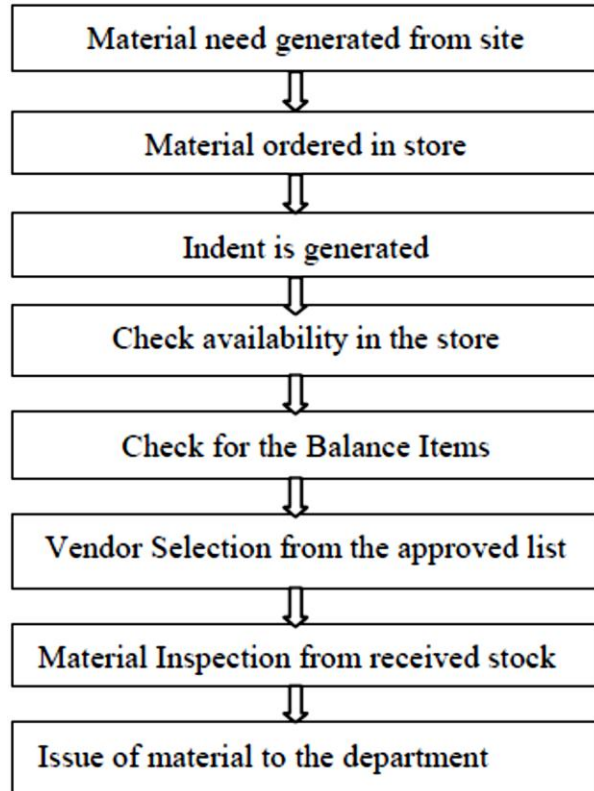


Fig. Process of Material Management

Advantages of Material Management

- Systematic operations
- Reduction in cost of material handling
- Reduction in overall cost of the project
- Increase in productivity of the labors
- Time management
- Quality control
- Better relations with suppliers
- Better relations with customers

Factors affecting material management for:

Large firms:

- Delay due to rejection of materials from quality control team
- Transportation problems
- Seasonal problems

Medium firms:

- Delay due to rejection of materials from quality control team
- Transportation problems
- Seasonal problems
- Labor strikes
- Improper handling of materials

Small firms:

- Delay due to rejection of materials from quality control team
- Transportation problems
- Seasonal problems
- Labor strikes
- Communication problems
- Hike in material prices
- Lack of material management
- Improper material handling

Different costs involved in Material Management

• Purchase Costs

The purchase cost of an item is the unit purchase price from an external source including transportation and freight costs. For construction materials, it is common to receive discounts for bulk purchases, so the unit purchase cost declines as quantity increases. These reductions may reflect manufacturers' marketing policies, economies of scale in the material production, or scale economies in transportation. There are also advantages in having homogeneous materials.

The cost of materials is based on prices obtained through effective bargaining. Unit prices of materials depend on bargaining leverage, quantities and delivery time. Organizations with potential for long-term purchase volume can command better bargaining leverage. While orders in large quantities may result in lower unit prices, they may also increase holding costs and thus cause problems in cash flow. Requirements of short delivery time can also adversely affect unit prices.

• Order Cost

The order cost reflects the administrative expense of issuing a purchase order to an outside supplier. Order costs include expenses of making requisitions, analyzing alternative vendors, writing purchase orders, receiving materials, inspecting materials, checking on orders, and maintaining records of the entire process. Order costs are usually only a small portion of total costs for material management in construction projects, although ordering may require substantial time.

• Holding Costs

The holding costs or carrying costs are primarily the result of capital costs, handling, storage, obsolescence, shrinkage and deterioration. Capital cost results from the opportunity cost or financial expense of capital tied up in inventory. Once payment for goods is made, borrowing costs are incurred or capital must be diverted from other productive uses. Handling and storage represent the movement and protection charges incurred for materials. Storage costs also include the disruption caused to other project activities by large inventories of materials that get in the way. Obsolescence is the risk that an item will lose value because of changes in specifications. Shrinkage is the decrease in inventory over time due to theft or loss. Deterioration reflects a change in material quality due to age or environmental degradation.

• Unavailability Cost

The unavailability cost is incurred when a desired material is not available at the desired time. In manufacturing industries, this cost is often called the stockout or depletion cost. Shortages may delay work, thereby wasting labor resources or delaying the completion of the entire project. Again, it may be difficult to forecast in advance exactly when an item may be required or when a shipment will be received. While the project schedule gives one estimate, deviations from the schedule may occur during construction. Moreover, the cost associated with a shortage may also be difficult to assess; if the material used for one activity is not available, it may be possible to assign workers to other activities and, depending upon which activities are critical, the project may not be delayed.

II. OBSERVATIONS & DISCUSSION

It was observed from the literature that only large firms use typical protocol & software for material management, hence they faced minimum problems. On the other hand medium & small firms lack behind in material management as they don't use any software or they aren't aware of material management techniques. It was observed that there is no any material management department in small & medium construction firms. It was seen that though the large construction firms are using material management techniques, software, etc. still they are facing problems in the material management process. Lack of material

management ultimately results in delay in work, project cost overruns, decrease in labor productivity and wastage of materials.

Conclusion

- There should be a centralised material management team co-ordination between the site and the organization.
- Proper control, tracking and monitoring of the system is required.
- Awareness and accountability should be created within the organization
- There is a need of an efficient integrating of all aspects of material management.
- Firms employing proper material management system are seen to have increased their overall efficiency.
- Advanced softwares can be used for efficient planning of material management

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Revolution in Rural India through Solid Waste Management

^[1] Raj Parmar, ^[2] Dr Arti Pamnani

^[1] M. E student of B. V. M. Engineering College, Vallabh Vidyanagar

^[2] Sr. lecturer at B & B Institute of Technology, Vallabh Vidyanagar

Abstract— The majority of India population are still living in the rural area. According to census 2011 around 68.84 percent people are living in rural area of India. So the development of India is with development of rural area. One of the key point in rural development is effective management of solid waste. Due to change in lifestyle and economic revolution there is a quantum change in quality and quantity of solid waste. It is found that municipal solid waste management of medium scale towns and villages around are neglected due to lack of awareness and low budget allotment for these areas. Government is effectively working for cleanness of areas and solid waste management. The introduction of Swachh Bharat Mission has enforce gram panchayat to put in place a functional waste management system. At moment there are few SWM units and GPs (Gram Panchayat) in Tamil Nadu, Kerala, West Bengal, Gujarat and Rajasthan which are managing their solid waste successfully. The rural India is generating 0.3 to 0.4 million metric ton per day of solid waste in year 2016. In Gujarat around 25% of 14459 Gram Panchayat has started door to door collection of solid waste and after collection open dumping is done. This paper study the present scenario of solid waste management of Jetpur town which is located in western region of Gujarat state. Jetpur is a medium scale town with population of 1, 18,302 person. The existing data of solid waste management of the town has been collected. The analysis of this data has been done and identified the lacuna in the solid waste management system of the town. The waste generation rate of the town has been calculated which is 0.338 kg/capita/day. Also quantity of solid waste has been calculated ward wise and also future forecasting of population of the town have been calculated. Furthermore SWOT (Strength, Weakness, Opportunities and Threats) analysis of the town has been done. This paper also gives scientific methodology of solid waste management.

Keywords:- Rural solid waste management, Vermicomposting, Gram Panchayat, Door to door collection, Environmental Hazards.

I. INTRODUCTION

India is a country of villages and its development is synonymous with the development of the people living in rural areas. At the time of independence around 83 % of Indian people were living in the rural area. According to census 2001 around 72.77 % of people are still living in rural area of India. So still the majority of the India population are living in the rural area of Indian soil. The development of the India will be with development of rural area as the majority of the people are living in this area. So more focus has to be given on the rural development but Indian government are lacking in addressing this problem. There are many key point which government has to address for rural development. One of the key point in rural development is proper management of solid waste which is generating with rapid space. The term solid waste is defined as useless and discarded things from

community. In recent time solid waste management is becoming major environment concern all around the globe. MSWM includes collection, transportation and disposal of solid waste. Due rapid population growth and industrialization there is a quantum change in waste generation rate has generated challenges for MWSM. The rural India is generating 0.3 to 0.4 million metric tons per day of the solid waste in year 2016 (Ministry of Drinking Water and Sanitation (MDWS), Government of India). The waste generating in the rural area are community waste, agricultural waste and agro based industries, animal wastes and oil bearing seeds etc. The waste generation rate in small scale town in India is 0.41 kg/capita/day while the surrounding village generate around 0.08 kg/capita/day of solid waste. The composition of waste for small-scale towns was found to be 48% decomposable, 30% recyclable and 22% inert material while in the villages composition of waste was found to be 73%

decomposable, 20% recyclable and 7 % inert materials (Dass Ravi, 2007). The major problem related to rural solid waste management was that there was not any systematic way for collection of solid waste. Over the past few decades' people generally disposed of their generated solid waste by simply throwing on roads. Furthermore government has not taken any steps for management of solid waste in this rural area. Also in the majority of area there was not any organization which would take responsibility of solid waste management. Over the past few year the solid waste management of rural area has changed drastically. By introduction of the Swachh Bharat Mission (SBM-Gramin), it has forces every Gram Panchayat to put in place a functional waste management system (Centre for Rural Infrastructure, 2016). The door to door collection has been started in many areas of rural across the nation which has lead toward the proper collection of generated waste. In many villages gram panchayat has started providing the community bin dustbin for collect of the waste. Also in many part of the nation recycling or reusing of the organic waste has been started. Village has more compostable waste which is suited for composting so government has also planning to start some composting plan in rural areas.

At the present there are a few SWM units in Tamil Nadu, Kerala, West Bengal which has taken responsibility for management of solid waste in villages. Also one or two GPs (Gram Panchayat) in Gujarat and Rajasthan are managing their solid waste successfully. These GPs have a lot of practical suggestions to share with others GPs and SBM facilitators who are earnest about creating a system to manage solid waste at the Gram Panchayat level (Centre for Rural Infrastructure, 2016).

II. SOLID WASTE MANAGEMENT OF RURAL AREA OF INDIA

As per census 2011 around 68.84 % of people are living in the rural area of India. The rural India is generating 0.3 to 0.4 million metric ton per day of solid waste in year 2016. The waste generation rate of the rural area was about 0.08 kg/capita/day in 2007. The community waste generating from rural area was about 15 million tonnes in year 1990 which was about 0.81 % of total waste generated. The other types of waste are Agricultural Residues was about 17.4 %, animal dung

was highest about 73.74 %, Agro-Industrial by-products was about 2.65% and Oil Seeds was about 5.4% (A.P. Jain, 1994) In the Gujarat state around 25% of gram panchayat across the state are having door to door collection method and dumping in the pit and almost 52 % of those panchayat depends on self-disposal of waste in field for solid waste management (State of Environment Report Gujarat 2012). In the south India villages around 77% of the waste generated in the village was used as domestic fuel, animal feeder and organic fertilizer for crop production. The rest (23%) was left out in open fields for natural decomposition (M.Chowde Gowda, 1995). The villages in Tekapur area of Uttar Pradesh, generates about 287gms of residential/agriculture solid waste per capita per day. The common practice in these village for waste disposal is uncontrolled dumping (Rashmi Shah, 2012). In the Himachal area, the study on Shimla and Rangri villages revealed that in the villages around 49.7 % of solid waste is Biodegradable waste, 49.6% is non-biodegradable and 0.7 % is readily biodegradable waste. The common practice for waste disposal in the villages of Himachal is of open dumping. Some of the villagers directly dump their solid wastes by the road sides and nala. Around 44 % of the villagers burn their non-biodegradable waste in Shimla and Rangri village (Kesar Chand, 2014). In Maharashtra state, the Gondia town is generating 35 tons per day of solid waste in year 2012. The sources of solid waste in the town is from domestic waste (68.50%), Shops and Establishments (14.23%), Vegetable and Fruit Market (6%), Meat, Fish and Mutton Market (4.25%), Clinical Waste (3.52%), Construction/ Demolition (3.05%). From the study it was found that around 57.50% is biodegradable waste, Recyclable waste is around 17.5 %, Debris, Slit, Construction Waste is 10% and green waste is 15%. For the waste disposal of the town the common practice is of open dumping (Nambhau H Katre, 2012). In the Nagaland state, study on Kohima town revealed that the town is generating 54 MT of solid waste daily in 2007. The source of solid waste generation in the town are residential (57%), commercial (19%), institutional (15.5%), industrial (3%), hospital (0.5%), construction and demolition (5%). The common practice is open dumping in the Kohima town (R. Chatterjee, 2010).

III. ENVIRONMENTAL HAZARD OF DUE TO UNPLANNED MSWM

In India, due to unplanned solid waste management, the waste is left uncollected on the street, which has created a great threat to public health and environment. Around 88% of the total disease is due to improper solid and liquid waste management (Priyank Shah, 2015). The uncollected waste in rural area generally ends up in drain which will cause blocking of the drains and due to this, drain will get flooded and also create unhealthy conditions. Due to uncontrolled dumping of the solid waste, flies breed in solid waste and are very effective vectors that spread disease. Proportion of food waste in open dumping is an attractive shelter for rats. Rat consumes and spoil food and also spread disease. It was found that rats also damage the electric cables and other materials. Other than that in the rural areas solid waste is handling directly. Direct handling of solid waste can result in various types of infectious and chronic diseases with the waste workers and the rag pickers being the most vulnerable. For the disposal of the solid waste in rural area open burning of the collected waste is there which has created issues of air pollution (N. Ejaz, 2010). The waste plastics bags which are available in solid waste are a particular aesthetic nuisance and also cause death of the grazing animals that eat them. In the village the major method for disposal is open dumping which will create the leachate generation and pollute the ground water (Dass Ravi, 2007).

IV. DETAIL OF STUDY AREA

Based on population, the urban housing development Gujarat has classified town in following categories: small town- 5000-20000 of population, Small town II - 20000-50000 of population, Medium scale I- 50000-100000 of population, Medium scale town II- 11akh-51akh of population, Large city- 51akh-101akh of population, Metropolitan city I- 101akh-501akh of population, metropolitan city II- 501akh - 1crore of population, Mega polish - above 1crore of population. There are 73 Small scale towns II, 28 medium scale towns I, 24 Medium scale towns II, 2 large cities, 3 Metropolitan cities I, 1 Metropolitan city II exists in the state of Gujarat data according to census, 2011. Jetpur is a small scale town and a municipality in

Rajkot district in the western Indian state of Gujarat. Jetpur is situated on the western bank of the Bhadar River. The Bhadar River, which has a south-westerly course to within a few miles of Jetpur, here suddenly takes a curve-to the north for a few miles, and then turns to the west. A bridge has been constructed across the Bhadar about a mile north of Jetpur on the Rajkot-Junagadh highway. The coordination of Jetpur city are 21°45'15"N and 70°37'20"E. The city has average elevation of 184 m (604 ft). Jetpur city total geographical area is 36 sq.km. The mean average city temperature of city is 28°C. Highest temperature is 41°C and lowest temperature is 13°C. The hottest month of year is May (34°C avg) and coldest month is January (21°C avg). The annual rainfall is about 446.8 mm and humidity is around 57%.



Figure:-Location map of Jetpur town

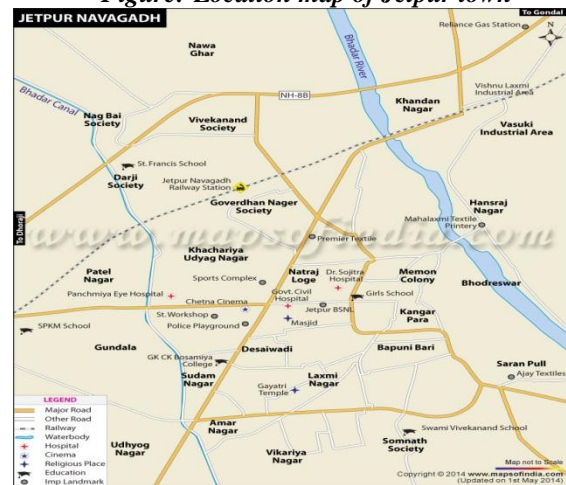


Figure: - Map of the Jetpur town

As of 2011 India census, Jetpur Navagadh had a population of 1, 18,302 people. Males constitute 53% of the population and females 47%. Jetpur Navagadh has an average literacy rate of 98% which is higher than the national average of 59.5%. The male literacy in this small scale town is 98%, and female literacy is 97% (Census India 2011)

Table I Population increasing in the Jetpur

Year	1991	2001	2011
Population	73560	104312	118302

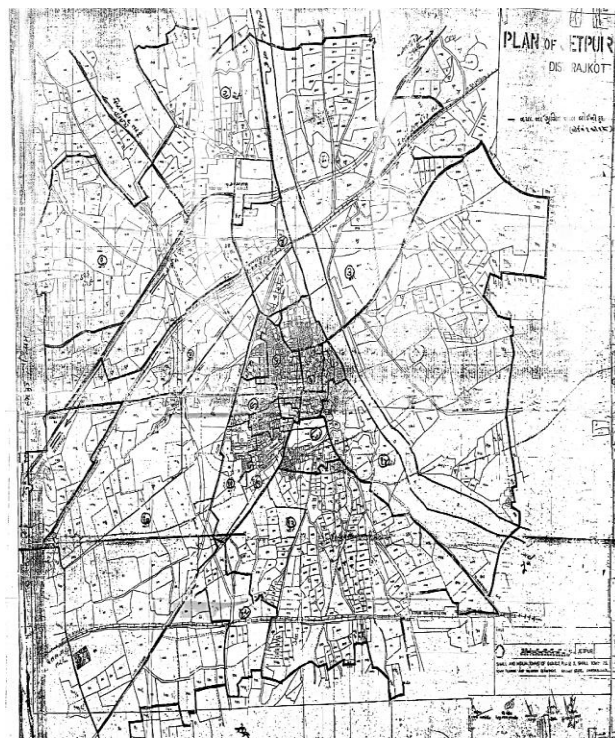


Figure: -Ward wise map of Jetpur town

V. PRESENT SCENARIO OF MSWM IN STUDY AREA

The detailed study of existing municipal solid waste management system of Jetpur Corporation has been study. The people live in the city produced 40 MTPD (Metric tons per day) from various sources like

household, domestic, industrial, construction waste, agricultural, school and office. Jetpur Municipal Corporation is working for collection, transportation and disposal of solid waste generated in city area. The general time for door to door collection is between 8 am to 6 pm. Street cleaning is done between 8 pm to 10 pm. All the 14 ward in city is collected by door to door collection on daily basis.

Table II Ward wise manpower of Jetpur town

SR NO.	WARD NO.	MALE	FEMALE
1	Ward-1	4	2
2	Ward-2	5	1
3	Ward-3	5	16
4	Ward-4	5	15
5	Ward-5	6	14
6	Ward-6	10	20
7	Ward-7	4	13
8	Ward-8	7	5
9	Ward-9	4	5
10	Ward-10	6	12
11	Ward-11	7	11
12	Ward-12	8	12
13	Ward-13	8	11
14	Ward-14	9	5

For solid waste management in the city they have 1 sanitary inspector, 4 SSI (Sanitary sub inspector) and 14 supervisors for 14 wards. They are responsible for all the management activity in the city for solid waste. For the street cleaning total manpower available to corporation are 230 worker. In that 14 wards male workers are 88 Nos and female are 142 Nos. (Table II).



Figure: - Waste collection vehicle

The Jetpur city municipal corporation has 14 tipper rickshaws for door to door collection of waste collection. In that vehicle, there are two separate compartment for dry and wet waste. They manually separate dry (recycled, reuse) and wet (cooked food) waste at collection point. Also the corporation has 6 tractor and 1 lifter. The tipper and tractor directly transport the waste to disposal site after collection of waste.

Table III Ward wise container of Jetpur town

SR NO.	WARD NO.	CONTAINER
1	Ward- 1	8
2	Ward- 2	6
3	Ward- 3	6
4	Ward- 4	11
5	Ward- 5	15
6	Ward- 6	22
7	Ward- 7	9
8	Ward- 8	10
9	Ward- 9	10
10	Ward- 10	18

11	Ward- 11	8
12	Ward- 12	10
13	Ward- 13	10
14	Ward- 14	12

The city has total 155 Nos of different waste collection points at different points of the city (Table III). From that point, community bin is transported to disposal site according to their fill ups.



Figure: - Waste collection bin of Jetpur town

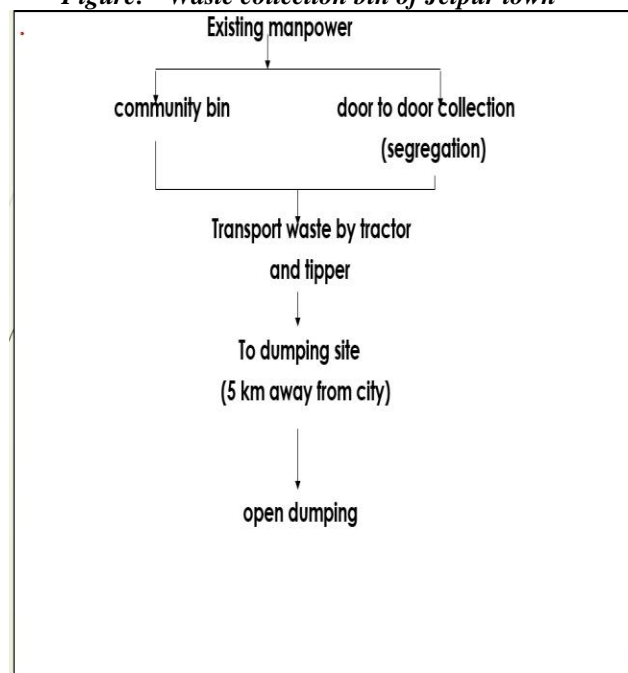


Figure: -Present SWM system in Jetpur town

The waste is collected and transported to the disposal site. The disposal site is around 7 km from the city boundary. The land available for waste disposal is around 10 hectares. The recycle waste is segregated from others hand on site. The waste is spread on the ground the recyclable waste is collected manually. The remaining other waste is then collected and open dumping is done. The recycle waste like paper, plastics, metals and various others things are sold local market and to scrap dealers.

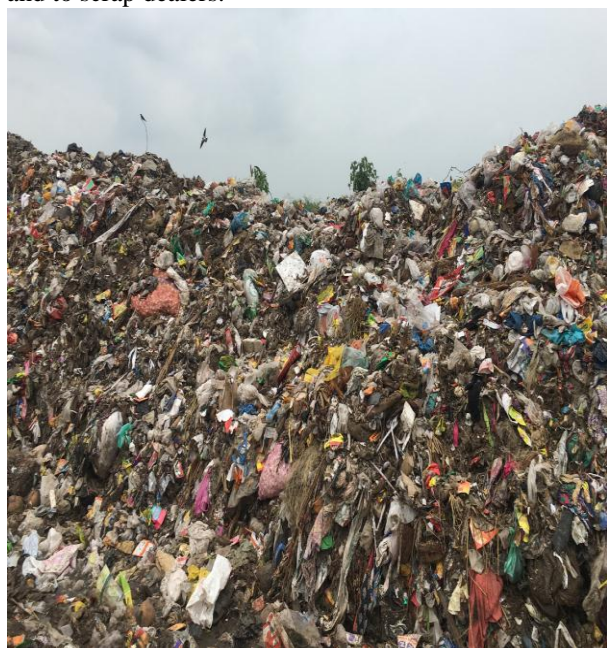


Figure: -Waste disposal site of the Jetpur town

VI. SWOT ANALYSIS OF SWM OF STUDY AREA

The SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis is a tool to identify the positive and negative points of the performance of any process, organization, project, and company. Strengths and weaknesses are internal factors while opportunities and threats are external factors.

STRENGTHS

Jetpur town has separate (sanitation) department for handling of solid waste management activity. So the environment sound technology for collection, transport, treatment, composting and final disposal can be

achieved. For proper management of solid waste the Jetpur Corporation has appointed 1 SI, 4 SSI and 14 supervisor. So that active planning can be done for SWM. The other strength of are they can attracts a large number of inflow people from other area. This can be done because Jetpur town has large number of industry. So manual labour are available for required solid waste management.

WEAKNESS

The Jetpur town certainly has various weaknesses which need to be addressed. Due to the lack of stakeholders' participation in setting up of the regulation or standard, their ability to meet with standards will be low. Also lack of public education for the waste segregation is the main weakness of the town. In terms of the financial issue, limited support from the government is an issue when implementing any activities. Beside that Jetpur town does not have any waste processing plant for solid waste. The main weakness is, they does not have any scientific landfilling site for disposal of the waste. Jetpur city handles their waste by open dumping which is creating the problem of leachate and ground water pollution.

OPPORTUNITIES

The location of the Jetpur town is good which will attracted large number of people for investment. Also engagement of private sector in solid waste management can change the economic structure of the town. It was found that small scale town have high percentage of organic fraction (50%). So it will create opportunities to implement of waste to energy plant like RDF and can also construct composting plant.

THREATS

Due to rapid growth and change in life style the waste generation has been increased which will lead towards increase in the consumption of resources. This will create threats to lost in natural resources. Due to the open dumping of solid waste many harmful disease can attack to people. Also the problem of leachate generation is there which will leads towards the pollution of the ground water.

VII. RATE OF GENERATION OF MSW OF STUDY AREA.

Waste generation of the city is 40 MTPD as in year 2017. The population is about 118302 of the city according to census 2011

The population of the city = 118302
Waste generation rate = 40/ 118302
=0.338 kg/capita/day

1991	73560	-	
2001	104312	30752	30752/73560 =0.418
2011	118302	13990	13990/104312 =0.134

VIII. POPULATION FORECAST FOR STUDY AREA

The present population of the city is about 118302. The future forecasting of population is done by two method.

