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Department of Civil Engineering,
East Point College of Engineering And Technology,
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The National Conference on "Cost Effective Civil Engineering, Practices for Rural & Urban, Infrastructure, Development", will, bring, together, the, distinguished,academicians, Planner, consultant, R & D, professionals, Practice, Engineers, research scholars and students. The objectives of the National Conference is to bring the awareness of role of efficient designs in Civil Engineering. The conference will provide all participants, an opportunity for efficient design practices in Civil Engineering.

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CONTENTS

National Conference on Cost Effective Civil Engineering Practices for Rural and Urban Infrastructural Development In association with International Journal of Scientific Research in Civil Engineering
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Stabilization of Black Cotton soil using Portland Pozzolana Cement and GGBS - A Case study

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ABSTRACT

Soil is the most commonly available natural material. The knowledge of the soil mechanics has application in many field of civil engineering like foundation, underground and earth-retaining structures, Pavement design, Excavations, Embankments and Dams. The particular, to highway engineering, soil used as sub-grade, sub-base and sometime embankment material. Construction of road in a black cotton soil is a challenging task in the civil engineering field. The B.C. soils are expansive in nature and possess high swelling and shrinkage properties. Such soil can be stabilized using waste materials like fly ash, Ground Granulated Blast furnace slag, bagasse ash, pond ash etc to make the soil to be stable. As Ground granulated blast furnace slag is freely available, for projects in the vicinity of a Thermal Power Plant, the properties of expansive soil with cement and Ground granulated blast furnace slag in varying percentages can be used. In the present study laboratory studies are carried out on two combinations of black cotton soil and binders -10% stabilizing agent with soil (70% GGBS + 30% cement) and 20% stabilizing agent with soil (75% GGBS + 25% cement). The effect of various combinations on strength and durability has been discussed here. The main objective of this research work is to obtain an improved construction material by making the best use of available clayey soil and to make the effective utilization of Ground Granulated Blast Furnace slag and Portland Pozzolana cement.

Keywords: Durability test, Ground Granulated Blast Furnace, Portland Pozzolona cement, Stabilization.

I. INTRODUCTION

Infrastructures projects such as railways, highways, water reservoirs etc., it demands huge quantity of soil. In urban areas, borrowed the soil is not easily accessible which in the must be hauled from a long distance. Quite often, large areas are covered with highly plastic and expansive soil, which is not suitable and not satisfied the engineering properties [1].

Soil is the most commonly available natural material. The mineral matter of soil is formed by the disintegration of rocks, by the action of the temperature, pressure, water, frost etc. the soil can be classifies based on agriculture, geologist and engineered material. The knowledge of the soil mechanics has application in many fields of civil engineering like foundation, underground and earth-retaining structures, pavement design, excavations, embankments, and dams. Especially construction of highway in a Black Cotton (B.C) soil is a challenging task in the civil engineering field. The B.C. soils are expansive in nature and possess high swelling and shrinkage properties. The B.C. soil is hard so long as it is dry but loses its stability almost completely when it becomes wet. When again it becomes dry it shows

lots of cracks on its surface and then we go for soil stabilization technique [2,3].

The term soil stabilization is a technique to improve the soil properties. Stabilization can be used in wide range of sub grade materials, varying from expansive clays to granular materials [4]. The process can be established using a different additive, including fly ash, lime and Portland cement other material by products used in stabilization include lime kiln dust and cement kiln dust. Improvement achieved by soil stabilization includes reduction of plasticity index or swelling potential, better soil gradation and increase in strength and durability [5].

There are several industrial wastes which are being produced in millions of tons as unwanted by-products in the manufacturing industries & thermal power plants every year in India as well as all over the world. Most of these wastes are left unutilized and are posing environmental hazard by polluting the soil, water, and air. Some of these wastes like fly ash & blast furnace slag have pozzolanic properties and are being used in the construction industry along with cement or lime as activators [6,7].

In this study, experimental investigations are carried out to study the beneficial effects of stabilizing black cotton soil using ground granulated blast furnace slag (GGBS) along with Portland Pozzolana Cement (PPC) in different proportions.