- 1) Arithmetic method
- 2) Geometric method

ARITHMETIC METHOD

In this method the average increase in population per decade is calculated from the past census reports. This increase is added to the present population to find out the population of the next decade. Thus, it is assumed that the population is increasing at constant rate. The formula is

$$P_n = P + n \cdot C$$

Where, P_n is the population after 'n' decades and 'P' is present population. C is rate of change of population with respect to time is constant.

Table IV Population forecasting of study area by Arithmetic method

YEAR	POPULATION	INCREMENT
1991	73560	-
2001	104312	30752
2011	118302	13990

$$C=22371$$

$$P_{2021}=140673; P_{2031}=163044; P_{2041}=185415$$

GEOMETRIC INCREASED METHOD

In this method the percentage increase in population from decade to decade is assumed to remain constant. Geometric mean increase is used to find out the future increment in population.

$$P_n = P (1 + IG/100)^n$$

Where, IG = geometric mean (%) P = Present population n = no. of decades.

Table V Population forecasting of study area by Geometric increased method

YEAR	POPULATION	INCREMENT	GEOMETRIC RATE

IX. FORECASTING OF SOLID WASTE GENERATION FOR STUDY AREA

The current waste generation of town is about 40 MTPD. Due to rapid growth and increase in the population, the waste generation will also be increased. The current waste generation rate of the city is 0.338 kg/capita/day. In 2021 the waste generation will about 47.54 MTPD and that generation will increased to 55.108 in 2031.

$$\text{Waste generation in 2021} = 0.338 \cdot 140673 = 47.54 \text{ MTPD}$$

$$\text{Waste generation in 2031} = 0.338 \cdot 163044 = 55.108 \text{ MTPD}$$

X. DETAIL SOLID WASTE GENERATION OF STUDY AREA

The Jetpur city has total 14 sanitation ward. The ward wise waste generation has been calculate

EX: - ward 1 (waste generation rate= 0.338 kg/capita/day)

$$\begin{aligned} \text{Waste generation} &= \text{population} * \text{waste generation rate} \\ &= 7956 * 0.338 \\ &= 2.69 \text{ MTPD} \end{aligned}$$

Table VI Ward wise quantity of solid waste generation in the study area

WARD NO.	POPULATION (as per census 2011)	WASTE GENERATION (MTPD) (population * waste generation rate)
1	7956	2.69
2	7612	2.57
3	8076	2.729
4	9020	3.048
5	10933	3.695
6	7125	2.408
7	6508	2.199
8	8022	2.711
9	6509	2.200
10	10535	3.560
11	8413	2.843

12	8397	2.838
13	11098	3.751
14	8098	2.737
TOTAL = 40 MTPD		

XI. SUGGESTION FOR SCIENTIFIC MANAGEMENT OF MSW OF STUDY AREA

The solid waste collection of the Jetpur town is done effectively but in many rural part solid waste has not been collected effectively.

For effective and scientific management of the solid waste in rural, the focus should be on management at house hold level. If the management is not possible at house hold level the management should done at community level. For the scientific management of solid waste following approach should have to be followed:

- Segregation of solid waste at the household level (biodegradable and non-biodegradable).
- Reuse of non-biodegradable waste at the household level to the possible extent.
- Pubic support has to be increase by educating them which will increase the source separation at generation point as biodegradable, inert and recyclable material.
- Identifying the infamous spots which are prone to waste disposal. Local government has to identify that and educate the people not to throw waste in this empty space.
- Government have to start focusing on door to door collection.
- Various tax has to be implement on solid waste management so that funds for inadequate resource of municipal bodies can be manage.
- For primary collection of waste private agencies and NGOs has to be involved.
- Viable composting plant has to be install so that dependency on landfill is reduced.
- Vehicles which are used for waste collection, transportation and disposal are of specific design and suiting waste characteristics.
- Manufacturing of non-recyclable materials like plastics bags should be banned or any alternative method should be research for manufacturing of biodegradable plastic bags.
- Sanitary landfilling sites needs to be developed instead of open dumping.

- Proper protection of ground water has to provide from leachate because leachate generally percolate from soil and mixed with groundwater.

XII. ADVANTAGES

- Educating people will increase awareness among the society about solid waste disposal and management to understand the importance of better solid waste management.
- Source segregation will help in better handling of solid waste.
- Proper Collection of waste will decrease the amount of waste on streets and also decrease the rate of disease related to it.
- By introducing the tax on solid waste collection, funds can be generated for vehicles so that effective collection and transportation can be done.
- Vermicomposting plant will decrease the load on landfilling and also it will generate useful fertilizer.
- Scientific landfilling site will decrease the amount of leachate generated and protect the ground water from getting polluted and also decreased the level of disease.

XIII. CONCLUSION

In many of the rural area of India, proper method for collection and facility for transportation of solid waste is still not there. As the majority of the people are still living in the rural area, Indian government have to take some serious steps to address this problem of solid waste management. The Jetpur town is generating 40 MTPD of solid waste. The waste is disposed of in open at dumping site which has created great problem for public health and environment. The SWOT analysis of the Jetpur town reviled that private sector play pivotal role in managing the solid waste effectively. The lack of government support in managing the solid waste is weakness of the Jetpur Corporation. The problem of solid waste can be solved by adopting the scientific way of solid waste management. This can be achieved by educating people about the importance of solid waste management, by achieving the source separation of solid waste, by introducing the effective method for collection and transportation of solid waste. In rural area as the major portion is of organic waste, composting facility is a good option for solid waste processing.

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LIST OF ABBREVIATIONS

Abbreviations	Full form
GPs	Gram Panchayats
MTPD	Metric ton per day
RDF	Refuse Derive Fuel
SBM	Swachh Bharat Mission
SI	Sanitary Inspector
SSI	Sanitary Sub Inspector
SWM	Solid waste management
SWOT	Strength Weakness Opportunities Threat

Advances in Transportation System

^[1] Rajvi Dharod, ^[2] Sanya Kaur Chandan

^[1] 3rd year diploma, S.B.M. POLYTECHNIC, Mumbai, ^[2] 3rd year diploma, S.B.M. POLYTECHNIC, Mumbai

Abstract— Transport is a means of carrying goods and people from one place to another. Transport refers to the activity that facilitates physical movement of goods as well as Individuals from one location to another. Transport plays an important role in today's modern world. It helps in removing the distance barrier. An efficient transport system is essential for sustainable economic development of the country and plays a significant role in promoting national and global integration. An efficient transport helps in increasing productivity and enhances competitiveness of the economy. Efficient transport is indispensable to the economic development of nation. The aim of the study is to create employment, industrial growth, place utility; it also serves several purposes, stability in prices, specialization and division of labour, use of economic resources and standard of living. In country like India, where the population is growing day by day need of advance in transportation is a basic necessity. Advances in the Bus system like BRTS, Rail system like METROS & AC locals, Smart airports and waterways will have a huge impact on human life as well as it will help in the sustainable development of the country. Advanced system like Hyperloop in India, can help passengers and freight travel within fraction of minutes from one's origin to a destination. The emerging transportation system in India will have a great impact on country's economic development. The rural areas will have a strong accessibility network and the problem of congestion will reduce to a great extent by adapting the advancement in the Transit system.

Index Terms: - Advanced Transportation, BRTS, Hyperloop, Metros

I. INTRODUCTION

Transport is a means of carrying goods and people from one place to another. Transport refers to the activity that facilitates physical movement of goods as well as Individuals from one location to another. Transport plays an important role in today's modern world. It helps in removing the distance barrier.

II. LITERATURE REVIEW

The old methodologies consist of walking, palanquins, bicycle, human-pulled rickshaws, cycle rickshaws, bullock carts/ horse carriages. Motor vehicle population in India is low as per international standards, with only 24.85 million cars on the nation's roads as of 2013. In total, about 21 per cent households have two wheelers whereas only 4.7 per cent of households in India have cars/jeeps/vans as per the 2011 Census. Despite this, the number of deaths caused by traffic is amongst the highest in the world and the increasing automobile industry in India is currently rapidly growing with an annual production of over 4.6 million vehicles, with an annual growth rate of 10.5% and vehicle volume is expected to rise greatly in the future.

India's rail network is the 3rd longest and the most heavily used system in the world, transporting 8.225 billion passengers and over 970 million tonnes of freight annually, as of 2015. The railways transport about 18 million citizens daily.

In 2015–16, Government of India, declared 106 National Waterways (NW) under Inland Waterways authority of India to reduce the cost of transportation and lower the carbon footprint by moving the traffic from surface roads and railroads to waterways. Despite ongoing improvements in the transport sector, several aspects of transportation are still riddled with problems due to outdated infrastructure and lack of investment in less economically active parts of the country. The demand for transport infrastructure and services has been rising by around 10% a year with the current infrastructure being unable to meet these growing demands. According to Goldman Sachs, India will need to spend US\$1.7 trillion on infrastructure projects over the next decade to boost economic growth. (2)

III. OBJECTIVES

Transportation planning tends to have multiple objectives, which usually include:

- Traffic congestion reductions

- Parking cost savings
- Consumer savings and affordability (savings to lower-income households)
- Improved mobility for non-drivers
- Improved safety
- Energy conservation
- Air, noise and water pollution reductions
- Habitat protection
- Support for local economic development. (2)

IV. METHODOLOGY & RESEARCH FINDINGS

Fuel consumption and emissions

As per a study conducted by Asian Institute of Transport Development (AITD) titled Environmental and Social Sustainability of Transport- Comparative Study of Rail and Road (2000), rail consumes 75% to 90% less energy for freight traffic; and 5% to 21% less energy for passenger traffic when compared to road. At present, railways are mostly dependent on electricity and high-speed diesel (HSD). The consumption of HSD on locomotive services in 2013-14 was 2780.90 million litres, a slight increase from 2699.62 million litres in 2012-13. The consumption of electricity on locomotive services increased from 13,853 million KWH in 2012-13 to 14411 million KWH in 2013-14. Direct consumption of coal by the railways is almost negligible on account of the phasing out of steam locomotives.

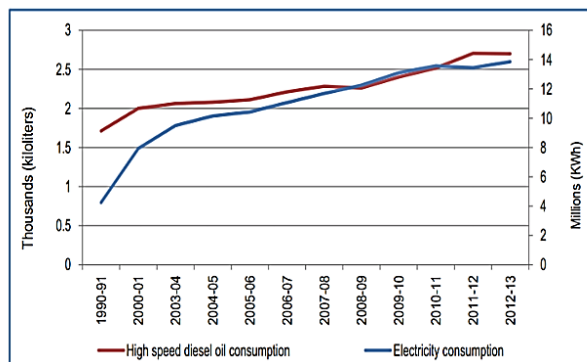


Fig. 01. Growth in consumption of electricity and hsd by railways for locomotive service

Source: (MoR 2015a)

In terms of emissions, rail transport emits 17-gram CO₂ equivalent per PKM as compared to 84-grams per PKM in case of road transport. Similarly, rail transport emits

28-gram CO₂ equivalent per NTKM as compared to 64 grams per NTKM in case of road transport.

Road sector is highly energy intensive in comparison to railways. It is also the largest consumer of energy within the transport sector from petroleum products. The road transport sector, comprising both passenger and freight transport, accounts for nearly 72 percent of High Speed Diesel (HSD) consumption in India. While the consumption of HSD in the road transport sector increased by 7.4 percent from 33.74 MT in 2009-10 to 36.24 MT in 2010-11, the consumption of motor spirit increased at a higher rate of nearly 11 percent from 12.82 MT in 2009-10 to 14.2 MT in 2010-11. With increasing air traffic, the fuel needs in the sector have also increased over the years particularly post 2000-01. The overall consumption of aviation turbine fuel (ATF) by the aviation sector grew from 3.3 MT in 2005/06 to 5.54 MT in 2011-12. During the Eleventh Plan period (2007-12), the average compound annual growth rate (CAGR) of ATF consumption was 6.8%. Water transport is one of the most environment friendly, cost-effective, and efficient modes of transportation. During 2011-12, the shipping sector consumed 0.54 MT of High Sulphur Diesel (HSD), 0.002 MT of Light Diesel Oil (LDO), and 0.37 MT of furnace oil.

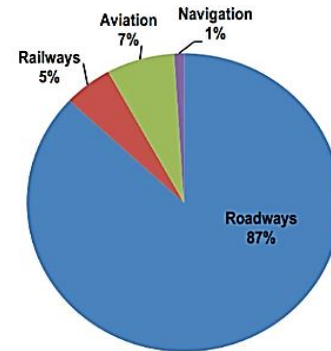


Fig. 02. Share of CO₂ equivalent emissions from transport sector in 2007.

Vehicle growth and composition

The total number of registered motor vehicles in India has increased from 0.3 million as on 31st March, 1951 to about 159.5 million as on 31st March, 2001. The total registered vehicles in the country grew at a Compound Annual Growth Rate (CAGR) of 9.9% between 2001 and 2011. In the business as usual

scenario, the total fleet size is further expected to increase to about 400 million by 2030. This growth will further worsen the traffic situation in the country and aggravate the related problems of increasing pollution levels, traffic jams, and vehicular emissions; having impact on the health and quality of life. The vehicle composition is primarily dominated by personalized modes (mainly two wheelers and cars) which account for nearly 86 percent of the total number of motor vehicles in the country. Two-wheelers alone accounted for 72 percent in the total vehicle population, followed by passenger cars at 13.5%, buses at 1.05%, goods vehicles at 4.8% and other vehicles (a heterogeneous category that includes three-wheelers, trailers, and tractors) at about 8.25%, as on 31st March 2012. Number of registered vehicles in five metropolitan cities, namely, Delhi, Bengaluru, Chennai, Hyderabad and Pune accounted for 49.3% of the total registered vehicles among the 35 million plus cities. At present, State Transport Undertaking (STU's) are primarily responsible for provision of interstate and intercity public transport services, in the form of bus services. Apart from the government run public buses, private run services also play a significant role in meeting the mobility needs in urban as rural India. These include various modes like buses, minibuses, low capacity vehicles like auto rickshaws, tempos, jeeps, etc. While personal vehicles have shown a phenomenal increase, the percent share of buses in the total number of registered vehicles has declined from 11.1 percent in 1951 to 1.1% in 2011-12, indicating slow growth. In India, the share of buses held by STU's in terms of total registered vehicles has decreased over years. The number of buses both held and operated by STU's have however shown an increase post the launch of Jawaharlal Nehru National Urban Renewal Mission (JNNURM) in December 2005, a Government of India scheme providing financial assistance for infrastructure development in cities. As per MORTH statistics, the total bus fleet held by STU's in India was reported at 1.40 lakh as on 31st March 2014 as against 1.02 lakh in 2006, registering an increase of more than 38 % over a period of eight years. Only 89.5 % of the total fleet held by STU's was operated in 2015.

Though the number of buses has increased post 2006, a gradual decline in the total number of passengers carried has been observed by the STU's. The total

number of passengers carried by the STU's in 2013-14 was 2,51,111 lakh passengers which was 1.6% lower than the number of passengers carried during 2012-13.

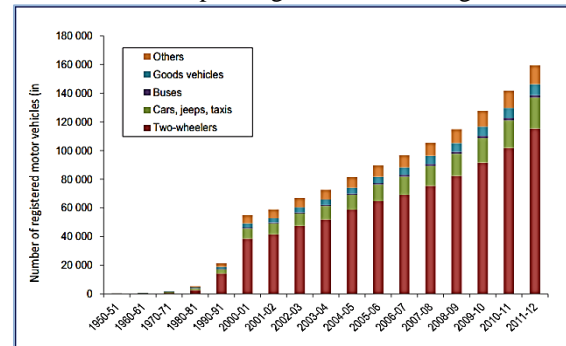


Fig. 03. Growth in the total registered motor vehicles in India (1951-2012)

**Source: MoRTH, 2013a
Traffic**

Though a decline was seen in traffic in 2008 due to increase in fuel costs and global economic recession, the sector however recovered once again in mid-2009. The traffic is further expected to rise exponentially in the coming decades.

Passenger traffic: In 2010-11, domestic air traffic in India carried by scheduled carriers was 54 million and is expected to increase by more than 8 times reaching 438 million passengers in 2030-31. International traffic at the Indian airports moving to and from India by 2030-31 is also expected to grow by 5.7 times from 38 million in 2010-11 to about 217 million in 2030-31. Freight traffic: As per the Report by the Working Group on Civil Aviation for the NTDPC, India's domestic and international cargo traffic (carried) from and to India is projected to reach a level of 3.6 and 8.2 million metric tonnes (MMT) per annum by 2030-31 respectively from the level of 0.5 and 1.2 MMT per annum in 2010-11. The Indian aviation sector is constrained in terms of capacity. Given the expected increase in traffic in future, the sector would need to develop adequate infrastructure and undergo extensive capacity augmentation to meet the rising demands. As per the Twelfth Five Year Plan (2012-17), it is estimated that there is an additional requirement of 30 functional airports by 2017 and about 180 functional airports in all over the next 10 years. In terms of investments, a total investment worth of INR 3, 77,275

crores have been estimated for airport infrastructure development work by 2031-32. (1)

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V. SCOPE OF THE STUDY

To provide innovative services relating to different modes transport and traffic management and enable various users to be better informed and make safer, more coordinated and smarter use of transport networks. (3) As it is fast, reliable, efficient, transportation is clearly the key in reducing supply chain costs and lead times between manufacture and consumption. Major motive of any transportation system is to make sure that the passage of people and commodities is secure, structured, swift, pleasant, suitable, inexpensive and eco-friendly. It is evident that transportation is the key component of a nation's progress transportation system needs to cope with this progress. (4)

VI. FUTURE SCOPE

As per our study, advancement in Rail systems, BRTS will help reduce the pollution and traffic congestion as demand for the private vehicles have increased. Advanced system like Metro rails, Mono rails and Hyperloop are designed to save time consumed for traveling, and also it is cost effective.

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Water Credit Management System for Urban Smart City Planning

^[1] Reva Gaykar, ^[2] Sai Prakash Rajendran, ^[3] Dr. Shantini Bokil, ^[4] Prof. Priyanka Chandure
^[1, 2] Reserach Students, Department of Civil Engineering, MITCOE, Pune
^[3] Professor and Head, Department of Civil Engineering, MITCOE, Pune
^[4] Professor, Department of Civil Engineering, MITCOE, Pune

Abstract— The world is facing improper distribution of water and one of the major barriers to safe water and sanitation is affordable financing. There are millions of families spending more than 20% of their income on water. The truth is that many of these families can get a water or sanitation solution in their home for a fraction of their annual water costs. All they need is access to affordable financing to make this a reality. An attempt has been made through this paper to offer financial services to low income population through water credit system. Many financial systems in developing countries weren't offering loans for water and sanitation to the poor. This paper focuses on water credit system as an exclusive solution to work in microfinance. Water credit system has been proved to be very effective solution for water management in rural area. This research highlights that the water credit is recognized as a proven, powerful smart solution to slum and rural areas and it has reached more than nine million people through more than 2.2 million loans. As every urban area is facing challenge of merging the connected rural areas as a part of smart city initiative. This research paper primarily aims at putting forth an optimal solution for dynamic parameters of rural and urban areas.

Index Terms: - Water credit, microfinance, rural areas, smart solution.

I. INTRODUCTION

Poverty is a complex phenomenon and its effects are more complex processes. In every developing nation, the ongoing crucial issue is socio-economic development and poverty alleviation. One of the major barriers to safe water and sanitation is affordable financing. Water is an indispensable natural resource for the survival and well-being of human kind. There are millions of families spending more than 20% of their income on water. They are caught in a cycle of poverty, unable to afford permanent access to water in their homes and beholden to water merchants who charged exorbitant fees. All they need is access to affordable financing to make this a reality. Many financial systems in developing countries weren't offering loans for water and sanitation to the poor. It is very difficult for the poor to get small working capital from formal banking system for various reasons. "Money makes money and when you got a little, it is often easy to get more. The great hardship is to get the little." (Adam Smith) Millions of people around the world could get access to safe water in their homes with the help of small, affordable loans. The truth is that

many of these families can get a water or sanitation solution in their home for a fraction of their annual water costs. Hence, water credit is new system which offers financial services to low income population. There is both a need and demand for these loans, because when people have access to safe water, they get time back to go to school, earn an income and take care of their family. It changes their world.

II. LITERATURE REVIEW

Literature review includes case studies of Bangladesh and Tiruchirapalli in which concept of microfinance is used. Microfinance is bringing credit, savings and other essential financial services within the reach of. Millions of people who are too poor to be served by regular banks, in most cases because they are unable to offer sufficient collateral. This literature overviews about access to micro-finance in rural and slum areas and use of that principle in water supply and sanitation.

A. FUNDAMENTALS OF WATER CREDIT

Water credit leverages philanthropy to allow people to tap into their potential as customers. For example, it

provides subsidies and technical assistance to microfinance institutions to help them launch loan portfolios. The loans enable the world's poor to pay for a connection to a water source or install a toilet in their homes. Water credit accelerates progress toward ending the global water crisis. But for this initiative to reach its full potential, we need to unlock more, affordable social investment capital to help microfinance institutions and other enterprises scale their water and sanitation efforts to meet market demand.

1. BANGLADESH CASE STUDY

Bangladesh is a pioneer and home of conceptualizing micro-finance program. It has undertaken a number of such programs to reduce poverty and bring about socio-economic changes in the rural community. The main purpose of this case study is to give an overview about access to micro-finance for rural poor and its impact on their poverty situation and relevant factors related to income of the micro-finance recipients. The principal method employed for this case study was a field survey using a semi-structured interview schedule. The study was conducted in six villages of three unions of Gangachhara Upazila of Rangpur district in the northwest region of Bangladesh. The study villages and unions were selected based on availability of credit recipient people. Only the micro-credit recipients of the study area were considered as population for the study. All micro-credit respondents were female according to credit distribution criteria. The whole set of individuals i.e. microcredit recipients under the study were estimated to be around 940. Among them, 360 respondents were chosen as sampling. Credit respondents were randomly selected using proportionate random sampling procedure considering each of the village population. Additionally, 60 non-credit respondents taking 10 from each village were also selected and interviewed as a control group for comparative analysis. Standard of living includes sources of drinking water, toilet condition, medicare, number of clothing per year and electricity consumption level. Change in sources of drinking water was considered by number of users before and after joining the credit program. It indicates that all respondents (100%) used tube-well to meet their daily water requirement after their involvement in credit program whereas before joining it was 93.4% and the rest 6.6% used either river or pond water as shown in Fig.no.1

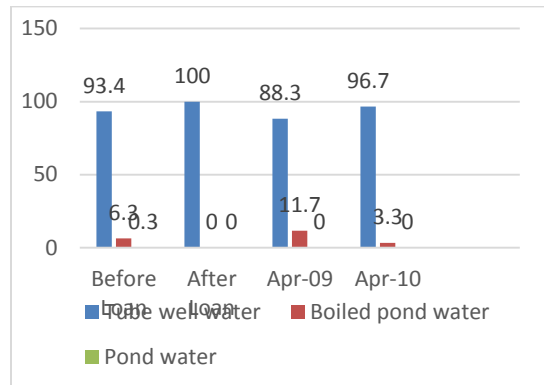


Fig.no.1: Comparison of credit system

A significant change followed within the members in respect of their using drinking water between the study periods (from April 2009 to April 2010). Financial solvency of the credit respondents influenced to fix and use tube-wells in the study area. The increasing trend of fixing and using tube-well also influenced the members since they could consume it from other owner's tube-well without spending money. This indicates that credit respondents' health consciousness has substantially improved. Change in use of latrine was considered by number of different types of latrine users before and after joining the credit program. It shows that after involvement with credit activities, percentage of pucca (metaled latrine) and ring slab (pit) users increased from 44.5 to 82.3%. It also indicates that after involvement in credit program, percentage of kutcha (without ring slab and only earthen) and open space users decreased from 55.5 to 17.7%. Sanitation behaviour has changed within the credit respondents. This may be due to their involvement with credit program. It also enhanced respondents' financial ability and became more aware of health and sanitation practices by taking lesson from NGO workers. In short, it is generally perceived that micro-credit program helps to improve socio-economic status of the rural women in Bangladesh the involvement in credit program had a positive impact on different dimensions of the participants' standard of living. Majority of the respondents appear to upscale their poverty situation by properly utilizing the credit received.

2. CASE-STUDY: TIRUCHIRAPPALLI, INDIA

According to the study of Andrew Barenberg, a network of women’s self–help groups in Southern India are responsible for the development of a water and sanitation loan fund. The success of the loan fund reduced barriers to credit from formal lending institutions and increased investment in water and sanitation facilities the objectives of his case study are to summarize this loan program and explore the possibilities and limitations of this new financing model for the water and sanitation sector. Gramalaya, founded in 1987, works within three regional areas of Tamil Nadu. Access to improved sanitation in these areas is severely limited. Only 36% of the population had access to a basic toilet (Geetha, 2008). Those household without toilets use public facilities or defecate in open areas. Public toilets in urban areas were generally not well maintained, overburdened, and often required a fee. Due to privacy and cultural concerns, women and girls were often unable to defecate during the day, which subjected them to serious health problems and dangerous situations at night. While 90% of the target population was officially listed as having access to water facilities, many of the water systems in the area were overloaded, poorly maintained, or broken. In urban areas, women waited for hours, for water available only during certain period, on certain days. In most poor neighbourhood’s locations, this process took two to three hours. So, in 2004, Gramalaya began its micro–loan program for water and sanitation improvements. This program was executed through its Women’s Action for Village Empowerment (WAVE) Federation network. Gramalaya provided loans directly to SHG (Self-help group) and SHG members distributed the loans among borrowers with all members sharing joint liability. The women directly paid for the construction work while Gramalaya monitored the construction. SHG members were key program planners and community organizers that helped to stir community demand for safe water and toilets. As of December 2007, Gramalaya had disbursed nearly \$200,000 in loans directly, with an average loan size of \$91 per borrower. Loans were for 24 months with 12% or 18% percent interest rate and were used to construct latrines, toilets, bathing facilities, water connections, and stand posts. Many borrowers constructing latrines also accessed a subsidy from the state of Tamil Nadu of a 1500 rupees reimbursement.

Before the program, loans for water and sanitation were not available in the formal market and could only be accessed at interest rates often over 120%. Hence, Results of this case study suggest that when tied to participatory community –groups, a viable market can be made for credit for water and sanitation improvements.

B. GROWTH OF MICROFINANCE

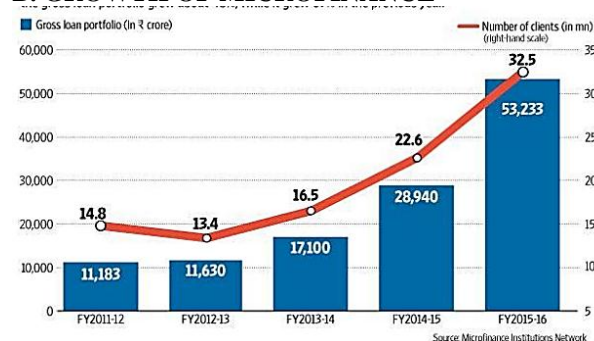


Fig.no.2: Comparison of growth of microfinance

This bar chart shows that increase of microfinance over the last 5 years in India by private firms. This means there is a demand of concepts like microfinance in India.

C. CHALLENGES AHEAD

Microfinance helps to cater to the needs of poor but there are also certain challenges. Loan default rate is high. Also, as micro finance loans are offered without any collateral, the extent of default is more. The other major challenge is to have a strict supervision on the business happenings. This helps to keep a proper check on the activities. However, MFI (Microfinance institution) combat these risk through field visits and surprise visits to their branches. MFI about 31 of them, still follow traditional way of doing business. Use of technology can help to lower operational cost. Automation is anytime better as compared to use of traditional ways of doing business. High-performing microfinance institutions have developed methodologies to extend credit, saving and other services to the poor clients. Many banks and other institutions with nationwide distribution system are beginning to take keen interest in reaching poorer clients. Advances in information technology have the opportunity to lower the cost and risk of providing

microfinance to the poor. The challenge is to mobilize this knowledge and apply it on a much vaster scale, creating financial systems that work for the poor and boost their contribution to economic growth.

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D.INTERPRETATIONS AND RECOMMENDATIONS

- Standardization of policies for staff (so that there is a less chance of fraud),
- Effective internal control on any human error,
- Recording of fraudulent staff,
- Background verification of staff before recruiting.
- Technology driven processes also helps to reduce human errors.

III. CONCLUSION

Due to urbanisation, unplanned slum areas are growing drastically which is a major problem in smart city planning. This leads to water distribution and sanitation problem. In first case study of Bangladesh they had a problem of poverty and over the time they improved the condition of people by microfinancing whereas in second case study of Thiruchirapalli indicate that micro-finance principles can be successfully applied to the water and sanitation sector. So, initiatives like water credit should be taken by the government to connect slum and rural area which are going to be part of urban smart cities. A Nationwide drive promoted by our Prime Minister for involving smart zones and connecting to rural areas, water credit system can be promising solution for distribution of water work department. In this dynamic era, there is a need to connect rural area on all fronts with the urban planning of smart cities. Distribution of water has been very challenging aspect for any state public work department in our country. For the further generation there is a need to broaden the perspective and applying water credit system as one of the innovative solution.

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9/11: a Terrorist Attack or a Conspiracy?

^[1] Sarvesh S. Nerurkar, ^[2] Swati D. Sakpal.
^{[1][2]} MITCOM- MBA (PCM).

Abstract— September 11th, 2001 was a clear Tuesday morning in New York City, USA. But, a series of events started taking place from 8:45 am that made a huge impact on the whole world. The series of four attacks by the terrorist group Al-Qaeda, in which two passenger planes crashed into the financial hub of the USA. Twin towers of the World Trade Center were attacked and were 'brought down' as reported by the media. These were the reports submitted by the written and television media, but, considering the nature of demolition of the buildings, the nature of construction of the buildings, the parameters considered while designing the buildings and several other factors, this massacre doesn't seem as easy to occur as it was reported. In this research report, the authors would go through all the smaller and bigger factors that prove the demolition/ 'bringing down' of the buildings was not just due to collision of the planes but there were more factors related to it. Also, this report focuses on the collapse of other two buildings that were affected i.e. WTC- Building 7 and The Pentagon. The collapse of these buildings weren't usual and normal as well. This paper goes through all the structural factors which deny the official reasons for the collapse of these buildings.

I. INTRODUCTION

1. About New York & World Trade Center :

New York is a densely populated state in the United States of America (USA) which is considered as a global power city as it is the financial and media capital of the world. In the heart of this city, at the banks of river Hudson was the trade complex – World Trade Center, which consisted of 7 buildings which was built in the year 1973. Out of these 7 buildings featured the landmark twin towers. These twin towers were the tallest in the world after its construction was completed. Structure wise, the buildings were developed by the Port Authority of New York and New Jersey in the Lower West side on Manhattan, New York City.

II. ABOUT THE STRUCTURE

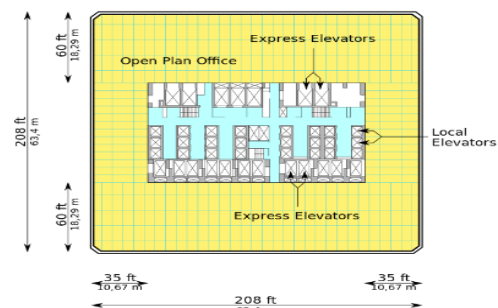
2.1 Nature of structure :

Considering the height of the towers and their nature of use, they were constructed as framed tube structure in which the building is designed to act like a hollow cylinder, cantilevered perpendicular to the ground. The construction of both the towers started in 1968 and was completed in 1972. The project of construction was given to Port Authority because they had experience in executing such large projects. The main reason for construction was to increase the volume of international commerce coming through the Port of New York.

With a mandated space requirement of

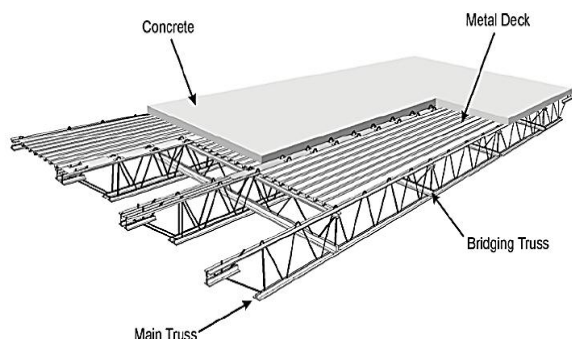
9,30,000 square metres of office space to be included in the new WTC, the initial design had 80 storeyed two towers. Another limiting factor was the number of elevators to be provided to the towers as height limited the usability of elevators in the towers. The solution to this was given by providing sky lobbies at regular intervals. As discussed earlier, the buildings were framed tube structure, with a square plan of about 208m x 208m.

System Design Concept



For the structural designing, the draft version of 1968 building codes were used. Consisting of several new inventions in the field of constructing sky scrapers, it was 'one of its kind' project in 1970s. The columns were made from high strength, load bearing steel columns which were called as Vierendeel trusses. In all, there were 60 close spaced columns on each side at the

perimeter of the towers. The perimeter columns resisted all the vertical loads (eg : wind loads) and also provided support to the core columns. The steel used in the perimeter were structural steel of grade ranging from 260 to 670 MPa, with the strength and thickness of the steel decreasing with height. All the columns were placed on bedrock. The core of the towers included 47 core steel columns which running from the bedrock to the top of the building. Core also had elevators, utility shafts and other support spaces. The large space between the perimeter and the core was bridged by prefabricated floor trusses. The floors had a 4inch concrete slab resting on a steel deck with shear connections for composite action. Most of the joints were bolted and welded. The connection of floor slabs and



The perimeter columns were done using viscoelastic dampers which reduced the amount of sway.

2.2 Wind Load:

The structure was relatively light weight structure due to the tube frame system, which resulted into more swaying compared to the traditional towers such as Empire State. To withstand the swaying action of the building, viscoelastic dampers were developed to absorb some of the sway.

2.3 Aircraft impact and fire protection :

Both the towers of WTC were tested for aircraft impacts. The tests were carried out in 1964 concluded that the towers would withstand an impact from Boeing 707 without collapsing, which was a huge passenger plane in those days. Though Boeing 767 (that crashed into the towers) were slightly larger than 707, but 707 had more destructive force at cruising speed.

“We looked at every possible thing we could think of

that could happen to the buildings, even to the extent of an airplane hitting the side... Our analysis indicated the biggest problem would be the fact that all the fuel (from the airplane) would dump into the building. There would be a horrendous fire. A lot of people would be killed. [But] the building structure would still be there” said lead structural engineer John Skilling to The Seattle Times. Considering the intense grid of the towers, it was assumed to be resistant to multiple plane crashes. Sprayed Fire Resistant Materials (SFRMs) and gypsum wallboard were used to make the structure, including the core columns, fire resistant. Post a fire incident and bombing attack, the fire resisting system was made more strict. Also, sprinklers were installed in both the buildings by the end of 1993. So, considering the whole structure, it was built strong enough by taking under consideration all the possible harms that can be done to the towers. The same was the case with WTC building 7 which was a steel framed structure too. This building was a part of the WTC complex whose construction was completed in the year 1987. It was a 47 stories tall sky-scraper with a red granite façade. The fourth important building to be considered is The Pentagon which is the headquarter of the US Defense which is one of the world’s largest office building, pentagonal in plan and is located in Virginia.



Thus, we will be considering these four buildings (WTC twin towers, WTC building 7 and The Pentagon) for the case study of the structures after the attacks. A detailed report will be presented regarding the probable behavior of the structures that were expected and the actual behavior that was observed and also the reason behind the observation will be worked out.

III. WHAT ACTUALLY HAPPENED?

The Tuesday morning of 11th September, was a usual one until the clock struck 8:46 am when Flight 11 of the American Airlines crashed into the North Tower of the WTC. Unless people could realize about the incident, a second plane, Flight 175 (a Boeing 767) crashed into the South Tower of the WTC at 9:03 am. By this time, all were informed that the USA was under a terrorist attack with two more airplanes in the air that are being hijacked. By 9:37 am, the third plane, flight 77 (Boeing 757) crashed in the west side on The Pentagon whereas fourth plane, Flight 93 (Boeing 757) that was supposed to hit targets in Washington DC was forcefully crashed in Pennsylvania. The initial two crashes of the twin towers raised the emergency alarm for the security officials of the USA. Just 56 minutes after the



Impact of the flight, the South tower collapsed. Also, after 1 hour and 42 minutes after the impact of airplane, North tower collapsed. At 10:50, 5 floors of The Pentagon collapsed due to the impact of the airplane. At 5:20 pm, Building 7 of the World Trade Center

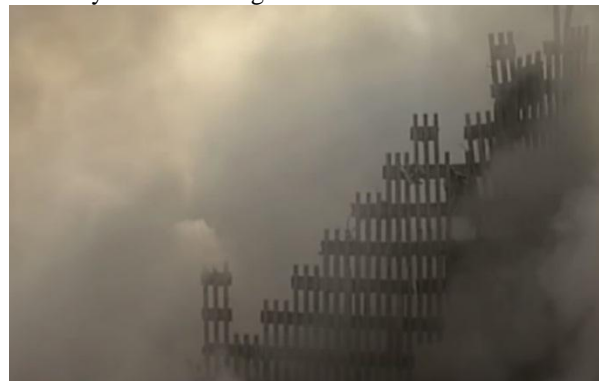
complex collapsed which wasn't even hit by any aircraft.

IV. HOW THE DOUBT CLICKED?

The television media was replaying the footages of the planes hitting the towers and the buildings collapsing. However, the manner and style of collapse of both the towers instantly rang a bell of doubt in the minds of people of the construction industry.

4.1 What was the cause of doubt?

Both the towers collapsed in a span of 8 to 11 seconds which practically shows that they came down under 'free fall' velocity, without any resistance. Also, the damage done to the towers was asymmetric but the collapse of the towers were symmetric which is scientifically impossible. Many Civil engineers, structural engineers and explosion experts were watching these footage on the day of attack and it didn't take much time for them to realize that the collapse is not due to the impact of aircrafts. Also, the sudden collapse of Building 7 have certainly planted an instant doubt in the minds of experts from construction industry as it was neither hit by any aircraft nor did it have any serious damages.



The surrounding was covered with fine, toxic dust which is unacceptable as the planes were hit in a certain part of the towers and it is not possible to disintegrate the structure into such fine particles. These were the reasons for the instant doubts that arose in the minds of the experts watching the footages which motivated them to conduct their own investigation about the happenings of the incident. Henceforth, we will see the points that were observed by the authors of this paper while going through more than 50 footages

and 100+ photographs of the attacks. This paper is not a detailed investigation about the attacks but a basic, informatory paper which will highlight the structural changes in the towers during the attack. It also highlights on the studies carried out by the government bodies.

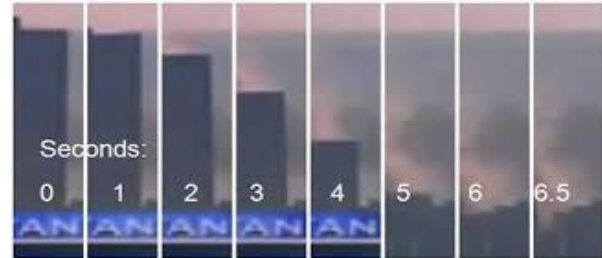
V. REASONS FOR DOUBT OF TWIN TOWERS:

5.1 Artificial symmetry:

The collapse of the two towers had its own characteristics of totality and uniformity, also, all the debris of the towers was centered at the building core. Taking an example of cutting a tree, as the axe chops a certain side of a tree, the tree collapses at a certain eccentricity. Considering the tree as the tower and impact of axe as the aircraft, no such eccentricity was observed in the debris of the towers. For a symmetric collapse, all the connections in the towers need to fail simultaneously, in a sequence but it is not possible in an asymmetric impact of aircraft. Also, both the towers had similar pattern of collapse. Even if the collapse was a result of weakening of steel, the collapse wouldn't have been as symmetric as it was.



Considering building 7 of WTC, it also collapsed rapidly and evenly. It wasn't hit by an aircraft though. The pace of collapse and the uniformity of the tower makes the assumption of controlled demolition very obvious. The reason



for this collapse was given as office fire. However, office fire does not generate enough heat to collapse a steel structure.

5.2 Lateral ejections:

In the videos and pictures, lateral ejections of free flying steel sections are observed. These ejections can occur only when explosion takes place as it needs a lot of force to laterally discharge heavy steel components.



These steel sections were seen several feet away from the debris. Also, they were discharged with a lot of force.

5.3 Involvement of explosives & weak fire:

The phenomenon of lateral ejection of steel section certainly proves involvement of explosives in the process of collapse. It was reported that the concrete in the debris was powderised which is not acceptable. In case of collapse due to fire, the debris of lower floors should be in chunks, which was not found. According to the official structural report, the sudden, progressive and total collapse of the towers was due to the weakened steel due to fire. However, the heat generated by jet fuel isn't sufficient to weaken steel in open air. A fire of about 750° C can be under a steel beam forever and will never reach high enough temperature to bend

the structural steel. The only way to collapse the columns were to compromise with the core columns. The below picture shows a lateral ejection caused due to explosion in the lower floor during the collapse.



Also, to support the theory of collapse were many witnesses who reported sounds of consecutive blasts during the fall of towers. More than 100 witnesses reported hearing and seeing multiple explosions. But these reports were not taken into consideration by the officials during the investigation. Most of the jet fuel was burnt in the fire ball in initial time and hence not much jet fuel was available to weaken the steel structure. The steel in the floors below the impact floors were stone cold steel as they were not into direct contact with any kind of fire. Considering building 7, the reason for collapse was reported “due to fire fueled by office furniture” as quoted by Shyam Sunder, Lead Investigator – NIST. This reason doesn't prove sufficient to bring down a 47 stories steel structure which had fire proof components in it. You need not be an architect or an engineer to judge this collapse.

5.4 Molten steel:

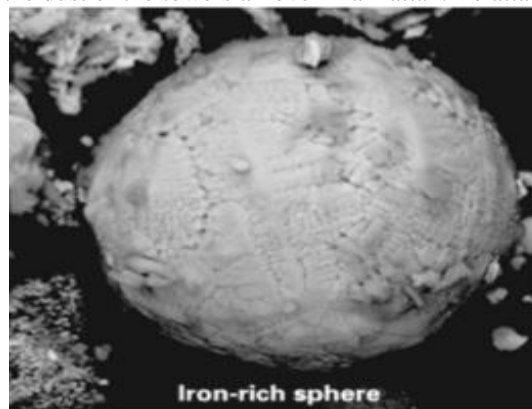
It was observed in the videos, pictures and also the witnesses confirmed the sight of red liquid metal falling off from the towers just before the collapse. The fire fighters reported presence of molten steel in the debris. The geological surveys carried out by the US found iron-rich microspheres. These spheres were found in dust of the towers all over the Manhattan. During cleaning of ground



zero, there were difficulties in cleaning due to the presence of this liquid metal. “21 days after the attack, molten steel was still running” said Leslie Robertson, who is one of the design engineers of WTC.

5.5 Involvement of thermite:

Out of studies carried out on the debris and dust from the collapse, it was concluded that there was presence of very effective agent of violence that was more effective than explosives – Thermite. Thermite is a chemical obtained from ferrous oxide and aluminium. Molten steel that was recovered from ground zero is the direct evidence of use of thermite. Thermite works by way of thermal heating because of which not much noise is generated. Molten spheres of metal were found in the dust of the towers all over Manhattan. To attain



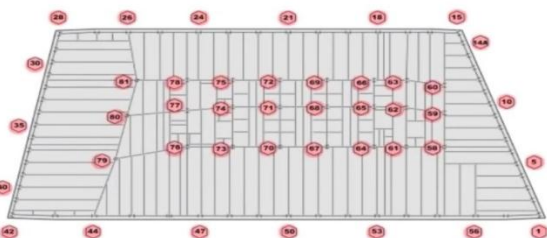
These spheres need high temperature heat which can be attained by an exothermic chemical reaction. Ground zero was the longest burning commercial building fire in US history which explains the use of thermite. Also, a team of international scientists conducted studies on the dust and found unreacted, finite thermite particles. Melting point of steel is 1371°C which can be attained by using thermite as the exothermic reaction can give

out heat up to 4000°C.

VI. ABOUT WTC BUILDING 7:

The weird fact about Building 7 is, no plane was hit yet the whole building collapsed. Official report says the reason of collapse being “fire due to furniture” which is not sufficient enough to bring down a 47 stories, steel structure. The fire was due to the debris that was laterally ejected from North and South building.

About the pattern of collapse, to attain such even and controlled collapse, all the core columns need to fail at same time which is practically impossible due to asymmetric impact. The reason for fire was given as the fire induced from the lateral ejections from adjoining North and South towers. NIST stated that the collapse of the whole building was due to failure of just one column (i.e. Column 79). Fire induced floor system was the only possibility that was considered by NIST. Talking about the fires in the tower, they were not studied in detail, as in case of north and south towers. This collapse was due to the failure of just one column, Column 79, which was said to be the support system to the above floors. However, it is reported that fire due to furniture resulted into weakening and collapse of such critical component of the tower which practically sounds absurd. The timing of the collapse also supported the conspiracy theory. It hardly took 5.4 seconds for the whole 47 storied building to come to ground i.e. near to free fall acceleration. A building of that importance and design did not provide any resistance to free fall acceleration also gives birth to doubt.



• The Pentagon :

The Pentagon is the headquarter of US security department and has 5 buildings built in ring pattern. On 11th September, 2001, the Pentagon was hit by a Boeing 757 but the hit point that was seen on the building was too small to accommodate a 100 ton jet

plane. The building is a seven floored building with height of 23.56m from ground level. The plane that crashed into the building (Boeing 757) is 13.5m in height. It is physically impossible to fly a Boeing 757 at such low altitude at a speed of 800+ kmph. The hole dimension of the damage that was caused due to impact of the plane was 9.33meters which gives birth to another conspiracy theory. A taller plane couldn't produce such small hole. The videos recovered from CCTV of Pentagon didn't show any such jet plane crashing into the building. This crash lacks logic.



VII. CONCLUSION:

Considering all the above mentioned theories, we have come to the conclusion that the attacks of 9/11 were conspiracy. The reason for undertaking the attacks have several other conspiracy stories attached to them. However, this attack have certainly had a huge impact on the whole world as several new policies were introduced by the US as a result of these attacks. If we happen to believe all the official theories that were presented as the reason for the structural failures, we would defy the basic principles of the construction industry. It would absurd the laws of structural integrity. It is rightly said that to get to the roots of such big conspiracy, 'follow the capital' related to it. Just months before the 9/11 (June 2001), the WTC's lease was sold to American Businessman Larry Silverstein. Silverstein took out an insurance plan that 'fortuitously' covered terrorism. The insurance company was taken to the court and he claimed to be paid double the amount as there were two attacks. He was later awarded \$4,550,000,000. Less than a month after 9/11, U.S. troops invaded Afghanistan in an attempt to dismantle Al-Qaeda (the terrorist group that claimed responsibility for the attacks). U.S. troops further invaded Iraq and deposed President Saddam Hussein

which was a key part of America's newly launched war on terror. After 9/11, budgets for defense-related agencies skyrocketed as well. Several other policies such as creation of a new cabinet-level federal agency, the USA PATRIOT Act of 2001, Information Awareness Office (IAO) which directly affected the privacy of US citizens. It also made the airport security more strict and alert.

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Development of Working Model for Ogee Profile Spillway Using Steps and Roller Bucket for Enhancement of Energy Dissipation

^[1] P.B. Nangare, ^[2] A.A.Patil, ^[3] S. A .Pande

^[1] Assistant Professor, AISSMS's COE Pune 411001, INDIA

^{[2][3]} U. G. Student AISSMS's COE Pune 411001, INDIA

Abstract— The terminal structure of a spillway plays a major role in dissipating specific energy of excess flood to safeguard the river channel and downstream structure. The ogee profile spillway is hydraulically efficient, structurally stable and more adequate to dispose excess flood effectively on downstream end of river channel. This spillway will be helpful to control the erosion, scouring and pondage if suitable energy dissipater provided at terminal structure. Due to high discharge of excess flood there are chances of causing erosion on Spillway bed, which is a major problem to affect the spillway capacity. Excess air entrainment causes positive pressure on spillway bed and helpful to achieve maximum energy dissipation by replacing ogee profile by steps. Therefore the above problems are rectified by developing the working model on ogee spillway with consideration of combined effects of steps and roller bucket etc. In this present research the experiments are performed in a range of discharge 0.0052-0.0063 m³/s with different devices on developed model at 4 – 6.5 m head etc. It is observed that the ogee spillway with combination of plain roller bucket, steps and stilling basin device achieved 80.24 % energy dissipation and maintained 0.23 m tail water depth in stilling basin with Froude number 5.53. Therefore it is concluded that this device is found to be best suitable energy dissipating device to overcome the spillway problems by enhancing maximum energy dissipation.

Keywords: - Ogee spillway, terminal structure, roller bucket, steps and energy dissipation etc.

I. INTRODUCTION

In ogee spillways the hydraulic jump type of stilling basin is generally preferred as an energy dissipater but it requires the longer span and creates the problems like scouring, erosion due to high amount of specific energy generated at toe portion of spillway. Roller bucket is another option of energy dissipation but it has the limitations. The movement of roller that mixes with incoming flow results in dissipation of energy and prevents the scouring. It requires also sufficient tail water depth for functioning effectively and need to maintain the tail water depth in a range of 1.1 to 1.4 time's sequent depth and preferred if Froude number is greater than 4.5. The stepped spillway is also more prominent and its steps act as roughness elements to reduce flow acceleration and terminal velocity. The reduced velocity and the cushioning effect of the entrained air thus reduce the cavitation's potential. There is now increasing interest and broad scope in finding ways to bridge gap by providing suitable energy

dissipating devices at terminal structure to overcome the erosion and scouring problems in ogee spillway. In this present research the attempt has been made to identify effect of steps and roller bucket utilized to overcome the scouring and erosion in ogee spillway. Energy dissipation devices dissipate the kinetic energy of excess flood with the help of effective devices at the toe portion of spillway. It helps to obtain uniform flow at the downstream side of river also minimizes the erosion damage at the downstream end. To normalize the velocity distribution on spillway there is a need of suitable energy dissipation devices. Many failures of dams have been reported due to inadequate capacity or improper design of spillway. It improves the project with the ability to release excess or flood water in a controlled or uncontrolled manner to ensure the safety of the dam. To avoid the overturning of the dam. It is of paramount importance for the spillway facilities to be designed with sufficient capacity to avoid overtopping of the dam, especially when an earth fill or rock fill type of dam is selected for the project. Spillway is a

hydraulic structure used to release water on a regular basis for water supply, hydroelectricity generation etc. Spillways are provided with energy dissipation devices (e.g. Stepped spillway, Stilling Basin, Chute blocks, Buckets, Friction Blocks, End Sill) for dissipation of energy arising out of change in energy level upstream and downstream of the structure. The present research is highly emphasis on utilization of combined effects of steps and roller bucket combinable at terminal structure of ogee spillway. Henceforth the model has been designed and developed with a scale of 1:33.33 for ogee spillway.

II. OBJECTIVES

- To study the problems with the existing ogee spillway and identified suitable energy dissipating device.
- To develop a working model of ogee spillway with combination of steps and roller bucket etc.
- To compare the results obtained from the experiments with different discharges and heads.
- To identify the best energy dissipating device for ogee spillway to rectify the existing problem by enhancing maximum energy dissipation.

III. METHODOLOGY

The following methods are usually adopted for energy dissipation in spillway:-

- By formation of hydraulic jump at the downstream portion of spillway
- The use of various types of roller buckets (Plain and Slotted)
- Jet Diffusion and free jet stilling basin
 - a) Jet diffusion Basin
 - b) Free jet stilling basin
 - c) Impact stilling basin
 - d) Hump stilling basin
- Intersecting jet and other special type of stilling basin

3.1 Development of Working Model

The design model is in scale 1:33.33 compared to actual design. Materials used for model are Foam sheet, Acrylic sheet of 6mm diameter, PVC sheet etc. Also the model joining material Lambi. The scale ratio of 1:1 of Auto-Cad sheet of Spillway profile of ratio 1:33.33 was provided for marking on foam sheet. Model cross-section cutting was done according to design sheet. Then the steps were made of foam sheet according

design of rise and tread were 12 in numbers. Once the step profile got done we moved towards Ogee profile which was to be made from PVC sheet as per the design. The whole set up of profile is joined with the help of Lambi as sticking material. For no leakage criteria Acrylic sheet was joined to whole set up of spillway model which was cut with the help of cutter especially used for Acrylic sheets and foam sheet. A 0.3 m length barrier is provided front of energy dissipater at distance of 1 feet. Also 0.3m length Acrylic sheet is extended from crest height for non-ricocheting flow of water. At Equal distances of 4.5cm for ogee profile the pressure tubes brass holes of 6mm diameter were inserted. Total 20 pressure taps are marked on whole spillway. On middle part of tread of stepped spillway the pressure taps are created. Also for head measurement we pasted the measuring Ruler at short intervals. Dimensions of developed model are shown in following fig 3.2, table 3.1 and 3.2.



Fig.3.1 Working Model of stepped spillway

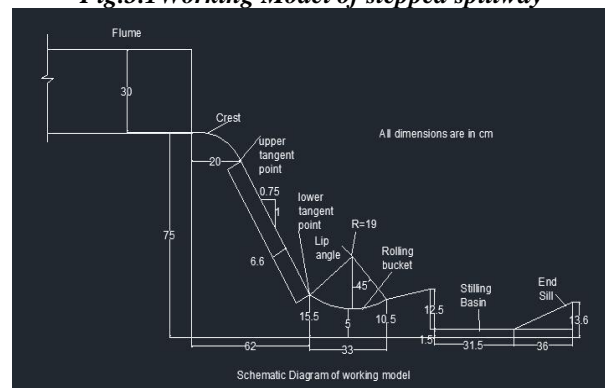


Fig.3.2 Dimensionsof working model

Table 3.1 Dimensional Analysis

Sr.No	Description	Prototype (Khadakwasla Dam)	Model
Geometrical Similarities			
1	Crest Width (B)	10 m	0.3 m
2	Height (H)	23.75 m	0.7625 m
3	Length (L)	15.73 m	0.472 m
Kinematic Similarities			
1	Velocity (V)	0.586 m/s	0.1013 m/s
2	Discharge (Q)	2700 m ³ /s	0.418 m ³ /s
3	Head (H)	4.29 m	0.128 m(theoretical)

Table 3.2 Dimensional Analysis for Rolling Bucket

Description	Prototype	Model
R= P/4 Width & Spacing = 0.05R	= 5.93 = 0.05x5.93 = 0.296 ≈ 0.3	= 0.178 = 9x10 ⁻³ m
Width at Bottom = 0.125R Width at Top= 0.05 R	= 0.125x5.93 = 0.74 = 0.3	= 0.022 m = 9x10 ⁻³ m
Distance from depression = 0.5 R	= 2.96	= 0.088 m

3.2 Location of Hydraulic Jump

By performing experiment on working model with different heads the hydraulic jump has been located as shown in following tables

Table 3.3:-Location of Hydraulic Jump

Sr. No.	Description	Location Of Jump	
		Model (M)	Prototype (M)
For 6.5m Head			

1.	Step Set -01	0.85	28.30
2.	Step Set -02	0.83	27.66
For 4m Head			
1.	Step Set -01	0.79	26.33
2.	Step Set -02	0.77	25.66

Table 3.4:-Dimensions of Stepped Profile Spillway

Sr. No	Particulars	Dimensions	
		Set 01	Set 02
1	Length of Block	63cm	63cm
2	Width of Block	30cm	30cm
3	Thickness of Block	6.5cm	6.5cm
4	Rise of Steps	4cm	4.5cm
5	Tread of Steps	3.3cm	5cm
6	No. of Steps	12	9

IV. RESULTS AND DISCUSSION

The experiments are performed with a discharge in range of 0.0052 to 0.0064m³/s. The results of all devices are compared with specific energy and their energy dissipation values. The obtained results with ED and TEL are shown in table 4.1 and table 4.2.

Table 4.1:- Comparison TEL for Ogee and Stepped Spillway for 4m head

Tapping distance cm	Ogee spillway (OS) TEL m	Stepped Spillway (SS)	
		Set 01	Set 02
		TEL m	TEL m
23.5	0.695	0.6825	0.682
27.5	0.643	0.6139	0.613
38.5	0.499	0.49	0.495
65	0.195	0.1753	0.177
73	0.255	0.2497	0.250
99	0.245	0.236	0.238
118	0.19	0.2328	0.234
147.5	0.215	0.2392	0.239
156	0.237	0.2375	0.237

Table 4.2:- Comparison ED for Ogee and Stepped Spillway for 4m head

Tapping distance cm	Ogee spillway (OS) ED %	Stepped Spillway (SS)	
		Set 01	Set 02
		ED %	ED %
23.5	12.68	14.25	14.32
27.5	19.22	22.87	22.99
38.5	37.31	38.44	38.44
65	75.50	77.97	78.01
73	67.96	68.63	68.71
99	69.22	70.35	70.35
118	76.13	70.75	70.85
147.5	72.99	69.95	69.97
156	69.45	70.16	70.22

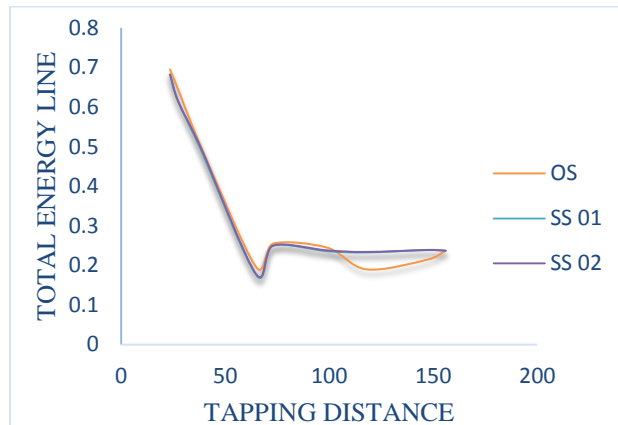


Fig. 4.1:- Comparison for TEL of Ogee and Stepped Profile Spillway for 4m head

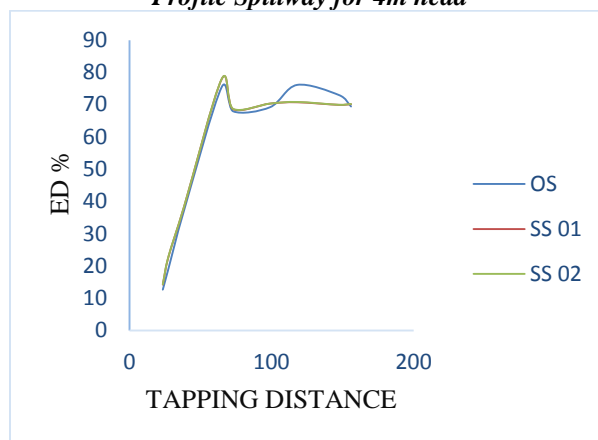


Fig 4.2:- Comparison for % Dissipation of Ogee and Stepped Profile Spillway for 4m head

Findings:

- T.E.L for spillway with ogee profile is 0.195 which is more over stepped profile spillway as 0.177 at tap distance 65 cm.
- % ED for spillway with steps is 78.01 which is more over ogee profile spillway as 75.5 at tap distance 65 cm.
- Spillway with steps shows better result over ogee profile spillway up to tap distance 65 cm.

Table 4.3:- Comparison TEL for Ogee and Stepped Spillway for 6.5m head

Table 4.3:- Comparison TEL for Ogee and Stepped Spillway for 6.5m head

Tapping distance cm	Ogee spillway (OS) ED %	Stepped Spillway (SS)	
		Set 01	Set 02
		ED %	ED %
23.5	6.73	12.36	12.36
27.5	10.67	22.32	21.32
38.5	34.05	31.16	37.16
65	68.61	77.32	77.23
73	67.59	63.72	63.72
99	67.21	64.94	64.94
118	68.23	65.65	65.65
147.5	67.59	65.00	65.00
156	66.05	63.53	63.53

Table 4.4:- Comparison ED for Ogee and Stepped Spillway for 6.5m head

Tapping distance cm	Ogee spillway (OS) TEL (m)	Stepped Spillway (SS)	
		Set 01	Set 02
		TEL (m)	TEL (m)
23.5	0.734	0.688	0.688
27.5	0.703	0.619	0.619
38.5	0.519	0.495	0.495
65	0.247	0.179	0.179
73	0.255	0.286	0.286
99	0.258	0.276	0.276
118	0.25	0.271	0.27
147.5	0.255	0.275	0.275
156	0.267	0.287	0.287

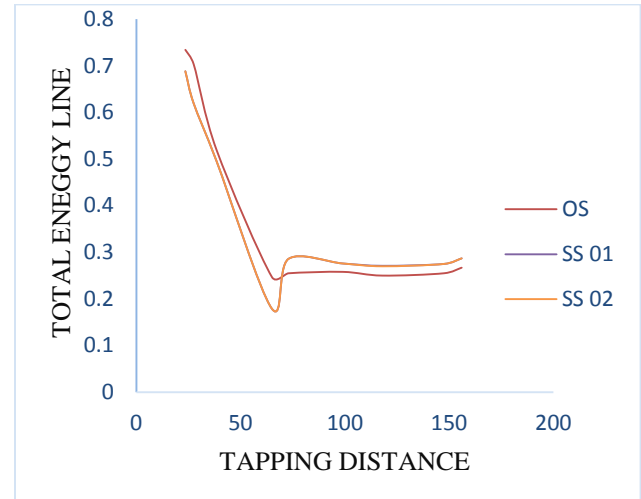


Fig 4.3:- Comparison for TEL of Ogee and Stepped Profile Spillway For 6.5m head

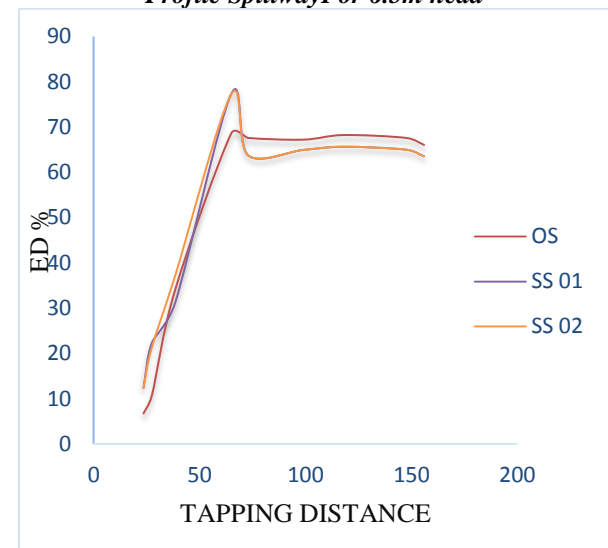


Fig 4.4 Comparison for % Dissipation of Ogee and Stepped Profile Spillway for 6.5m head

Findings -

- T.E.L for spillway with ogee profile is 0.247 which is more over stepped profile spillway as 0.179 at tap distance 65 cm.
- % ED for spillway with steps is 77.23 which is more over ogee profile spillway as 68.61 at tap distance 65 cm.

- Spillway with steps shows better result over ogee profile spillway up to tap distance 65 cm

V. CONCLUSION

In this model the functions of roller bucket can be achieved effectively by raising the level of tail water in stilling basin by retaining flow backwith V Notch, which is helpful to achieve favorable condition for roller bucket. Due to provision of steps the intensity of velocity is reduced and the load of energy dissipation on roller bucket is automatically reduced. The energy dissipation is observed throughout its profile and finally achieved in stilling basin. It is observed that the energy dissipation is increases with decrease in step numbers and discharge value. The energy dissipation is increases with increase in length of steps and achieved the best results with the non-dimensional parameter (yc/h) upto 0.8. Therefore by consideration of above results with different models for different heads, it is found that stepped spillway with stilling basin for V notch up condition achieved the maximum energy dissipation. Therefore it is concluded that the ogee spillway with combination of plain roller bucket and stilling basin model (set 02) found to be the best suitable model for ogee profile stepped spillway.

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Properties of Concrete Containing Wollastonite

^[1] Shubham Dahiphale, ^[2] Kabir Khan, ^[3] Kshitij Tikhe

^{[1][2][3]} (MBA in Project Construction Management, MIT College of Management, MIT ADT University, Pune, India)

Abstract— Wollastonite is a naturally occurring mineral known as calcium metasilicate (CaSiO_3). It contains silica which reacts with water to form calcium-silicate-hydrate (CSH). CSH is also responsible for imparting strength to cemented material when Portland cement hydrates. In this study wollastonite was used to replace cement in concrete mix up to 30 %. There were 9 concrete mixes prepared with different wollastonite percentages which are 0%, 5%, 10%, 12.5%, 15%, 17.5%, 20%, 25%, 30% by weight of cement. Water cement ratio used was 0.44. It was observed that there was a rise in compressive strength at 10%, 12.5%, 15% wollastonite replacement as compared to control mix. Highest rise was observed at 15% wollastonite replacement.

Keywords: - Wollastonite, Tilting Mixer, RHA (Rice Husk Ash), Compressive Strength, Silica.

I. INTRODUCTION

Concrete is a material composed mainly of water, aggregate and cement. Often additives and reinforcement are added to achieve desirable physical strength. Concrete is highly used construction material strong, durable and efficient binding material and most vital ingredient of concrete is Cement, So far India is second largest manufacturer of cement across the globe. Despite being giant producers we are facing serious Environmental issues. The cement industry is mass producers of Carbon dioxides. To deal with environmental issues we need to find alternate sources. And from many general studies we can conclude that addition of minerals admixtures to concrete gives more durable concrete which is more resistance to environmental agencies responsible for concrete degradation. Wollastonite is naturally occurring mineral formed due to interaction of limestone with silica in hot magmas (Paul 1977). It is chemically calcium-metasilicate (Ramchandra et al 1981) wollastonite was found to possess reinforcing quality and resistance to chemical attack even in high temperature (USGS minerals book 2009). It is white mineral highly modulus. India produced 120000 tons of wollastonite in year 2010 which accounts 22% of total world production. It is abundantly available in Rajasthan Pali Sirohi Dist Udaipur and also found in Tamil Nadu, Uttarakhand and Andhra Pradesh. It is being used for reduction of shrinkage cracks ceramic tiles and refractory improvement in tensile strength of plastics.

Study available so far about wollastonite indicates that it is potential mineral responsible for properties enhancement. The objective of the present work is to facilitate the utilization of wollastonite as a new material in concrete with partial replacement of OPC. And this is done by determining the optimum level of replacement based on compressive strength.

II. BACKGROUND LITERATURE

According to previous study of Aditya Rana, Pawan Kalla and Sarabjeet Singh. With addition of wollastonite in concrete mixes compressive strength dropped marginally at water binder 0.45 and 0.50 but noticeable strength was witnessed at 0.45 water binder ratio. Low Beaudoin in their study observed that additional of wollastonite to cement matrix improve both flexural and ductility of hydrated cement and cement silica fume matrices it was found that 2 to 15 percent volumetric additional of wollastonite results in strong and tough matrices results in strong and tough matrices. These properties were found best in base matrix at 11.5 percent wollastonite content and 5.2 percent silica fume by volume. As per Mathur et al Incorporation 10% wollastonite as a substitute cement and sand improves compressive strength by 28-35 % at 28 days and 56 days respectively. It was observed that additional of wollastonite reduced water absorption drying shrinkage and abrasion loss of concrete improvement in durability against alternate freezing and thawing and sulphate attack was also observed. A

previous study by Ransinchung and Brind Kumar has shown that the mortar containing wollastonite and microsilica attains higher compressive strength than the conventional mortar. Test results than the conventional mortar test results of this work indicated that the mortar containing 82.5% cement 10% wollastonite and 7.5% micro silica as binding material attended the highest compressive strength of 63 MPa the mortar which contained 77.5% cement ,15% wollastonite and 7.5% micro silica also achieved 2.8% higher compressive strength than conventional mortar.

III. EXPERIMENT

For the experiment Ordinary Portland Cement (OPC) of grade 43 confirming IS 12269 was used. Wollastonite was procured locally. Aggregates used in this study were procured locally and natural potable water was used. All the experiment was performed in the Concrete Lab of Priyadarshini College of Engineering, Nagpur. Suitability of materials like wollastonite, OPC, aggregates was examined first. The test performed on these materials are shown in the table below:

S.N	Test	Relevant Codes
1.	Fineness test of wollastonite	IS 4031 Part 1-1996
2.	Sieve analysis	IS 383-1970
3.	Specific gravity	IS 2386 Part 3 – 1963
4.	Water absorption	IS 2386 Part 3 – 1963
5.	Free moisture content	IS 2386 Part 3 – 1963

Concrete mixes were prepared using water binder ratio as 0.44. Concrete mixes were prepared for 9 percentages of wollastonite i.e., 0%, 5%, 10%, 12.5%, 15%, 17.5%, 20%, 25%, 30% each percent having 9 cubes of size “150 x 150 x 150 mm”. The properties of concrete mixes prepared replacing cement were compared with the control mix concrete. Cubes were casted for 3 days, 7days and 28 days.

Ratio used for preparing the control mix was:-

1:1.52:1.05:1.58 = cement: sand: 10mm aggregate: 20mm aggregate.

All materials of mix design were brought at room temperature 27°C before preparing mixes. Cement

samples were thoroughly dry mixed with hand before their use to ensure proper blending and uniformity in the material. Aggregates were separated in fine and coarse fractions and were recombined for each concrete batch to obtain the desired grading. IS 4.75mm was used to sieve the sand, IS 10mm was used for separating 10mm aggregates and IS 20mm sieve was used to separate 20mm aggregate. The quantity of cement, sand, aggregate, wollastonite was determined by weight and water was measured in litres. Drum tilting mixer was used to prepare the concrete. The materials were first dry mixed for few minutes then water was added and the mix was done by setting the drum to desired angles. Slump test was performed for every mixes prepared. Slump between 90mm – 100mm was selected for casting. Cube moulds were oiled before filling the mix to avoid adhesion with concrete. Specimens were compacted to produce full compaction of the concrete with neither segregation nor excessive slurry flow. The moulds were filled in three layers and each layer was compacted by vibrations. After compaction of the top layer, the surface was levelled with the help of trowel. Total 9 mixes were prepared and 9 cubes for each mix were prepared i.e., 63 cubes. Test specimens were then stored in moist air for 24 hrs before de-moulding. After de-moulding the cubes were marked with markers and kept in curing tanks until their time of testing. Average of three test values were taken to calculate the compressive strength.

IV. RESULT ANALYSIS

Effect of wollastonite on properties of concrete like compressive strength was investigated at 3 days, 7 days and 28 days. With the increase in wollastonite content, workability was found to be decrease slightly as compared to control mix. Results of compressive strength of wollastonite added concrete at 3 days, 7 days and 28 days respectively are shown in figure. Incorporation of wollastonite in concrete mixes resulted into slight rise in compressive strength at 10%, 12.5%, 15% wollastonite replacement compared to control mix. There was slight decrease in compressive strength at 5 % replacement but at 10 % and 12.5%& 15% replacement there was rise in compressive strength. Maximum strength observed was 39.56N/ for the control mix prepared without any wollastonite replacement. Minimum strength observed was 34.5 N/

for 25% wollastonite replacement.

MIX	COMPRESSIVE STRENGTH N/mm ²		
	3 days	7 days	28 days
CM / 0%	19.56	27.7	36.74
5%	23.11	28.03	36.67
10%	19.05	26.95	37.11
12.5%	18.22	25.03	38.96
15%	18.05	25.89	39.56
17.5%	17.93	26.67	36.3
20%	17.56	25.75	35.85
25%	18.2	25.33	34.5
30%	18.3	25.64	35.1

Table 1:- Compressive Strength of cube for 3, 7 & 28 days

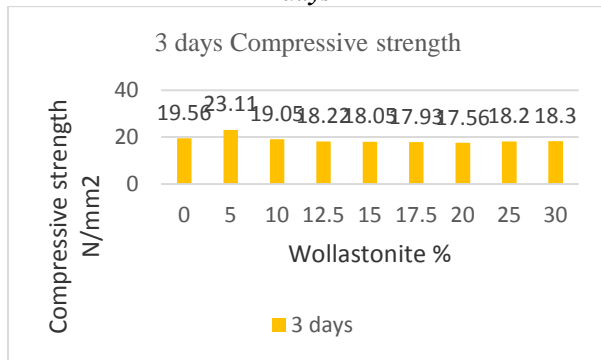


Fig 1:- 3 days Compressive Strength

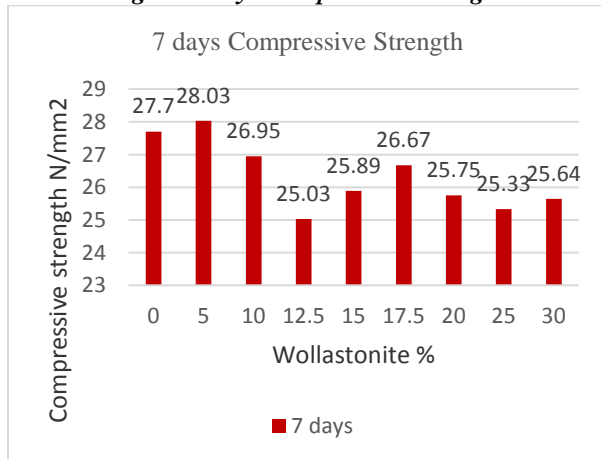


Fig 2:- 7 days Compressive Strength

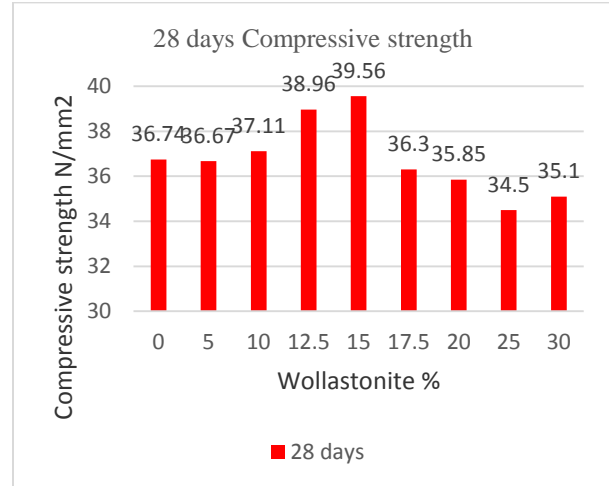


Fig 3:- 28 days Compressive Strength

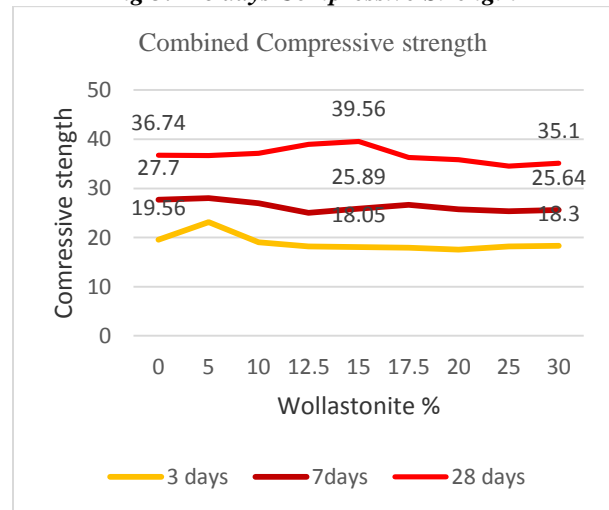


Fig 4:- Combined Compressive Strength

V. CONCLUSION

- There was slight decrease in compressive strength at 5% replacement but at 10%, 12.5% & 15% replacement there was rise in compressive strength.
- Optimum percentage of replacing cement with wollastonite selected is 15%.
- The presence of silica in wollastonite is responsible for imparting strength in concrete.
- It is advantageous to use wollastonite in replacement of cement as it reduces pollution

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which occurs while making cement.

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13. IS 2386 Part 3 – 1963 for different test on aggregates.

Green Skyscraper: A Smart Solution for Sustainable Infrastructure

^[1] Mr.Shubham Patil, ^[2] Miss.Vaishnavi Dawkore, ^[3] Mr.Yash Deshpande, ^[4] Mrs.Dr.Shantini Bokil
^[1,2,3] Research Students, Department of Civil Engineering, MITCOE, Pune.
^[4] Professor and Head, Department of Civil Engineering, MITCOE, Pune.

Abstract— Green Skyscraper concept has been emerged to mitigate the effects of the increasing impact on the environment and it can work as a smart solution, to improve the building construction process. This research has been emphasized on integration of plants in skyscraper design, which play a vital role for the energy conservation by the building as well as improving the living quality into these vertical cities. Throughout the thesis work, it has been studied to establish the necessity of planting to incorporate into skyscrapers, for the well-being of our economy, society and the environment. The rules and regulations in various countries have been studied. The provision of integrating plants into skyscraper includes the four possible options like Green Roof, Green Wall, Bio-filter and indoor potting plants which can be incorporated into the design. The benefits and impacts have been studied in terms of energy savings and indoor environmental qualities. Green roof can reduce 50% of cooling load; Green wall can reduce 100 C indoor temperature; whereas Bio-filter and internal plants purify indoor air by 50-60%.

Keywords: - Green skyscraper, Integration of plants, Green Roof, Green Wall, Bio-filter, Environmentally optimized solution and aesthetics.

I. INTRODUCTION

The Skyscraper is a Dutch term which literally translated refers to a building that gently touches the sky. The concept of Skyscraper was introduced in Europe for first time in for of European Skyscraper. The construction of John Hancock Center in Chicago in 1969 marked a new phase in the evaluation of the skyscraper in United States. Skyscrapers, by definition are not primarily ecological. The construction and running of these tall buildings can only be achieved at the cost of an extraordinary input of primary energies and raw materials (Powell and Robert, 1999). They will ensure highly efficient use of spatial resources if provided with high density of quality workstations and good connections to public transport system. Thus, skyscrapers today deserve more emphasis for its impact on environment. The reestablishment of “green” that was eliminated by its construction can be a possibility to refurbishment the nature as well as improve the quality of living into it. The theory of ‘Green’ Skyscraper has been notably shaped by the writing of Ken Yeang. He proposes, in his theories, the interconnecting measures regarding the use of energy, water and light. He further relates these to green plants,

local climate, and ecology to the spatial conditions and the functions of the building (Lepik, Andres, 2004). Thus, the planning and design of skyscraper influenced by a complex series of demands, where green plants can play a vital role for the energy conservation by the building as well as improving the living quality into these vertical cities. The Minara Mesiniaga in Malaysia (1992) is such practical example of an ecological tall building. Green Skyscraper refers to both the practice and product of creating tall buildings which are better for our health, environment and economy. It will be environmentally responsible and resource efficient throughout its life-cycle, as well as a sustainable and high-performance building for economy, utility, durability, and comfort (EPA). Definitions of green skyscraper vary but the green movement has five main goals.

- a) Ensure a healthy, productive indoor environment for occupants to work and live.
- b) Prevent negative impacts to our environment and improve its health.
- c) Reducing operating cost and increase profitability for building owners through energy and resource conservation.
- d) To find out the provisions of integrate plants

into the skyscraper design.

- e) Analyze their impacts on energy consumption and living environment.
- f) Suggest some alternative solutions to eliminate the drawbacks and propose some guidelines for good practice to make it viable economically, socially and environmentally.

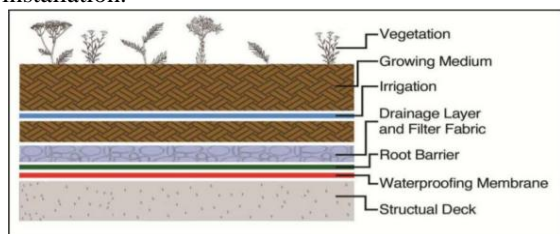
II. COMPONENTS OF THE GREEN SKYSCRAPER

1. Green roof
2. Green wall
3. Bio-filter
4. Indoor potting plants

1. Green Roofs: Green outer

Green roof has been in existence for over 3000 years, the earliest green roofs were seen to be as form of a turf roof. The turf roof contains growth of grasses and plants roots and this kind of roof is still in existence in Norway and Iceland. In warm climatic region green roof was first identified as roof garden which was seen in the ruins of Pompeii after the volcanic eruption of Vesuvius Mountain in AD 79. Green roof was also seen in the famous Hanging Garden of Babylon which was constructed around 500 B.C. During Middle Ages green roof was also found in Guinigi Tower, Lucca, Italy.

Green roof can be defined as a roof that contains plant or vegetation and it may be fully or partially covered on the roof and it's an addition on a normal concrete decked roof. Green roof has several layers the top layer is the vegetation stratum, followed by growing medium or soil layer, irrigation layer, filter fabric layer, drainage layer, waterproofing membrane layer, and then the roof deck. Green roofs cost more than the normal traditional roof but it has its own advantages and benefits on the long run which will counter the initial cost of installation.



A) Fig.no.1

As shown in above figure types of Green Roof

According to Mentenser et al. (2006) depth of green roof substrate layer defines green roof into two types which are the intensive and extensive green roof. Intensive Green Roof Intensive green roof is the type of green roof that contains different types of vegetation starting from grasses, shrubs to small trees. It's often roof garden and it may also include walkways, benches, tables, and fountain on the roof. The intensive green roof has a depth greater than 150mm. This type of green roof has a heavy weight and required high maintenance. The slope of an extensive green roof is less than 100. Intensive green roof can weigh from 171 – 391kg/m² (Breuning, 2015) Extensive Green Roof The extensive green roof is simpler compare to intensive green roof because it's lightweight and requires low-maintenance and drought resistant plants usually sedum species are used. It also has thickness of less 150 mm. According to Breuning (2015) extensive green roof can weigh from 73kg/m² to 122 kg/m². Looking at extensive green roof from sustainable point of view it's considered to be more important because it has low weight and can be used in more rooftops compare to the intensive type. When elements of both extensive and intensive green roof are found in green roof it's considered to be semi intensive green roof.

Benefits of Green roof:

- a) The roof act as an important parameter during monsoon since it absorbs the storm water and prevents the wastage of storm water and also reduce the probability of floods.
- b) It acts as the insulating barrier in summer as well as in winters since it prevents the heat flux transfer.
- c) Green roofs cover the waterproofing membrane, protecting it from UV rays and extreme daily temperature fluctuations. This protection extends the lifespan of the waterproofing twice as long as conventional roofing, meaning that membranes under green roofs last twice as long as those on traditional roofs.
- d) Green roofs make the most of unused space within the increasing density of our cities. Rooftops can be developed into social and recreational spaces and used for urban agriculture.

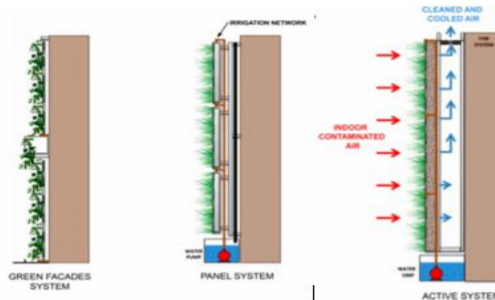
2. Green Wall:

Green-wall technologies, are also known as Vertical Greening Systems (VGS) or bio walls. They consist of vertical structures that spread vegetation that may or may not be attached to a building facade or to an

interior wall. Attending to the level of complexity, there are several green-wall typologies that range from the simplest configuration to the most complex and high-tech design. Based on the type of vegetation and support structures used, these systems can be divided into two major groups: green facades and living walls.

In green facade systems, or green screens, the vegetation cover is formed by climbing plants or cascading groundcover as shown in Fig.no.2. Specially designed structures can be used to force the plant development through the building's wall, which can serve as support for the climbing vegetation. Normally, green facades are rooted at the base in the ground or in plant boxes, but intermediate planters, fixed to the wall at a certain height or even on rooftops as a falling green cascade, can also be used. Due to the lower diversity and density of plants, green facades normally require less intensive maintenance and protection than living walls. Living walls are generally more complex infrastructures that involve a supporting structure with different attachment methods. A waterproof backing is required to isolate the living wall from the building in order to avoid problems. The irrigation network is also necessary while fertigation, monitoring, and lighting systems are optional. There are many ornamental species and there are many successful experiences of planting edible herbs and vegetables to create vertical gardens of lettuce, mints, thyme, strawberries, etc.

On the other hand, species used in outdoor living walls vary greatly depending on location, as well as site specific microclimate (sun and wind exposure, height, etc.). Traditionally, the green wall has acted as a "passive" bio filter, but new approaches and technologies are moving towards the integration of living walls (both indoors and outdoors) within the building's air conditioning and ventilation systems. The result is called "active living wall," in which an air current is forced to pass through the green wall and collected afterwards so that the recycled fresh air can be supplied to the building's interior as the air has been cooled, filtered, and humidified by the plants and growing media.



B) Fig.no.2

• Lists of plants in Green wall

- Spider plant
- Dracaena
- Ficus
- Peace lily
- Boston fern
- Snake plant
- Bamboo palm

Benefits of Green Wall:

- a) Reduces urban heat island effect and smog.
- b) Cleans outside air pollutants and dusts and offsets the carbon footprint of people and fuel emissions.
- c) Acts as a sound insulator.
- d) Cleans the water that flows through the wall.
- e) Acts as the heat insulation and helps in reducing the cooling and air condition load.
- f) Acts as an oxygen supplier at high level.
- g) Prevents the waste of wall area.
- h) Increases real estate value.
- i) Prevents the wastage of rain water sliding over the wall.

3.Bio-Filter:

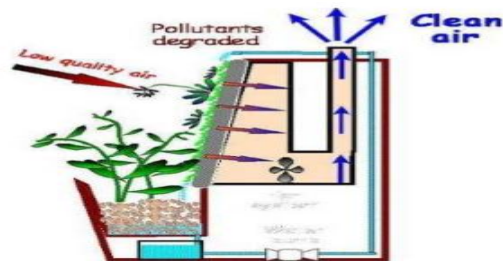
Bio-filter is one of the organic methods which includes Bio-reactor containing living material which captures and diminishes the pollutants biologically. A bio filter is a bed of media on which micro-organisms attach and grow to form a biological layer called bio film. Bio filtration is thus usually referred to as a fixed film process in which bio film is formed by a community of different micro-organisms. Nature has the built-in capacity to adjust to environmental changes. It can repair itself after damage or adapt to exposure from a wide range of compounds. Although the time scale may vary from minutes to centuries, in time a natural ecosystem can repair almost any damage it may sustain.

For example, given enough time nature can restore a site contaminated with organic compounds such as VOCs (Volatile Organic Compounds). One reason for this is that, frequently, materials such as VOCs that are toxic to some life are food for others. Most of the biological breakdown of VOCs is done by microbes (bacteria), although higher plants may also be involved. Some pollutant-degrading species are usually present and active in most environments, and the act of introducing the pollutant only increases their relative numbers and/or activity levels (Yeang, 2006).

Biofilter act as a vegetated return air register. It is a vertical hydroponic green wall containing a range of specifically selected plants. The plants include ferns, mosses and a range of other flowering and foliage plants. Air is actively drawn through the green wall of plants and highly specialized beneficial microbes actively degrade pollutants in the air into their benign constituents of water and carbon dioxide. The clean air is then distributed throughout the space by a mechanical ventilation system. Through the natural processes of biofiltration and phytoremediation, the system removes and breaks down common indoor air pollutants. The System is an ecological approach to maintain the indoor environment with the whole life cycle of the system taken into account. Although the systems are typically designed up to over 20 years of operation, the biological aspects have the ability to continue with their functions forever. The biology component is a self-repairing, self-rejuvenating air cleanser.

Benefits of Bio-filter:

- a) Bio filters are less subject to variable or intermittent loading and to hydraulic shock.
- b) Because micro-organisms are retained within the bio film bio filtration allows the development of micro-organisms with relatively low specific growth rate.



C)Fig.no.3

IV. INDOOR POTTING PLANTS:

Urban Indoor Air Quality (IAQ) is an international health issue, since city dwellers spend 90% of their time indoors. So, it has become necessity to improve the indoor air quality. Interior landscaping has become increasingly popular during the last 30 years. Most architects now include plants in their design specification for new shopping centres, office complexes and other public areas, and people expect to see when they walk through the door. Thus, plants became such important building accessory. The main reason is, indoor plants look attractive – people get charmed by the graceful arch of palm leaves or the exotic beauty of orchids. However, recent research has shown that the value of plants goes far beyond the purely aesthetic. Plants are actually good for the building and its occupants in a number of subtle ways and are an important element in providing a pleasant, tranquil environment where people can work or relax.

Types of Indoor Plants:

There are Different varieties of indoor plants which can be used to serve different purposes. Some plants are good for day time whether some are useful for night time workers. Based on the functionality or occupancy time these plants are helpful to decorate and enhance the indoor environmental quality. According to the study of Dr. B. C. Wolverton about indoor plants are as follows:

- a) Night time workers Bromeliads, orchids and succulents exchange Oxygen and Carbon Dioxide at night rather than as most other plants do during the daytime. This makes them perfect bedroom plants to refresh the air for breath during sleep.
- b) Plants which raise humidity levels as plants return 97% of the water human give them back into the air, water loving plants help to raise humidity levels. Particularly useful in centrally heated or airconditioned buildings. Examples of some water loving plants are Schefflera, Bamboos and Hemp.
- c) Peace Lily: *Spathiphyllum*. Winner of Dutch office plant of the year 2007. A good all-rounder and best at removing all toxins.
- d) Boston Fern: *Nephrolepis exaltata* and obliterate. Good air cleaner; also good for raising humidity levels and keeping the environment comfortable, particularly useful in centrally heated or

air-conditioned rooms/spaces. *Dracaena deremensis*, *marginata* and *fragrans*. One of the best plants at removing Trichloroethylene emitted by photocopiers and printers, perfect for the home office. Umbrella plant: *Schefflera actinophylla*. Good air purifier and also a water lover which means *Schefflera* is good for humidifying the air, like Boston ferns. Ivy: *Hedera helix*. Good at cleaning the air, the plants can also help to reduce the physical signs of stress.

Benefits of Indoor plants:

- a) Reduces the air pollution.
- b) Reduces work place illness.
- c) Reduce stress and negativity.
- d) Contributes to meet at-least 75% of indoor environmental quality(IEQ) criteria.
- e) Enhances aesthetic view.
- f) Absorb and buffer noise.

III. CONCLUSION

The aim of the thesis was to find out the possible ways to integrate plants into skyscrapers and assess how the integration of plants into the skyscraper design can help reducing the energy use, and enhance the living quality. The impacts of these options on energy consumption and living environment, such as the benefits of Green roof, Green wall, Biofilter and Indoor potting plants on living condition, environment, economy and society is elucidate with some of their drawbacks, and the available technologies to integrate these options into the buildings. Discussion and recommendations were made to overcome some of the drawbacks and some guidelines were proposed for good practice to make the 'Green Movement' viable economically, socially and environmentally. Thus, this research has fulfilled its aim and objectives to its full extents for designing a Green Skyscraper with incorporating the plants into it.

IV. FUTURE SCOPE:

The Green roof can be a good replacement for the land which is been used as the recreational area on the plot. The Green walls can be more improved by combining green wall as the part of vacuum as the outer panel so this will lead to development of the natural and permanent sound insulator and air purifier resulting in reduction in the air conditions load and artificial sound

barrier. This is the smart solution in the city area as well as industrial areas as these are the area which are mainly facing the sound and air pollution. The Green walls and Green roof will increase the planting of different plants thus converting the concrete world into the green world and hence there is much more area available for the development of water storage lakes, for developing different types of infrastructure requirement as there is scarcity of land. Green Infrastructure is the need for the design of sustainable structure and can satisfy the demands of the future generation. This research is an attempt to highlights various methodology to save energy as a when feasible. The paper recommends the need of designing and implementing all possible energy saving integrated technique for sustainable development in our country. It also highlights that rules and regulations are supposed to be modified and policy decision should be incorporated by the authorities at the national level.

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Study and Design of Roundabout at Charkop Market, Kandivali (West)

^[1] Sandeep B. Rajurkar, ^[2] Mithil S. Soni, ^[3] Mohan M. Dusane, ^[4] Kunal A. Mahale, ^[5] Amar S. Gorule.

^{[1][2][4][5]} Civil Engineering Student, Vidyavardhini's college of Engineering and Technology, Vasai (W).

^[3] Assistant Professor at Department of Civil Engineering, Vidyavardhini's college of Engineering and Technology, Vasai (W).

Abstract— The developing cities are having a lot of traffic problems with increasing rate of vehicles. In present time charkop market and Hindustan naka, kandivali (west) part of Mumbai city, Maharashtra. Traffic problem are due to private vehicles running in this part of city these increased rate of vehicles require space for movement, with safety having enough capacity of roundabout's intersection. So capacity evaluation needs to be done on roundabout intersection for easy operation of traffic. During the past decade major cities have under gone hazard growth of Industrialization, urbanization of country, and kandivali is not exception for that. Traffic is increasing day by day, so it is almost impossible for traffic police to control the traffic manually at the intersection. Although the signals have been provided on both intersection but the traffic congestion has not been reduced effectively. In order to improve the traffic conditions as well as the aesthetic view at the said intersections, we suggest to design the roundabout at these intersections to reduce traffic congestion keeping in view high traffic and conditions favoring the roundabout. For this traffic volume surveys, study and the design is done accordingly.

Keywords: - Traffic, Roundabout, Charkop Market, Intersection and Kandivali.

I. INTRODUCTION

Table No. 1.1 : Fundamental elements of Roundabouts
Roundabouts are a type of circular intersection or junction in which road traffic flows continuously in one direction around a central island. With the rapid growth of traffic it is experienced that widening of roads and providing flyovers have become imperative to overcome major conflicts at intersections such as collisions between through and right turn movements. In this way, major conflicts are converted into milder conflicts like merging and diverging. The vehicles entering the roundabout are gently forced to move in a clockwise direction. Roundabouts are the efficient intersection design over the signalized intersections depending upon traffic and site data. Depending on the size of circular traffic intersections it may be classified as Rotary, Roundabout, lanes urban compact, compact and Mini-roundabout. Roundabout are suitable when there are more approaches and no separate are available for right turn traffic thus making the intersection geometry complex. Under low traffic conditions, a roundabout offers higher capacity as compared to a two-way stopped control or an all-way stop-controlled

intersection. Roundabouts were developed in the 1960's and able to handle heavy traffic. Mini-roundabouts are best suited to areas with low speeds and there is no feasibility to use roundabout with a raised central island. Mini-roundabouts are common in the United Kingdom (U.K.), France, United State and Germany since their introduction in the early 1970's. But from past few year's uses of roundabouts and rotaries with or without signal system is also increasing in India.

A. Types of Roundabouts

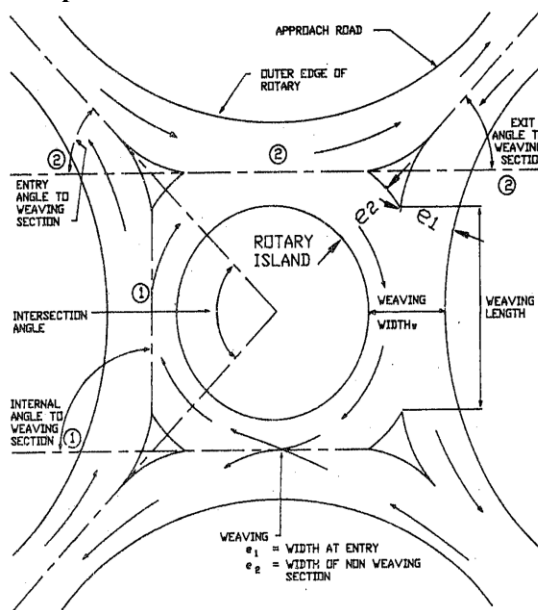
- Mini roundabouts
- Urban compact roundabouts
- Urban single lane Roundabouts
- Urban double lane roundabouts

Fundamental elements of all above roundabouts are compare in table no 1.1 below. Components of Roundabouts

Design element	Mini	Urban compact	Urban single lane	Urban double lane
Recommended max entry design speed	25km/hr	25km/hr	35km/hr	40km/hr
Max no of entering lanes	1	1	1	2
Inscribed circle diameter	13m to 25m	25m to 30m	30m to 40 m	45m to 55m

Fig No. 1.1 Components of Roundabout

B. Components of Roundabouts



• **Design Speed**

All the vehicles are required to reduce their speed at a rotary. Therefore, the design speed of a rotary will be much lower than the roads leading to it. Although it is possible to design roundabout without much speed reduction, the geometry may lead to very large size incurring huge cost of construction. The normal practice is to keep the design speed as 30 and 40 KMPH for urban and rural areas respectively.

• **Entry, Exit and Island Radius**

The radius at the entry depends on various factors like design speed, super-elevation, and coefficient of

friction. The entry to the rotary is not straight, but a small curvature is introduced. This will force the driver to reduce the speed. The speed range of about 20 KMPH and 25 KMPH is ideal for an urban and rural design respectively. The exit radius should be higher than the entry radius and the radius of the rotary island so that the vehicles will discharge from the rotary at a higher rate. A general practice is to keep the exit radius as 1.5 to 2 times the entry radius. However, if pedestrian movement is higher at the exit approach, then the exit radius could be set as same as that of the entry radius. The radius of the central island is governed by the design speed, and the radius of the entry curve. The radius of the central island is about 1.3 times that of the entry curve for all practical purposes.

• **Shape of Central Island:**

The shape and disposition of central island (control island) depend upon various factors such the number and disposition of intersecting roads and traffic flow pattern. Islands. The conditions under which a particular shape is favored are discussed below in Table no. 1.2:

Type	Central Island
Circular	Equal importance to all road meetings
Squares with rounded legs	Suitable for predominantly straight ahead flows
Elliptical, elongated, oval or rectangular.	To favour through traffic/to suit the geometry of the intersecting legs/ to provide longer Weaving lengths.
Irregular	Shape is dictated by existence of large number of approaches.

Table No. 1.2 : Shapes of central Island and conditions

• **Width of the Rotary**

The entry width and exit width of the rotary is governed by the traffic entering and leaving the intersection and the width of the approaching road. The width of the carriageway at entry and exit will be lower than the width of the carriageway at the approaches to enable reduction of speed. IRC suggests that a two lane road of 7 m width should be kept as 7 m for urban roads and 6.5 m for rural roads. Further, a three lane road of 10.5

m is to be reduced to 7 m and 7.5 m respectively for urban and rural roads. Traffic rotaries reduce the complexity of crossing traffic by forcing them into weaving operations. The shape and size of the rotary are determined by the traffic volume and share of turning movements. Capacity assessment of a rotary is done by analyzing the section having the greatest proportion of weaving traffic. The analysis is done by using the formula given by the width of the weaving section and it should be higher than the width at entry and exit. Normally this will be one lane more than the average entry and exit width. Thus weaving width is given as,

$$W = \text{weaving} = [(e1+e2) / 2] + 3.5m$$

Where e1 is the width of the carriageway at the entry and e2 is the carriageway width at exit. Weaving length determines how smoothly the traffic can merge and diverge. It is decided based on many factors such as weaving width, proportion of weaving traffic to the non-weaving traffic etc. This can be best achieved by making the ratio of weaving length to the weaving width very high. A ratio of 4 is the minimum value suggested by IRC. Very large weaving length is also dangerous, as it may encourage over-speeding.

Weaving Length:

The weaving length determines the ease with which the vehicle can maneuver through the weaving section and thus determines the capacity of the rotary. The weaving length is decided on the basis of the factors, such as, the width of weaving section, average width of entry, total traffic and proportion of weaving traffic in it. It is desirable to prevent direct traffic cuts and this can be achieved by making the ratio of weaving length to weaving width large enough. A ratio 4:1 is regarded as minimum. The minimum values of weaving lengths as recommended by IRC are given below Table No. 1.3:

Design Speed (kmph)	Minimum length of Weaving (m)
40	45
30	30

Table No. 1.3 : Suggestions for weaving length

C. Advantages over Signal System:

- The main advantage of roundabout over signalized system is that the vehicles don't have to halt and can continuously move around roundabout.
- Also electricity can be saved in roundabout over a

signalised intersection. As per the survey conducted by Hindustan Times, Rs 6.5lakhs/month is consumed in Delhi for signalised system.

- The conflict points in signal system, for vehicles is 32 and that for pedestrians is 8 that is in all 40 conflict points are provoked. But the same in roundabout is 8 for vehicles and 4 for pedestrians in all 12 conflict points. Shown in figure below

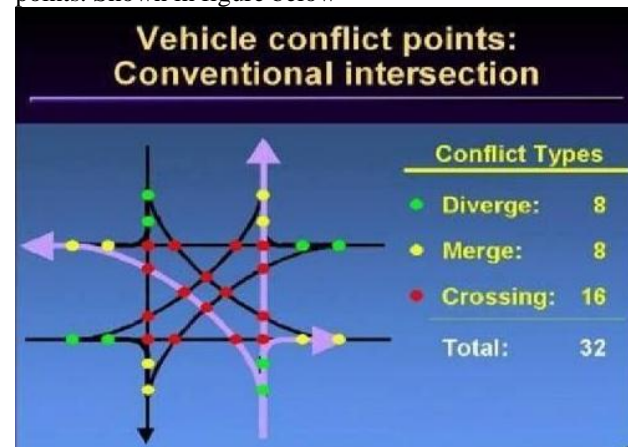


Fig. No. 1.2: Conflict Points at signalized system

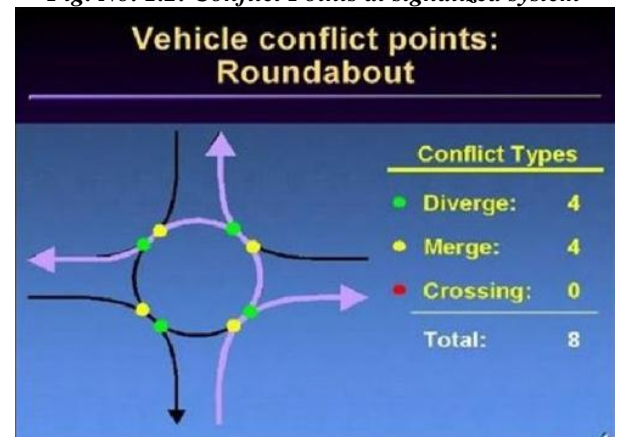


Fig. No. 1.3: Conflicts point at Roundabout

II. LITERATURE REVIEW

From study of previous work done in field of highway design we have found that experts in this field have focused on link between traffic condition, traffic volume and geometric design to see whether designed roundabout is able to perform the desired operational performance. IRC SP 41 and IRC 65-1976 recommends

the guidelines, factors on the design of traffic rotaries. S.K. Mahajan, Kruti Jethwa, et al (2013) in their paper have discussed a new geometric concept to design roundabout and a software package has been developed by them to be used in road works. Waheed Uddin (2011) concluded in his paper that Roundabout has proved in increasing the capacity of intersection, decreasing delay and reducing number of crashes and number of injury and reducing vehicle emission. From this he marked roundabout proved beneficial junction increasing traffic flow and decreasing delay. Junaid Yaqoob, & Er. Amir Lone (2016) in their paper stated that rotary are a tool that increases safety along the street, enhances driver attentiveness, reduces automobile idling, and efficiently streams traffic through an area.

III. METHODOLOGY

Traffic surveys at intersection were conducted by manual method. For this method we had first studied about the procedure and collected the required information & forms, then we performed traffic survey at the intersection. Traffic survey was conducted by splitting three field observers at each leg. One observer was appointed to count overall vehicle volume passing through fixed point, while other two were appointed to count left and right turning vehicle volume. Six surveys were carried out at peak hours at study area, charkop market. The traffic flow mainly includes cars, auto-rickshaw, two wheelers, bus, trucks and other light commercial vehicles such as tempos. From survey performed, we preferred survey No. two (morning) for design purpose as it had maximum traffic volume amongst all surveys then calculations of traffic intensity by multiplying with their respective Passenger Car Unit (PCU) had been done. After this we have carried out calculation for weaving length, entry, exit radius etc. and other factors such as radii of Central Island were referred from IRC 65. Obtained data were impart to AutoCAD Civil 3D to design roundabout for specified condition.

IV. LOCATION: CHARKOP MARKET, KANDIVALI (WEST) MUMBAI, MAHARASHTRA

The location selected for designing the roundabout is

situated at Charkop Market, Kandivali (West), Mumbai, Maharashtra is pretty much crowded area due to market situated in this region. At the intersection there are four roads namely RPD Road No. 4, RPD Road No. 5, RPD Road No 6 and DR. Babasaheb Ambedkar Road, which are major district roads with 8 meter carriage way. In fig. No. 4.1 exact location of the junction is given. Due to rapid growth and development population of this area has been increased in last decade which also leads to increase in number of vehicles and traffic congestion. All four roads have traffic signals of 30 sec allowance which is not efficiently handling the traffic so to overcome this problem we think that roundabout will be more efficient option and hence we are designing the roundabout for said intersection.



Fig. No. 4.1: Location plan Source: Google maps

V. DATA COLLECTION AND EXTRACTION

To design roundabout we have carried out surveys on morning evening basis. On Tuesday, Friday & Sunday respectively, so that we can cover traffic on weekdays as well as weekends. The survey reports are represented in the bar graph as shown below.

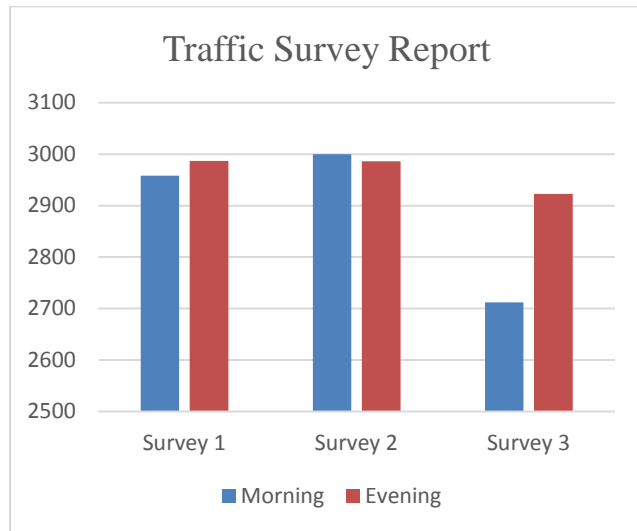


Fig. No.5.1: Representation of Traffic Survey

In Fig. No.5.1 we can see that survey 2 (Morning) had maximum number of vehicles so it is more favorable to take this data for design purpose so that designed roundabout can handle traffic more effectively. Survey 2 (morning) data is shown in the table 5.1 below:

Approach	Lane	Left turning			Straight ahead			Right turning		
		Car/Auto	Two wheeler	Truck/bus	Car/Auto	Two Wheeler	Truck/bus	Car/Auto	Two Wheeler	Truck/bus
N	D	86	66	12	123	104	10	114	94	11
E	A	127	156	10	247	76	23	165	102	15
S	C	106	105	18	96	66	6	109	94	14
W	B	137	115	12	184	50	20	202	104	21

Table 5.1: Survey 2 (Morning) data

VI. CONDITIONS AT INTERSECTION AND THEIR SUITABILITY

A. As per IRC 65, a roundabout can handle 3000 vehicles per hour from all leg efficiently. At study area i.e. charkop market we did 6 surveys, 3 in morning peak hours and remaining 3 in evening peak hours, on

the basis of this surveys we can firmly say that this intersection does not cross this permissible limit so by considering this point, we can say that this intersection is suitable for roundabout.

B. Also in IRC it is mentioned that if traffic volume with more than 30% right turning then roundabout is suitable in such cases, so we thus calculate total volume of right turning traffic, and it is more than 30% on each leg following calculation from survey 2 (morning), which makes our above statement valid

$$\text{Leg A} = (\text{right turning volume})/(\text{overall volume}) = 282/921 \times 100 = 30.61\%$$

Similarly,

$$\text{Leg B} = \frac{327}{845} \times 100 = 38.69\%$$

$$\text{Leg C} = \frac{217}{614} \times 100 = 35.34\%$$

$$\text{Leg D} = \frac{219}{620} \times 100 = 35.32\%$$

So also from this point of view the intersection is suitable for roundabout.

C. Apart from this pedestrian crossing is also considerably low at this study area which is given below

$$\text{Leg A} = 87 \text{ pedestrians/hour}$$

$$\text{Leg B} = 62 \text{ pedestrians/hour}$$

$$\text{Leg C} = 79 \text{ pedestrians/hour}$$

$$\text{Leg D} = 92 \text{ pedestrians/hour}$$

So we can also say that it's suitable from pedestrian point of view too.

D. Roundabout required large area for construction, the concerned intersection have major district roads which are wide enough to construct roundabout. Also all four legs have equal volume of traffic, so this things are also suitable for roundabout. So from above points we strongly recommend roundabout at considered intersection i.e. at charkop market.

VII. DESIGN OF ROUNDABOUT

For designing roundabout different components of roundabout are need be design separately which are entry, exit curve, waving width, radius of central island etc. this components has been discussed already in this paper so now moves towards designing calculations and adoption for roundabout at charkop market.

a. Design speed

For measuring speed of vehicles at selected intersection we did spot speed study by stopwatch method and the speed we took for design speed as 30 KMPH which is also recommended by IRC 65 for urban areas.

b. Shape of central island

Shape of Central island mainly depends on number and type of roads at intersection. Concerned intersection have four legs which almost 90 degrees angle to each other and also it has relatively equal traffic volume from all four legs so we going to adopt Circular shaped central island.

c. Entry radius (e1)

Entry radius depends upon design speed, and in this case we had already adopt design speed as 30 KMPH. Suggested value for e1 as per IRC 65-1976, page No. 9 table No. 1 is 15 meters to 25 meters so take e1 = 15 meters

d. Exit radius

In IRC it is mentioned that Exit radius should slightly more than entry radius so that driver can increase their speed at exit the recommended value is 1.5 times of e1 So, exit radius = 1.5 × 15 = 22.5 meters.

e. Radius of central island

Radius of central island should be bigger than radius at entry generally it is adopted as 1.33 times of entry radius. Which is also mentioned in IRC 65-1967. So, Radius of central island = 1.33 × 15 = 19.95 meters say 20 meters.

f. Weaving length

The weaving length determines the ease with which the traffic can merge and diverge. The weaving length decided on the basis of factors such as the width of weaving section, the average width at entry, total traffic and the proportion of weaving traffic in it.

Weaving length from page No. 10 from IRC 65-1967 For design speed 30 KMPH minimum suggested value for weaving length is 30 meters.

So, take weaving length = 30 meters

g. Weaving angle

Weaving angle should be as small as possible but should not be less than 15 degrees.

So take weaving angle = 45 degree

h. Width of carriageway at entry and exit

The carriageway width of the intersection leg is governed by the design year traffic entering and leaving the intersection. Since the maximum width of

carriageway of the concerned intersection is 16.76 meters ≈ (17 meters).

Minimum width of entry should be 8 meters so we proposed width of entry 10 meters at RPD road No. 04 & RPD road No. 06, and width of entry at RPD road No. 05 and Dr. Babasaheb Ambedkar road is 8 meters.

i. Width of Non Weaving section (e2)

IRC 65-1967, on page No. 10 recommends that the width of non-weaving section should be equal to the widest single entry into the roundabout and should generally be less than width of weaving section.

Therefore,

$$e2 = 10 \text{ meters (from above point H)}$$

j. Width of weaving section (w)

Width of waving section of roundabout should be one traffic lane wider (3.5 meter) then the mean entry width. i.e.

$$\text{Mathematically, } w = \frac{e1+e2}{2} + 3.5 = \frac{15+10}{2} + 3.5 = 16 \text{ meters}$$

k. Capacity of Roundabout

Approach	Left turning	Straight ahead	Right turning
Leg D (North)	169.1	229	215.3
Leg C (South)	235.15	162.3	218.7
Leg A (East)	272	368.4	283.5
Leg B (West)	256.85	277.5	338.8

Table No.7.1: Traffic volume in PCU/hr.

The traffic in terms of PCUs from each leg is illustrated in fig No.7.1 below:

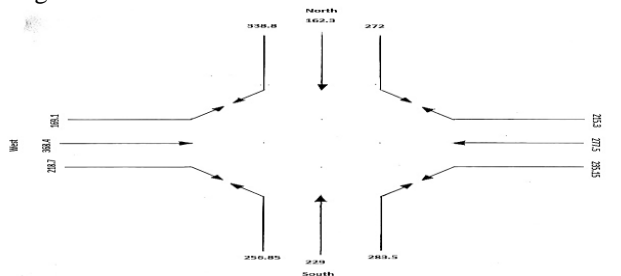


Fig No.7.2: Traffic approaching from each leg to roundabout in PCU/hr.

Fig No.7.2.1: Traffic approaching on each leg in PCU/hr.

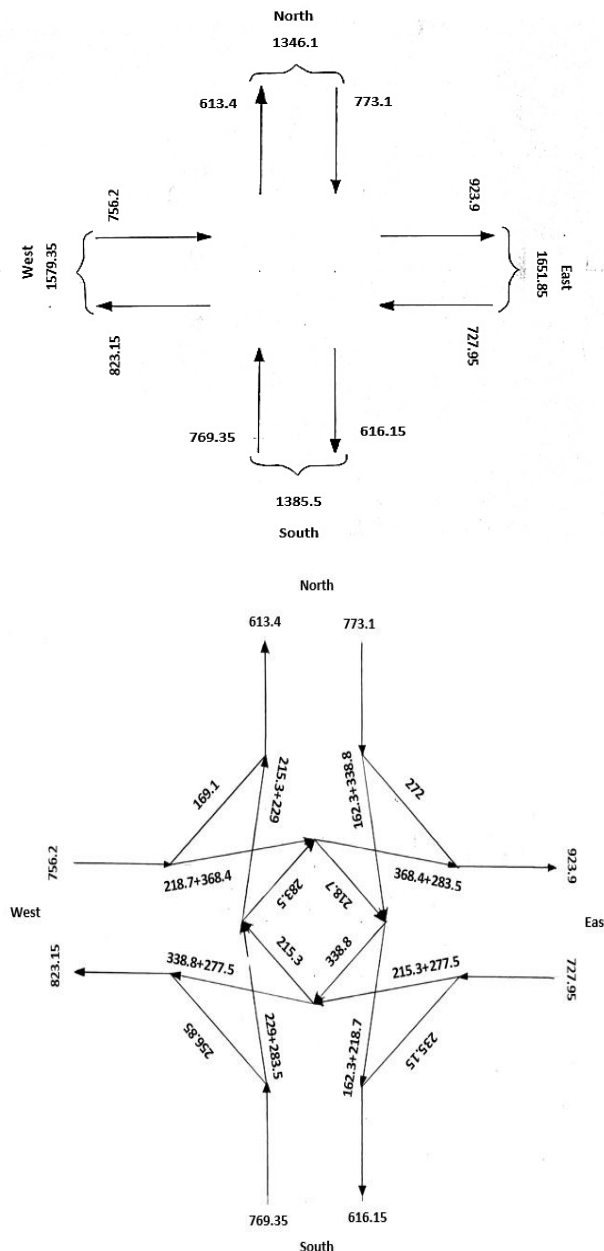


Fig No.7.3: Traffic flow is allocated to the network

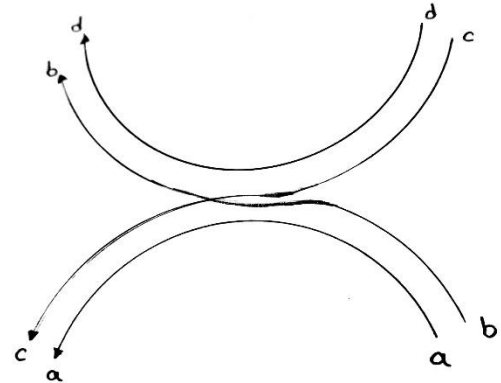


Fig No.7.4 : weaving traffic

Weaving traffic from east to south i.e. from Leg A to Leg C

a= 338.8 PCU/hr.

b= (162.3+218.7) = 381 PCU/hr.

c= (215.3+277.5) = 492.8 PCU/hr.

d= 235.15 PCU/hr.

P = (b+c) / (a+b+c+d) from IRC 65-1967 Page No.

Therefore, $P = \frac{(381+492.8)}{(338.8+381+492.8+235.15)} = 0.56$

Hence mathematical formula for capacity of roundabout, from IRC 65-1967 Page No.

$Q_p = \frac{280 * w [1 + (e/w)] * [1 - (P/3)]}{[1 + (w/l)]}$

$Q_p = \frac{280 * 16 [1 + (10/16)] * [1 - (0.56/3)]}{[1 + (16/30)]}$

$Q_p = 3861.56$ PCU/hr.

Similarly, weaving traffic from West to South i.e. Leg B to Leg c

a= 215.3 PCU/hr.

b= (229+283.5) = 512.5 PCU/hr.

c= (338.8+277.5) = 616.3 PCU/hr.

d= 256.85 PCU/hr.

P = 0.705

$Q_p = 3632.08$ PCU/hr.

Weaving traffic from West to North i.e. Leg B to Leg D

a= 283.5 PCU/hr.

b= (215.3+229) = 444.3 PCU/hr.

c= (368.4+218.7) = 587.1 PCU/hr.

d= 169.1 PCU/hr.

P = 0.695

$Q_p = 3647.91$ PCU/hr.

Weaving traffic from North to East i.e. Leg D to Leg A

$a = 218.7$ PCU/hr.

$b = (162.3 + 338.8) = 501.1$ PCU/hr.

$c = (368.4 + 283.5) = 651.9$ PCU/hr.

$d = 272$ PCU/hr.

$P = 0.701$

$Q_p = 3638.41$ PCU/hr.

Hence consider capacity of designed roundabout is minimum from above four Q_p i.e. 3632.08 PCU/hr.

VIII. RESULT

From above calculations, capacity for RPD road No. 06 (Leg A) to Dr. babasaheb Ambedkar road (Leg C) is 3861.56 PCU/hr. which is maximum from all weaving sections, capacity for RPD road No. 04 (Leg B) to Dr. babasaheb Ambedkar road (Leg C) is 3632.08 PCU/hr. which is minimum of all waving section, capacity for RPD road No. 04 (Leg B) to RPD road No. 05 (Leg D) is 3647.91 PCU/hr. and capacity for RPD road No. 05 (Leg D) to RPD road No.06 (Leg A) is 3638.41 PCU/hr.

IX. CONCLUSION

In our study we performed surveys and accumulate traffic data which was required for designing roundabout, and after studying all necessary requirements and calculation we found that minimum capacity of designed roundabout is 3632.08 PCU/hr. whereas maximum required capacity for concerned intersection is 3026.6 PCU/hr. hence we can conclude that designed roundabout can efficiently handle present traffic flow as well as if in near future if there is slightly increase in rate of traffic flow, designed roundabout is capable for managing the traffic. Apart from this if roundabout is provided at said intersection then traffic congestion will be reduced to some extent as well as the halt time of vehicles at intersection will be minimized. As discussed above roundabout has far less conflict points than signalized intersection so by providing designed roundabout pedestrian safety can also be achieved.

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Life Cycle Cost Analysis- A Decision Making Tool for Implementation of Green Infrastructure Projects

^[1] Monali Dhaware, ^[2] Ajinkyasingh Marod, ^[3] Shantini Bokil

^{[1],[2]} Research Students, Department of Civil Engineering, MIT, College of Engineering, Pune, Maharashtra, India.

^[3] Professor and Head, Department of Civil Engineering, MIT, College of Engineering, Pune, Maharashtra, India

Abstract— The sustainable infrastructure is the need of the next generations. There is no definite tool to give exact streamlined decision for the feasibility of the any project. Day by day, the depletion of environment due to construction activities is increasing. A solution to these crises is the construction of green structures which have minimal impact on the environment. In this process of shifting from conventional to green structures, the initial investment cost of the project may tend to rise higher, however, the entire structure gives huge returns over a period of 10-15 years due to which this shift can prove to be beneficial. The purpose of this paper is to highlight the role of life cycle cost (LCC) analysis in the feasibility study of construction projects and in deciding on the proposals of infrastructure projects. A study was made on the cash flows during the construction and further the expected returns were calculated. The results obtained, highlight that the factors like construction techniques, materials, etc. influence the cost of a green building. Therefore, after a thorough study of costs incurred and the future benefits and further the analysis of life cycle cost, we can state the feasibility of a green infrastructure project. Thus providing an alternative approach as to how to achieve long term minimum value of total costs from strategic point of view.

Keywords— Huge returns, cash flows, feasibility, strategic point of view.

I. INTRODUCTION

At the time of taking financial decision in construction projects decision maker tends to think in the short term. In large construction projects more importance is given to initial costs, with less attention to future cost. In order to improve long term decision making life cycle cost analysis is important. Purpose of life cycle cost analysis is to determine cost of project for any number of years. Life cycle cost analysis (LCCA) method consider initial cost, operation cost, energy cost, maintenance cost, repair cost and residual value to estimate cost effectively. LCCA highlights the opportunity for overall saving in the life of building that can be achieved by investing in more cost efficient solutions initially. LCCA provide future impact of decision which has been taken at the initial stage. Cost saving can be achieved by comparing alternative options. Lowest life cycle cost alternative will be the best alternative. Comparative study of various methods of LCCA shows that NPV method is more appropriate. Categorization of various costs related to construction, operation and maintenance of building are called

terminologies. Following are the terminologies used while calculating LCC of a building:

1. Initial cost: Initial cost includes land acquisition cost, design cost and construction cost.
 2. Operation Cost: Operational cost includes cost required for annual building utilities and services excluding maintenance and repair cost involved in the operations of facility.
 3. Maintenance cost: Maintenance cost includes cost required for the maintenance of water pump, maintenance of passenger lift, annual roof inspection etc.
 4. Repair costs: Repair cost includes cost required to extend the building life without replacing the system entirely
 5. Replacement costs: Replacement Cost required for replacement of entire component.
 6. Residual Value: Residual value is the value of the building at the end of the study period or at the life cycle period.
 7. Energy costs: Energy cost includes expenses for energy and other utilities.
-

II. LITERATURE REVIEW

Weerasinghe, et. al Thanuja Ramachandra and Niraj Thurairajah's paper states that, the green building investors continue to focus on minimizing construction cost and fail to appreciate the impact on life cycle economic performances. The construction cost of green buildings tends to be higher than traditional buildings, with comparatively lower operation and maintenance costs. Therefore, this study assesses the life cycle cost of green certified industrial manufacturing building and that of a conventional building to establish the impact of sustainable features on life cycle cost. The quantitative data on construction, running and end of life cycle costs of the selected green and conventional buildings were collected and analyzed using Net Present Value. The analysis shows that the construction cost of green industrial manufacturing building is about 28% higher than that of a conventional building. However, operation, maintenance and end of life cycle costs are in the range of 35 to 41%, 26 to 30% and 6 to 18% respectively lower than that of conventional building. The study found that the life cycle cost of green building is 24 to 28% less compared to conventional building. It is expected that the outcome of this research would contribute to the organizational learning of green built environment and thereby uplift the use of sustainable construction in Sri Lanka. Marketa Spickova, Renata Myskova's paper states that costs optimization is further developed not only by the pure economic theory but more with practical management. In the context of the economic crisis 2008 and the previous crises we do observe the pressure on the sophisticated cost optimization into the important strategic costs tools like Activity Based Costing, Target Costing, Life Cycle Costing. We use these methods for optimal costs management, observation, and the costs minimization. This article has described how to choose the most efficient project based on NPV. The main attention was focused on this most widely used method which is supporting the decision making. However, the authors are going to research the similar on sequences of other methods for economic evaluation and investment decision making. In general, we say that the using of mentioned methods is very helpful in practice. But there is a small paradox, because of the companies have not used them often and regularly. It is caused by a few existing limitations for instance the complexity of

information and the difficulties of data collecting.

III. METHODOLOGY

Although the concept of green buildings is gradually gaining popularity in India, it has still not become an integral part of the construction industry. One of the key reasons is the general apprehension of the building industry that green buildings are not viable from a business perspective. The capital cost involved in a green building is the biggest obstacle in allowing large-scale adoption of the concept by the construction industry. To address the issue, we conducted a study to assess the economic feasibility of incorporating energy-efficient design features in buildings with reference to improvement in their energy performance. The results are arrived by calculating a cost-benefit analysis of a building in Pune. Primary data (including information on general details of the building, the envelope system, lighting system, electrical system and water consumption) was collected. Future streams of costs arising from owning, operating, and maintaining, as well as the benefits arising from energy savings, were also evaluated. To conduct a comparative analysis of life cycle cost of green building with that of a conventional building, a benchmark (referred to as conventional case) was established. Financial tools such as payback period, life cycle cost and savings-to-investment ratio were used to assess the economic viability of additional investments made towards improving their energy performance.

Proposed building specification:

No. of flats- 6
No. of floors- 3
No. of occupants- 24

A. Calculations for Energy consumption in Conventional building:

Items	Watt age	Nos .	Approx.W orking hours per day	Energy consumption (wh/day)
Incandes cent lamps	60	36	8	17280

Fluorescent tubes in Flats	40	21	8	6720
Fluorescent tubes in common area	40	3	12	4440
Fan	70	21	10	14700
Computers	100-200	6	3	2700
Refrigerators	225-500	6	20	43500
T.V.	210-400	6	5	9150
Microwave	800-1000	6	1	5400
Heater/ Geyser	1000-1500	9	1	11250
Mixer	150-450	6	0.5	900
Iron	40-60	6	0.5	150
Washing Machine	600-800	6	2	8400
Radio	50-200	6	1	750
DVD	80-85	6	2	990
AC	1200	6	8	57600
Total				183930

Monthly consumption = 5701.83 kWh

Total electricity bill in Rs:

Fixed charge = 10 Rs × 21 rooms = Rs. 210

Energy charge = 5701.83 × 3.6 = Rs. 20526.588

Meter charge = 20 × 21 = Rs.420

Total electricity bill = 210+ 23104.548+ 240= Rs.20976.588

B. Calculations for Energy consumption in Green building:

Table No. 2

Items	Wattage	Nos.	Approx. Working hours per day	Energy consumption (wh/day)
Incandescent lamps	15	36	8	4320
Fluorescent tubes in Flats	35	21	8	5880
Fluorescent tubes in common area	35	3	12	1260
Fan	60	21	10	12600
Computers	100-200	6	3	2700
Refrigerators	225-500	6	20	43500
T.V.	210-400	6	5	9150
Microwave	800-1000	6	1	5400
Heater/ Geyser	1000-1500	9	1	11250
Mixer	150-450	6	0.5	900
Iron	40	6	0.5	120
Washing Machine	600-800	6	2	8400
Radio	50-200	6	1	750
DVD	80-85	6	2	990
Total				107220

Monthly consumption=3323.82kWh

Total electricity bill in Rs:

Fixed charge = 10 Rs × 21 room = Rs. 210

Energy charge = $3323.82 \times 3.6 = 11965.752$

Meter charge = $20 \times 21 = \text{Rs.}420$

Total electricity bill = $210 + 11965.752 + 240 = \text{Rs.}12415.752$

Total cost saving = $20976.588 - 12415.752 = \text{Rs.} 8560/-$

i. Installation of Solar panels:

Solar panels are provided to meet 100% demand for energy.

4 solar units of 5kW each are required to meet the requirement of the building considered.

Cost of one solar unit = $\text{Rs.}6,00,000$

Total cost = $600000 \times 4 = 24,00,000$

ii. Use of Passive architecture:

This method ensures natural ventilation and thus cuts down the need for AC and lighting.

C. Calculations for Water Consumption:

Per capita consumption = 150 litres/day

Occupants = $6 \times 4 = 24$

Monthly consumption = $24 \times 150 \times 30 = 108000$ litres

Car wash = $6 \times 6000 = 36000$ litres

Gardening = $120 \text{ litres} \times 25 \text{ m}^2 = 3000$ litres

Total requirement = $108000 + 36000 + 3000 = 1,47,000$ litres

i. Installation of Natural Water treatment plant:

Recycled water = $0.8 \times 108000 = 86400$ litres (Used for flushing, car wash and gardening)

Cost of Water as per PMC regulations = $\text{Rs.} 5$ per 1000 litres

Water saving = $86400 \times 5 = \text{Rs.}432/ \text{month}$

D. Using Lime bricks instead of conventional bricks:

Approx. bricks required = 125000 nos.

Total cost of conventional bricks = $\text{Rs.} 7/ \text{unit} \times 125000 = \text{Rs.}875000/-$

Total cost of lime bricks = $\text{Rs.} 4/ \text{unit} \times 125000 = \text{Rs.}500000/-$

Total cost saving = $\text{Rs.} 375000/-$

Evaluation criteria:

Duration considered = 25 years

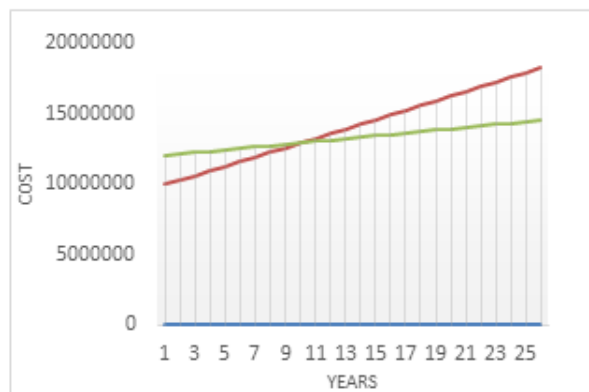
Table no. 3

Type of cost		Type of Building	
		Conventional	Green
Initial investment	Cost of Construction	1,00,00,000/-	96,25,000/-
	Solar panels	--	24,00,000/-
Yearly Energy		251719.056/-	14400/-
Yearly Water		8820/-	3636/-
Maintenance		72000/-	82000/-

Table no. 4

Year	Conventional	Green
0	10000000	12025000
1	10260539.06	12125036
2	10593078.11	12225072
3	10925617.17	12325108
4	11258156.22	12425144
5	11590695.28	12525180
6	11923234.33	12625216
7	12255773.39	12725252
8	12588312.44	12825288
9	12920851.5	12925324
10	13253390.55	13025360
11	13585929.61	13125396
12	13918468.66	13225432
13	14251007.72	13325468
14	14583546.77	13425504
15	14916085.83	13525540
16	15248624.88	13625576
17	15581163.94	13725612
18	15913702.99	13825648
19	16246242.05	13925684
20	16578781.1	14025720
21	16911320.16	14125756
22	17243859.21	14225792
23	17576398.27	14325828
24	17908937.32	14425864
25	18241476.38	14525900

Graph No. 1



Results for Green building:

Net benefit value= Rs. 3715573.38 (20% savings)

Savings to investment ratio= 0.308 (which is zero for proposed conventional building)

Life cycle cost= Rs. 1,45,25,900/-

IV. CONCLUSION

From the above analysis and evaluation, we found out that the life cycle cost of the green building is Rs. 1,45,25,900 and that of conventional building is Rs. 1,82,41,476.38, which is 125% greater than the Green building. It was also observed that the breakeven point of the green building is obtained in 9.5 years. The results prove that investing in green buildings is a profitable venture. Strategies that are integrated in the building and services design, and energy-efficient equipments installed to improve the energy performance of buildings, contribute towards the high initial investment as compared to conventional buildings. The graph no. 1 illustrates that, though the initial costs are high, the returns are significant in the long run. Getting to an equilibrium between the level of energy efficiency and life cycle costs serves as a challenge for the decision making process. Using LCC analysis as a decision support for investors in the early building design stages continues to resolve many difficulties and helps the investors to rely upon the green buildings than the conventional buildings. The decision makers and project managers, can analyze this breakeven point and optimize the investments and can plan the structures strategically giving excellent

benefits in all sectors of construction industry.

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“Intelligent Transport System”

^[1] Akshay Govindrao Shelke, ^[2] Shaikh Samrin Shaikh Irfan, ^[3] Akanksha Rajesh Shirwat
^{[1][2][3]} “Government Polytechnic, Aurangabad”

Abstract— A broad range of diverse technologies, known collectively as intelligent transportation systems (ITS), holds the answer to many of our transportation problems. ITS is comprised of a number of technologies, including information processing, communications, controls and electronics. Joining these technologies to our transportation system will save lives, save time, and save money.

There are many technologies involved in intelligent transportation system,

- ❖ Wireless communications
- ❖ Computational technologies
- ❖ Floating car data/floating cellular data
- ❖ Sensing technologies
- ❖ Inductive loop detection
- ❖ Video vehicle detection

“ Intelligent transportation system i.e. ITS has wide range of applications as,

- ❖ Electronic toll collection
- ❖ Emergency vehicle notification systems
- ❖ Cordon zones with congestion pricing
- ❖ Automatic road enforcement
- ❖ Collision avoidance systems
- ❖ Dynamic Traffic Light Sequence
- ❖ Intelligent Vehicle

Keywords— Automatic Number Plate Recognition System (ANPR), Reduce Fatal Accidents, Safety Rollers, Solar Cum Wind Mills, Protection from CO Emission.

I. INTRODUCTION

Background situations of promoting ITS :-

The future of ITS is promising. Yet, ITS itself, is anything but futuristic. Already, real systems, products and services are at work throughout the world. Still, the wide-scale development and deployment of these technologies represents a true revolution in the way we, as a nation, think about transportation. While many aspects of our lives have been made more pleasant and productive through the use of advanced technologies, we have somehow been content to endure a transportation system whose primary controlling technology is the four-way traffic signal, a technology that has changed little since it was first invented. It has taken transportation a long time to catch on, but now the industry is sprinting to catch up. Fulfilling the need for a national system that is both economically sound and environmentally efficient requires a new way of looking at and solving our transportation problems. The

decades-old panacea of simply pouring more and more concrete neither solves our transportation problems, nor meets the broad vision of an efficient transportation system. Traffic accidents and congestion take a heavy toll on lives, productivity, and wastes energy. ITS enables people and goods to move more safely and efficiently through a state-of-the-art, intermodal transportation system. Interest in ITS comes from the problems caused by traffic congestion and a synergy of new information technology for simulation, real-time control, and communications networks. Traffic congestion has been increasing worldwide as a result of increased motorization, urbanization, population growth, and changes in population density. Congestion reduces efficiency of transportation infrastructure and increases travel time, air pollution, and fuel consumption.

- ❖ Problems in transportation :-
- Fuel consumption

- To reduce road accidents
- Traffic congestion

❖ **Intelligent transportation technologies using ANPR :-**

The Automatic number plate recognition (ANPR) is a mass surveillance method that uses optical character recognition on images to read the license plates on vehicles. They can use existing closed-circuit television or road-rule enforcement cameras, or ones specifically designed for the task. They are used by various police forces and as a method of electronic toll collection on pay-per-use roads and monitoring traffic activity, such as red light adherence in an intersection.

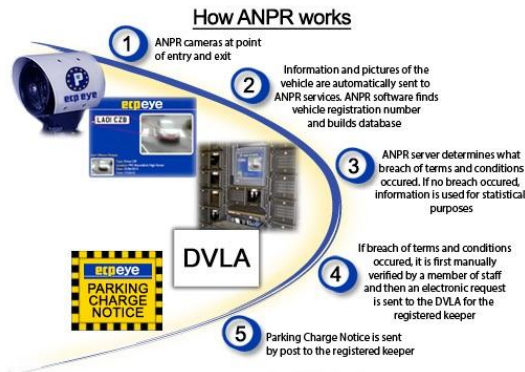


FIG NO.01 ANPR SYSTEM

ANPR can be used to store the images captured by the cameras as well as the text from the license plate, with some configurable to store a photograph of the driver. Systems commonly use infrared lighting to allow the camera to take the picture at any time of the day. A powerful flash is included in at least one version of the intersection monitoring cameras, serving both to illuminate the picture and to make the aware of his or her mistake. ANPR technology tends to be region-specific, owing to plate variation from place to place. Automatic recognition of car license plate number became a very important in our daily life because of the unlimited increase of cars and transportation systems which make it impossible to be fully managed and monitored by humans, examples are so many like traffic monitoring, tracking stolen cars, managing parking toll, red-light violation enforcement, border and customs checkpoints. Yet it's a very challenging problem, due to the diversity of plate formats, different

scales, rotations and non-uniform illumination conditions during image acquisition. This paper mainly introduces an Automatic Number Plate Recognition System (ANPR) using Morphological operations, Histogram manipulation and Edge Detection Techniques for plate localization and characters segmentation. Artificial Neural Networks are used for character classification and recognition.

- ❖ Benefits of intelligent transportation system (ITS)
 - Time savings
 - Better emergency response time and services
 - Reduce crashes and fatalities
 - Cost avoidance
 - Increased customer
- ❖ Provision of collision resistant safety rollers:-
Safety rollers is a safety fixtures that prevents drivers and passengers from fatal accidents by not only absorbing shock energy but also converting shock energy into rotational energy. Safety roller needs to be installed at site where vehicles are exposed to frequent accidents. Safety rollers will safely lead a vehicle back to the road or stop the vehicle by absorbing shock energy. Safety roller will effectively function or drivers to control vehicles with its noticeable color – luminescence.



FIG NO.02



FIG NO.03 COLLISION RESISTANT ROLLERS

❖ Hybrid solar cum wind mills on highways :-
“Wind energy is available when the wind is blowing...solar energy is available when sun is shining”



FIG NO.04 HYBRID MILLS

Hybrid mills is one of the renewable energy resources. it is made by integrating solar and wind energy. Street lights system on highways can be handle by this system properly.

OBJECTIVES:-

Background situations of promoting ITS :-

- Intelligent transportation technologies using ANPR
- Intelligent transportation appliances
- Provision of collision resistant safety rollers
- Producing unconventional energy using hybrid mills (solar cum wind mills) on highways.

III. CONCLUSION

- ✓ The use of ITS in some developed countries like America, Japan, England, etc. has given them high progress in the field of transportation and helped them in their economic progress.
- ✓ The ratio of traffic congestions and accidents as well as wastage of fuel will definitely decreased to a larger extent.
- ✓ By utilizing maximum unconventional sources and eco-friendly technics in ITS will increase the power generation as well as increase the rate of productivity.
- ✓ Hence, with much more interest & advanced research in the field of ITS, it can be implemented in our country and it will be the solution for our traffic.

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Books	In Text Example	References List Example
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SINGLE AUTHOR	S. NARASIMHA MURTHY (TRANSPORTATION ENGINEERING BASICS)	Second Edition ASCE Press ISBN (print): 978-0-7844-0464-5 ISBN (PDF): 978-0-7844-7059-6
TWO AUTHOR	DUSAN TEODOROVIC, MILAN JANIC (TRANSPORTATION ENGINEERING 1ST EDITION Theory, Practice and Modeling)	eBook ISBN: 9780128038895 Paperback ISBN: 9780128038185 Imprint: Butterworth-Heinemann Published Date: 27th September 2016

REFERANCE

Plumbing Department

Mobility Challenges in CBD areas of Cities_ A case of Rajmarg, Surat

^[1] Jay Bhagatwala, ^[2] Urvish Bhatt, ^[3] Rikta Desai

^[1] Student, M.Arch. (City Design), Faculty of Architecture, SCET, Surat

^[2] Student, M.Arch. (City Design), Faculty of Architecture, SCET, Surat,

^[3] Professor, Faculty of Architecture, SCET, Surat

Abstract— In today's world, aspiration of a better lifestyle and better opportunity for employment are the primary factors for rural to urban migrations and continuous increase in the urban perimeter of cities. In such situation, the role of central business areas of urban centers, known as CBD, become crucial, as they are the important links between the old and the new development. With concurrent development practices, majority of these CBD areas suffer from high population density, mixed use development, illegal encroachments, increasing number of vehicles and above all, old transport infrastructure incapable of holding heavy heterogeneous vehicular traffic, resulting into chaotic traffic conditions, traffic conflicts, time delay and limited mobility of its citizens. While CBD area should offer high accessibility through efficient transportation infrastructure, the actual mobility conditions of CBD areas in majority of the urban centers are threatening, resulting into waste of human hours, low productivity and environmental pollution, adversely affecting the well-being of citizens. This paper identifies the key causes for inefficient mobility on the major arterial road of Surat CBD, known as Rajmarg, and suggests phase wise implementation of the sustainable multimodal transportation network and strategies for better utilization of existing resources. Land use at Rajmarg has been studied and cross roads along the 2.4 Km long road analyzed for traffic congestion. Speed delay survey and pedestrian count of three days, i.e. Saturday, Sunday and Monday are taken in to consideration for analysis. .

Keywords— CBD, Public bicycle sharing system, Surat Rajmarg, Sustainable transportation network, Traffic congestion.

I. INTRODUCTION

Indian traffic is heterogeneous in nature where variety of vehicle moves over a single lane. With insufficient public transport facility within the old city areas, use of private vehicles and intermediate Para-transit vehicles is highly prevailing; making city roads densely congested with time consuming journey, further resulting into high level of environmental pollution. Urban population growth, changing land-use, and congestion are some major factors that affect the sustainability of the walled city area in majority of the walled city areas, it is the need of time today to manage the available resources and make potential use of it. Surat, the vibrant and dynamic city of Gujarat, considered for this study, is not a different case for above mentioned situation. With Ring and Radial growth pattern and city limits stretched often to outer perimeter, the city centre is essentially an active hub of commercial and economic activities. Although as a part of city mobility plan, Public transport bus services operating over few routes of the walled city area;

traffic, delay in journey, congestion and accidents have not changed significantly. Hence, enhancing the existing situation of infrastructure in the walled city area is among the fundamental needs.



Figure 1 Study area – Rajmarg

II. AREA: RAJMARG-SURAT

Fig-1 shows the old core of Surat city. It has organic growth with high concentration of residential and commercial activities. Rajmarg, the major arterial road of this core walled city, connects the Surat railway station and Chowk bazaar-the historic city centre. This road is 2.4 Km. long and having carriage way varying from 9.0 to 20.0 mt. 32 minor-major cross roads linked to Rajmarg connects the Rajmarg with other parts of the city.

III. STUDY CONCERNS

Primary focus parameters for analysis and solutions considered are: 1) Traffic monitoring and control on REAL TIME basis. 2) Improvement of public transport efficiency. 3) De-congestion of roads through better utilization of existing resources like buses. 4) Efficient use of existing parking spaces. 5) Smart traffic signal management according to current traffic on roads. 6) Emergency Vehicle Prioritization (EVP) for Ambulance, Fire brigade, Police and VVIP movement. 7) Implementing – SMC zoom application for better management of traffic and parking and to manage all

the above.

IV. METHODOLOGY

1) Literature review has been done and collected the require data. 2) Field study and observation for traffic movement and congestion points. 3) Analysis of collected data and findings. 4) Suggestion of action plan to make the efficient transportation network and batter utilisation of existing resources.

V. EXISTING SITUATION ANALYSIS

Analysis of building use: Rajmarg

Building use is prepared by ground verification i.e. the information collected on location. For study area, from the central line of the road; 50 meter width is considered on both sides which may affect the traffic of the Rajmarg. Building use distribution is shown in below table, map and chart. It is observed that there is high density commercial development throughout along the road width few important religious buildings is governing factors of traffic.

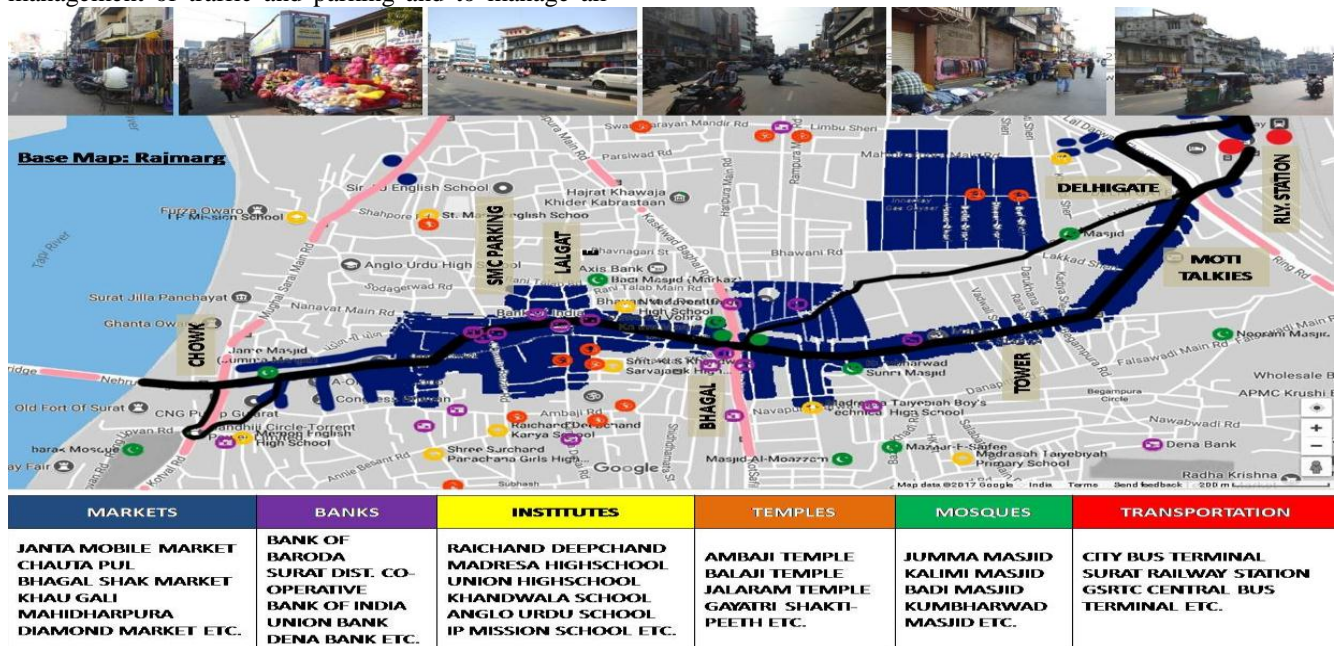


Figure 2 Base map of study area – Rajmarg

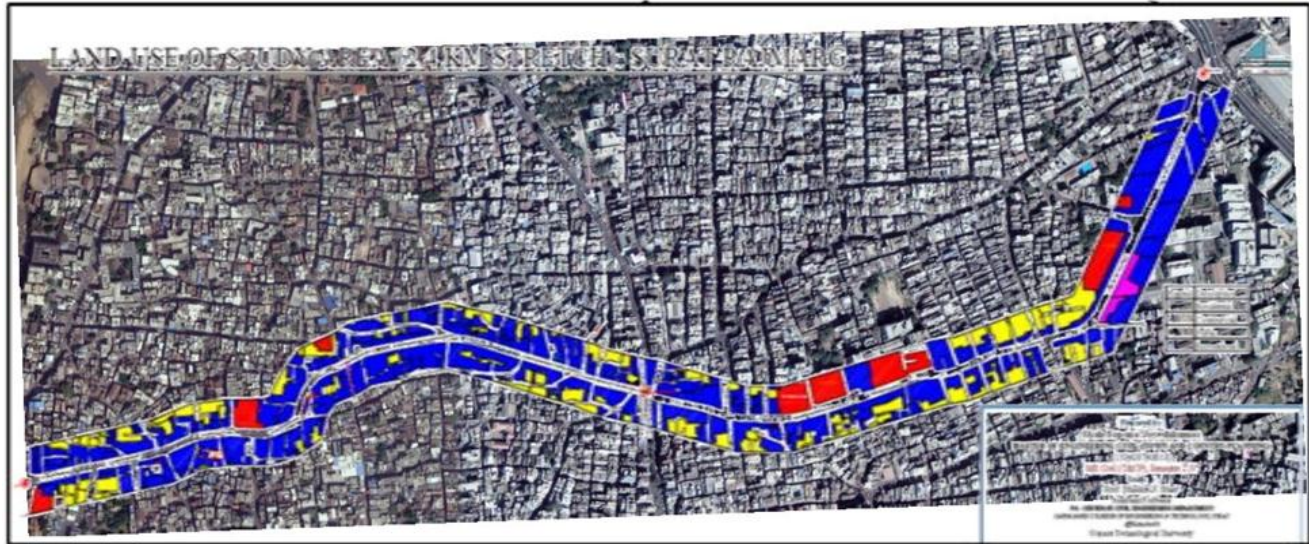


Figure 3 Building use – Rajmarg

both sides which may affect the traffic of the Rajmarg. Building use distribution is shown in below table, map and chart. It is observed that there is high density commercial development throughout along the road width few important religious buildings is governing factors of traffic.

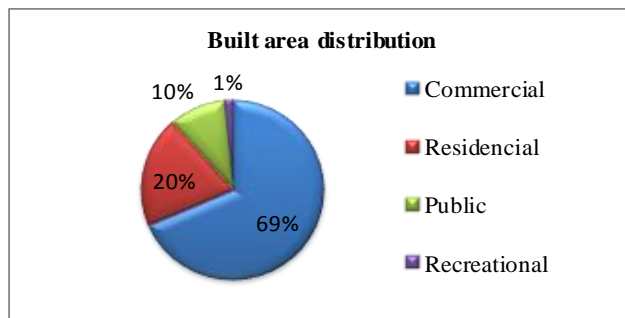


Figure 4 Built area distribution on Rajmarg Source: (Shah, Sutaria and Bhatt, 2016)
Table 1 Land use Distribution

Use of land	Area in Ha	%
Commercial	10.24	68.6
Residential	2.97	19.89
Public	1.50	10.05
Recreational	0.21	1.46
Final total	14.94	100

B. Analysis of traffic flow mapping: Rajmarg

Maps at every 2 hr. interval starting from 10 AM to 9 PM to identify the traffic pattern and conflict zones. Below are the tables shows the traffic situation at major junctions between

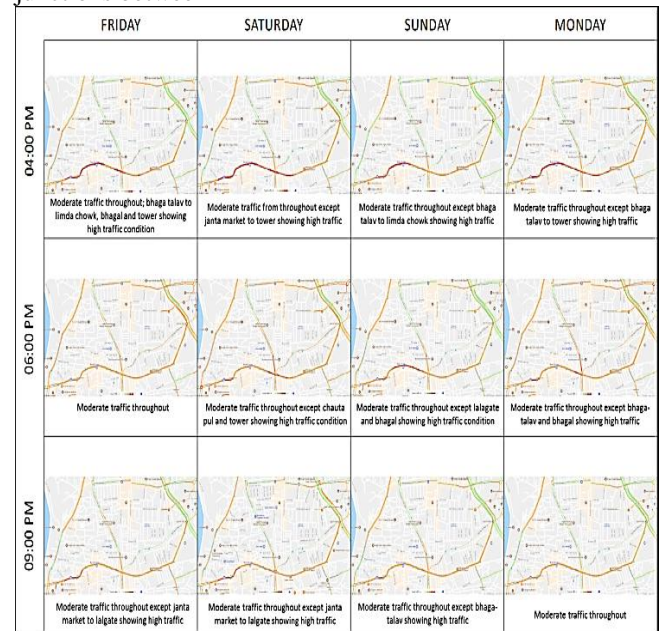


Figure 5 Maps of traffic flow at interval of 2 hrs (b) Source: (Google Maps)

C. Identifying existing traffic conflict points

The undivided Rajmarg intersects with 25 small-medium streets and 1 major road on northern face, while 32 small-medium streets and 1 major road intersects on southern face. It provides better accessibility to adjoining areas, but resulting into conflict zone and causes speed delays, congestion and safety issues.

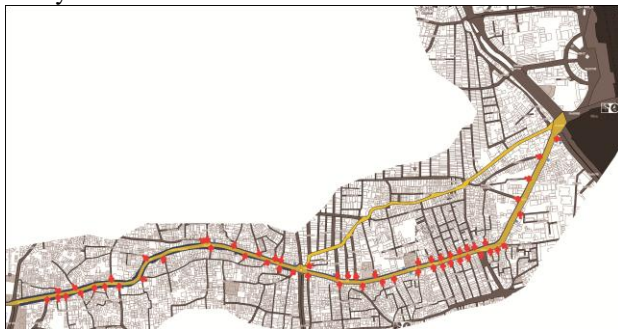


Figure 8 Existing approach roads meeting the Rajmarg Source: (Authors)

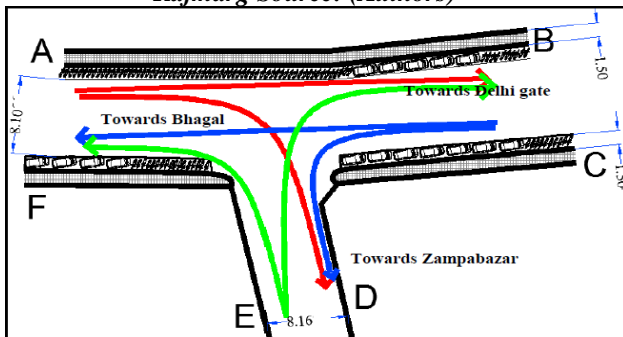


Figure 7 Conflicting Junctions (a) Source: (Shah, Sutaria and Bhatt, 2016)

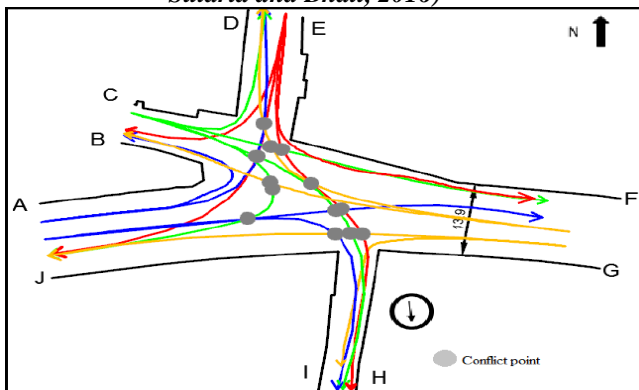
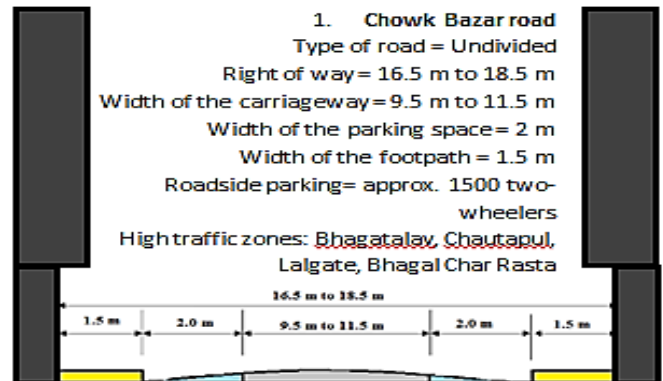


Figure 6 Conflicting Junctions (b) Source: (Shah, Sutaria and Bhatt, 2016)

Conflict occurring junctions and pattern in above diagrams and table shows that major conflicts occur because of unguided traffic and irregular streets meeting the Rajmarg from the other parts of the city. As there is no road divider traffic cannot be control in dedicated lanes.

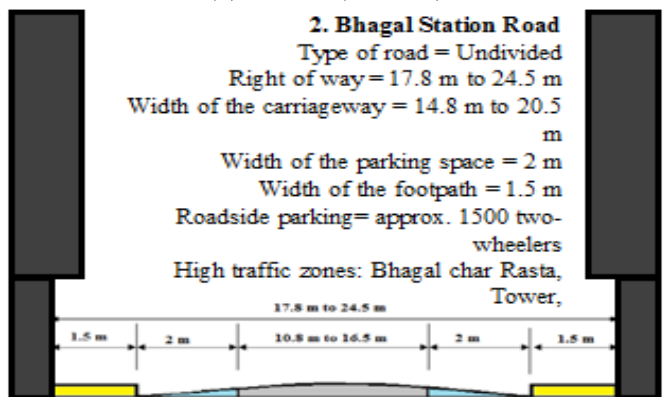
D. Analysis of road characteristics:

For analysis of carriageway and usage distribution of right way 2.4 Km long road is divided in two parts. One is from Chowk to Bhagal cross road and from Bhagal cross road to Delhi gate. These two divisions have significantly different width of road and hence different behavior of traffic.



CHOWK BAZAAR ROAD

Figure 9 Right-of-way distribution of Chowkbazaar road (a) Source: (Authors)



BHAGAL - STATION ROAD

Figure 10 Right-of-way distribution of Chowk bazaar road (b) Source: (Authors)

By observing the above traffic flow charts and road width and carriage way statistics, it can be seen that Rajmarg has more traffic and congestion between Chowk bazaar and Bhagal cross roads in compare to Bhagal to Delhi gate. There are two major reasons for this. First, road width is higher between Bhagal and Delhi gate and second there are two roads from Bhagal to Delhi gate.

E. Analysis of Modal share:

Average 2,00,000 commuters per day use Rajmarg for various purposes using various modes of transport. Only 12,000 (6 %) commuters per day use bus as mode of transport, where 88,000 (44 %) prefer auto-rickshaws and 70,000 (35 %) use personal two-wheelers.

Table 3 Conflict occurrence at the junctions

Location	Motorized						NMT		
	2W	Car	Rickshaw	Bus	Truck	Tempo	Pedestrian	Cycle	Hawkers
Chowk	41236	5690	25553	338	115	645	5693	1240	107
Lalgate	43120	7532	28754	300	129	977	9675	1863	240
Bhagal	81088	11388	42288	527	265	1626	16881	2831	320
Delhi gate	22596	2639	17489	214	83	543	7727	1432	97
Total	188040	27249	114084	1379	592	3791	39977	7366	764

Source: (Shah, Sutaria and Bhatt, 2016)

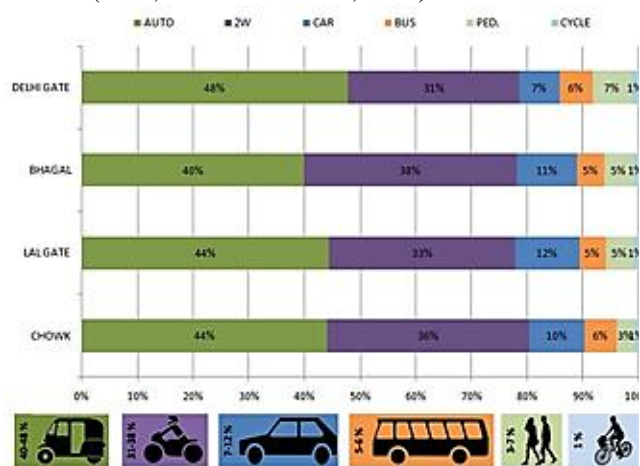


Figure 11 Modal share on Rajmarg Source: (Authors)

In the above fig-12, modal share of 2-wheelers and 3-wheelers (Rickshaw) is very high. There is a subtle share of the buses that depicts the absence of public transport facility.

F. Identifying issues with Para-transit mode

Presently there is a major share of Para-transit mode as a transportation system on Rajmarg. There are two types of Auto-rickshaws are working. One is single or special and the other is shared Rickshaws. Residents prefer this rickshaws as they are very affordable and can reach you anywhere at any time. Major times they are overloaded, there are no defined stops for such Rickshaws so they stops anywhere on the road. Unpredictable lane change and speed change makes them unsafe for fellow drivers. Moreover Government has no significant control over this system. Almost 60% of the rickshaws running on the road are very old and propelled from very poor quality fuel causing air-pollution and noise pollution. The issues regarding the Para-transit mode are:

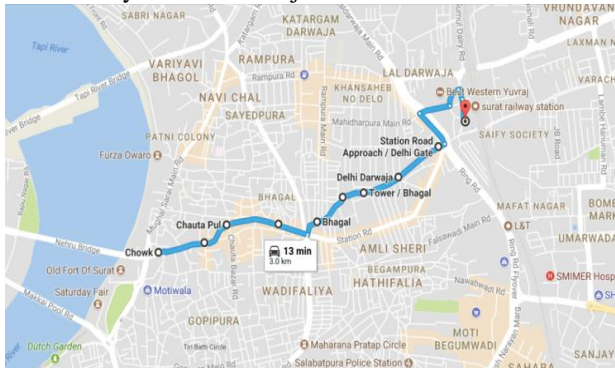
Table 2 Issues regarding Para-transit mode

Issue	Specifics
Governance	Lack of a multi-modal governing body Inadequate involvement of key stockholders in policy making (city government; manufacturers; unions; citizens; civil society)
Regulations	Lack of transparency in permits and fare policies Lack of policies to drive formalization of services (such as fleet companies)
Unorganized sector	Lack of employment benefits Poor inspection/maintenance Problems with financing Lack of brand image and poor driver behavioural practices
Infrastructure	Lack of provision of adequate stands Inadequate servicing centres for 4-strook engines.
Vehicles	Problems with designs (comfort, rain) 2-strook engines still prevalent in city
Operational inefficiencies	Significant empty trip making

G. Analysis of existing public transport service

Presently Sitalink operates the city bus services very efficiently all over the city. But also in the case of CBD area and ring road it requires making them more efficient. Presently city bus operation on Rajmarg has Bus capacity 30 seating + 30 standing total 60 with approximate travel time of 10 to 13 minutes. Frequency of the city bus on Rajmarg is varying between 8 to

10mins. It accommodates 12000 passengers per day with 6 to 8 stops between Frequency way station and Chowk bazaar. Some of the routes working are Route no: 106- Railway station to Abhva gam, 107- Railway station to Vivekananda College, 108- Railway station to Olpad, 116- Railway Station to Khajod gam and 03 / 04- Railway station to Adajan GSRTC.



H. Analysis of Proposed PBS system in walled city area

Public bicycle sharing system (PBS) is a service in which bicycles are made available to multiple users (on a sharing basis) for short duration trips, offering an option of returning them at different destinations.

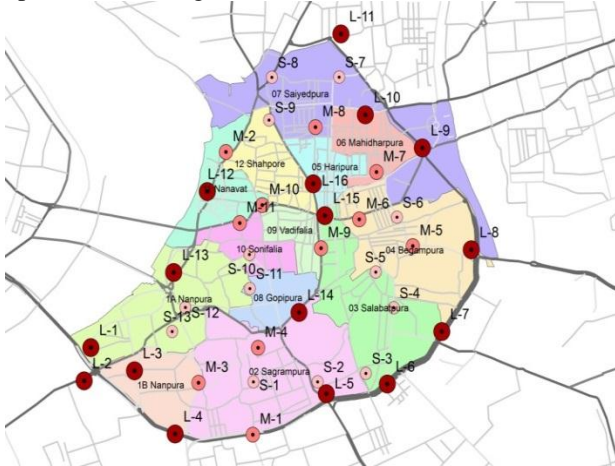


Figure 13 wards wise PBS Docking station location

Source: (Surat Municipal Corporation)

Fig-13 shows the locations of the docking stations of bicycles in CBD area for Phase I. Nanpura, Salabatpura and Sagrapura are having maximum numbers of PBS stations as these wards are having major activity centres and also having major arterial passing through these

wards.

i. Willingness to shift

Household survey was conducted by students of numerous technical institutes in different wards of Central Zone. The survey took a total of 856 HH samples covering total 3826 individuals. Samples were collected from all the 12 zones in proportion of their population so as to have rational understanding of the characteristics of people's travel behavior. The willingness of the residents to adopt the new mode of travel will make the proposed project successful. Two types of willingness was asked from the respondents 1) walking distance for cycle stand preferred by users and 2) Up to what distance users prefer for cycling.

Table 4 Preferred walking distance for Cycle stand

Preferred Walking distance for Cycle stand in %					
Locations	<100 m	100 to 200	200 to 500	>500	not interested
ward 1	19	38	0	6	38
ward 2	71	4	6	0	18
ward 3	12	37	19	6	25
ward 4	10	26	32	3	29
ward 5	31	23	10	7	29
ward 6	8	72	0	0	20
ward 7	10	43	10	3	33
ward 8	30	42	8	0	20
ward 9	41	34	8	0	17
ward 10	15	21	20	15	29
ward 11	20	28	32	12	9
ward 12	5	55	27	0	13

Table 5 Trip Distance in meter Preferred by PBS

Trip Distance in meter Preferred by PBS in %							
Locations	<100	100 to 500	500 to 1500	1500 to 2500	2500 to 5000	>5000	Not interested
ward 1	13	25	19	0	6	0	38
ward 2	44	25	13	4	4	1	9
ward 3	10	4	4	10	28	21	21
ward 4	0	6	10	26	13	15	31
ward 5	11	9	19	16	6	8	31
ward 6	8	64	0	8	0	0	20
ward 7	7	33	13	0	3	3	40
ward 8	14	58	6	1	0	1	21
ward 9	6	8	10	59	0	0	17
ward 10	0	3	10	20	25	14	28
ward 11	3	6	7	45	19	9	12
ward 12	2	31	32	21	1	1	12

ii. Occupation of respondents

The respondent occupation helps in deciding the particular types of the facility and how effectiveness it will be after implementation. Figure 15 shows the respondents' occupation Rajmarg is mainly comprises of commercial shops and major congestion is happen at certain nodes such as Chowk junction, Bhagatalav junction, Chautapul junction and Bhagal junction. Major consumers of PBS will be female and are of age group between 18 to 45 yrs. There are no or negligible space for bicycle. In present condition there is no Security for bicycle riders and bicycle from accidents. Amount of passengers vs. Availability of bicycles has very diverse figures. Cost of bicycle is very high in compare to the class who is going to use it. So the security of bicycle and its issue of theft are always there. Major users are carrying goods with them, and no provision for carrier such heavy goods in the bicycles.

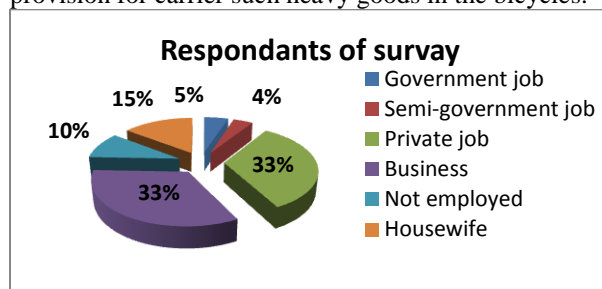


Figure 14 Occupation of Respondent (CBD)

Source :(Authors)

I. Identifying issues with present parking conditions

Rajmarg has provision of street parking on either side of the road based on odd-even dates. Besides that there is one multi-storey parking near Chautapul for 40 cars and 80 two-wheelers, which is insufficient. It is majorly used by shop owners and their staff, while visitors prefer on street parking.

- 20% of the traffic near markets is circulating looking for parking space
- Authorities are not able to manage street parking efficiently
- Random parking leads to chaos & wastage of parking space
- Commuters have no information about availability of parking spaces
- Poor user experience despite higher charges

VI. OBSERVATIONS AND IDENTIFIED ISSUES

- Nearly 70 % of buildings on Rajmarg are used for commercial activity.
- These commercial activities are reason for heavy traffic during day time specifically on weekends and holidays.
- Major traffic congestions occur at important junctions like Chowk bazaar, Chautapul, Bhagal, Tower, Moti talkies and Delhi gate.
- Nearly 60 numbers of small and medium streets intersect with undivided Rajmarg crating equal number of conflict
- Zones causing unsafe driving conditions and slower movements.
- Share of public transport is limited to 6 %, while the share of two wheelers is 31 to 38 % and share of auto rickshaws is nearly 48 %.
- More number of private vehicles on road causing traffic management issues.
- The frequency and safe accessibility of public transport need to be enhanced in order to increase the share of public transport.
- There is no space for dedicated bicycle lane; hence Suggestion of PBS is highly questionable.

VII. RECOMMENDATIONS AND SUGGESTIONS

To reduce the above mentioned conflicts, dividers are suggested on Rajmarg; opening at few specific junctions as shown in the map below. Suggestion of dedicated lanes is also suggested phase wise to organize the traffic as shown in sections. Rearrangement of existing road width can give the guided and restricted traffic lanes opens at few specific points only to get batter control over traffic and reduce the conflict between vehicle-vehicle and vehicle pedestrian. By rearranging these lanes provision for dedicated lanes for pedestrians and bicycle can also be obtained.

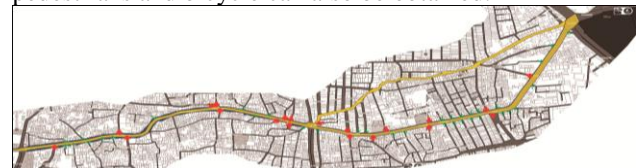


Figure 15 Suggestions of divider openings

Source: (Authors)

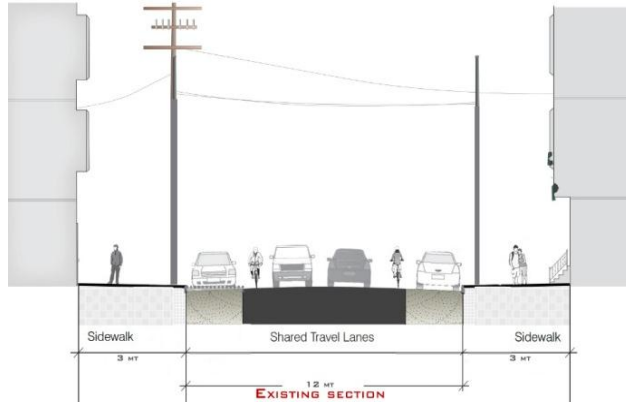


Figure 17 Existing (divided) road section Source: (Authors)

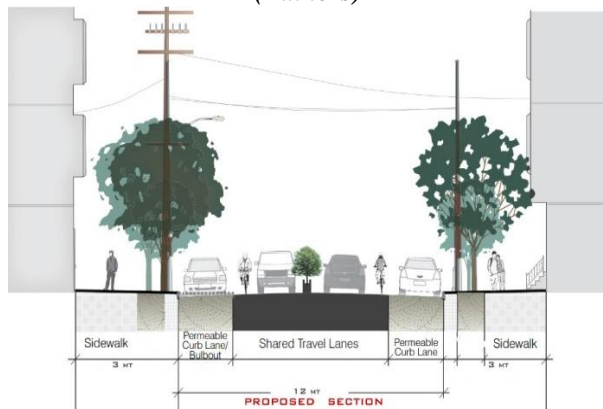


Figure 16 proposed (undivided) road section Source: (Authors)

A. Development of Smart Application

Smart application can be developed to manage all these amenities and to increase the public participation in managing the smart resources. SMCzoom application is envisaged to perform the desired functions. Some features of it are listed below:

i. Incident Reporting

- Citizens can report any incident with image and location proof on SMCzoom application.
- Authorities immediately get information and proof about the problem.
- Women can mark a particular area as UNSAFE AREA and the area can be Geo-fenced.
- Immediately all users get an alert when they enter that area.
- Citizens will be encouraged to report incidents in return for a small incentive.

ii. Technical requirements

- Basic android enabled smart phone with SMCzoom application preinstalled on it.
- Smart traffic controllers installed in all traffic signals.
- Server requirements – NONE as entire solution will be managed and hosted on Amazon cloud.
- SMCzoom application to be developed by leading solution providers.
- Smart hardware for parking area management

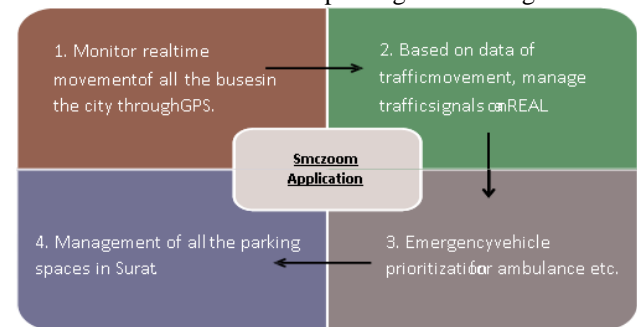


Figure 20 SMCzoom Application mode Source : (Authors)

B. Smart Signals

Traffic signals are often too long or too short and do not reflect the need of the hour. It does not take into account major events, functions leading to occasional and heavy traffic on a particular road. The flow of vehicles changes dynamically and often can't be predicted; hence predesigned signals are highly ineffective. Based on GPS data of bus movement, the traffic movement and congestion can be automatically monitored on a real time basis on the CLOUD through NM zoom application. The application server to manage traffic signals in the city, through the controllers on signals, which is very easy to retrofit in the existing signal controllers. If a stretch of road reports slow traffic movement thereby indicating traffic congestion, the traffic signals to automatically turn green for a longer period of time. Rajmarg comprises of numerous major and minor junctions. These junctions or cross roads are a major cause of unregulated traffic resulting into congestions. By incorporating road dividers, all minor junctions are looked into. However, major junctions like Bhagal char Rasta, Chowk, Lalgate, Delhi gate are regulated by means of traffic signals. These signals can be well managed by smart signal technology. All the signals of the city to be

turned SMART through a small hardware, thereby leading to better traffic management.

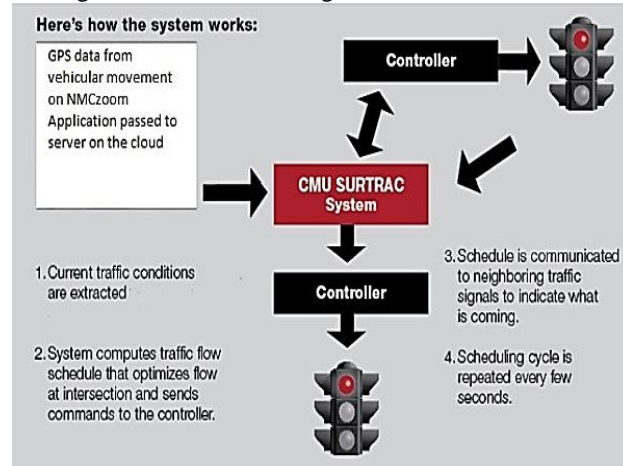


Figure 18 Working system of smart signals Source: (Web.archive.org, 2013)

C. Controlling Para-transit modes

There can be several Suggestions which can be taken to get control and regularize this Para-transit mode. First is to regularize it with PPP model such as collaboration with Jugnoo and ola. In this government has limited control over the system but maintenance, Supervision ,trained drivers, transparent fare system, no overloading etc. can be rewarded. Second way is government own this rickshaw and gives it on rent to operate. Pre-paid rickshaws can also be introduced. In this option government has to invest large amount for the instruments and also for their maintenance. In both the options, concept of colour coded autos; special autos for females with female drivers, Identification of defined routes with auto stands can be adopted.

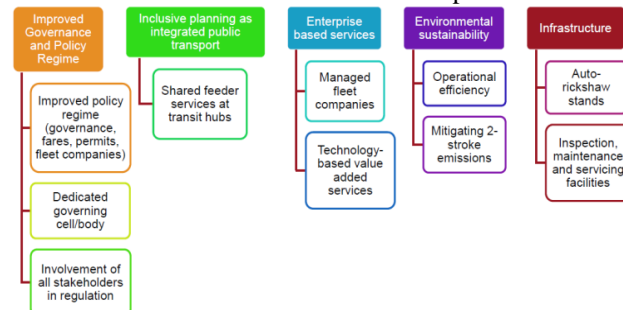


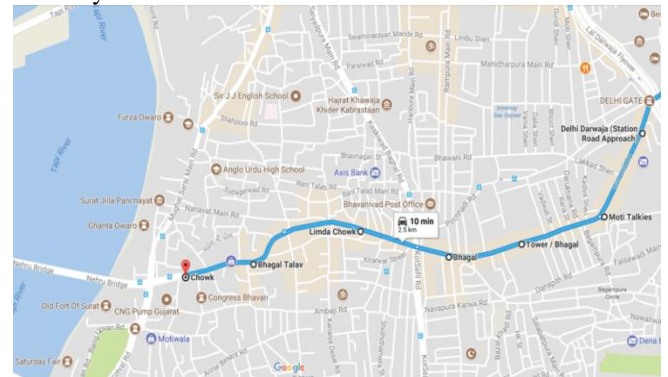
Figure 19 Framework to strengthen Para-transit mode Source: (Authors)

D. Enhancing city bus service

Bus capacity: 20 seating + 20 standing= 40
 Passenger Approx. travel time: 10 to 12 mins.
 Frequency: 2 to 3 mins
 Volume per day: 48,000
 Number of stops: 6 to 8
 Proper designed shelter at each stop

Exposer of Public transport is mandatory to make it more efficient. By increasing the frequency of public transport and its stoppages at the strategic locations will decrease the usage of private vehicles and eventually the congestion on Rajmarg.

As proposed in above numbers, by reducing the capacity of buses will decrease the travel time of the buses and also it is easy for buses to pass through the dense Rajmarg. It is important to have the information regarding routs and timing of buses is clearly visible and easy to understand.



E. Proposed road design

By considering the all above data and analysis we are suggesting the prototype of road section for batter utilisation of existing resources and traffic management.

Type of road = Divided
 Right of way = 16.5 m to 24.5 m
 Width of the carriageway = 9 m to 15 m
 Width of the parking space = 1.5 m
 Width of the footpath = 1.5 m
 Roadside parking= approx. 1200 two-wheelers
 Additional Vending space

F. Parking solution

SMC can update all the available parking spaces in the city on smczoom application.

- Citizens / societies can also upload their parking spaces in any area for parking in the central

database.

- Citizens looking for parking space can search for parking space in a particular area and can rent it online on smczoom application.
- This will encourage everybody with spare parking space to upload the same on smczoom, thereby creating more parking inventory.

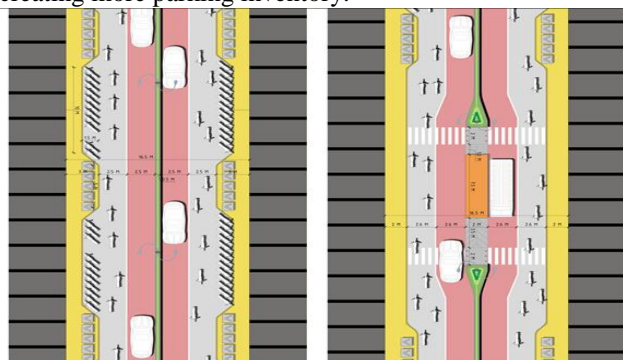


Figure 22 Proposed Right-of-way design on Rajmarg

Source: (Authors)

VIII. CONCLUDING REMARKS

From the discussion and suggestion presented above, major points to conclude is being a main arterial road of CBD area Rajmarg has to face the intense traffic situation on all times. Moreover it is passing through saturated walled city, so there is no scope for expansion. One needs to identify the system to utilize the existing resources in efficient and smart manner. By observing the behavioral pattern of the residents regarding public transportation, the robust and user friendly multimodal PT system needs to be developed. Consideration of pedestrians on both tracks and junctions need to be addressed as it is the most vulnerable category in existing traffic situations.

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MIT Art, Design & Technology University, Pune

Address: Solapur Highway, Near Bharat Petrol Pump, Loni Kalbhor
Railway station, Pune, Maharashtra-412201 Phone: 09595124234