II. EXPERIMENTAL WORK

The black-cotton soil was mixed with GGBS and PPC in different proportions and a series of laboratory tests were conducted on samples containing various percentages i.e.,10%, 20% by dry weight of the soil. The following tests were conducted on black cotton soil, GGBS and PPC mixes as per relevant IS codes of practice:

- Wet sieve analysis
- Atterberg limits
- Compaction
- Free swell Index
- Unconfined compression strength
- California Bearing Test
- Wetting and drying test
- Fatigue test

A. Materials

Black cotton (B.C) Soil

The soil was procured from Bijapur District, Karnataka. The physical properties of B.C soil is shown in Table I and Fig 1 shows the gradation curve of soil.

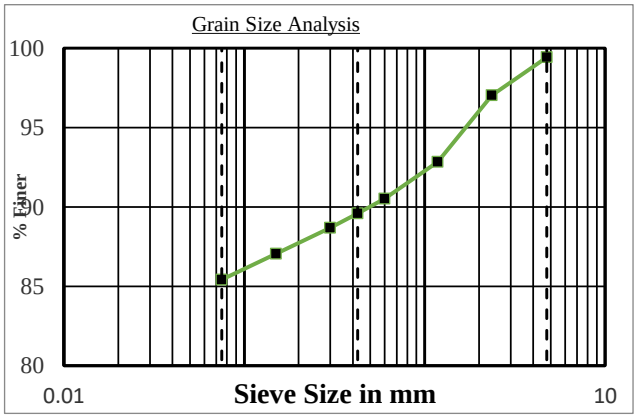

FIGURE 1: GRADATION CURVE - B C SOIL

TABLE I. THE PHYSICAL PROPERTIES OF B C SOIL

Sl. No.	Property	B.C. soil	IS code specification
1	Specific Gravity	2.82	IS 2720: Part 3
2	Grain size distribution		IS 2720: Part 4
	Percentage of gravel	0.56	
	Percentage of sand	11.74	
	Percentage of clay	87.70	
3	Atterberg's limits		IS 2720: Part 5
	Liquid limit %	76.16	
	Plastic limit %	36.66	
	Plasticity Index	39.50	
4	Soil Classification	MH	
5	Free Swell Index	75.91	IS 2720: Part 40
6	Compaction Characteristics		IS 2720: Part 8
	MDD(g/cc)	1.57	
	OMC%	21.80	

B. Ground granulated blast furnace slag (GGBS)

GGBS was procured from Jindal steels, Bellary district, Karnataka. Physical Properties of GGBS is shown in Table II.

TABLE II

THE PHYSICAL PROPERTIES OF GGBS

Sl. No.	Particulars	Results
1	Specific gravity	2.95
2	Fineness (%)	8.0

C. Cement

Portland Pozzolana Cement (PPC) 53 grade was used.

The physical properties of cement is shown in Table III.

TABLE III

THE PHYSICAL PROPERTIES OF PPC

Sl. No	Physical Properties	Results
1	Specific Gravity	3.13
2	Standard Consistency	27%
3	Initial Setting Time	50 minutes
4	Final Setting Time	235minutes
5	Soundness Test (Le Chatelier's Method)	1.0mm
6	Compressive Strength @ 28 day	53 MPa

D. Proportioning of soil

Two mix proportions were used in this study. The Table IV shows the final mix proportion of B.C soil with GGBS and PPC cement.

TABLE IV

DETAILS OF MIX PROPORTION OF SOIL

SL. No.	Soil (%)	GGBS (%)	PPC (%)
1	90	7	3
2	80	15	5

III. RESULTS AND DISCUSSION

A. Atterberg Limits

Table V

RESULTS OF ATTERBERG'S LIMITS TEST

Particulars	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
Black cotton soil	76.16	36.66	39.50
Black cotton soil + 10% additive	67.9	39.97	27.93
Black cotton soil + 20% additive	63.6	36.96	26.64

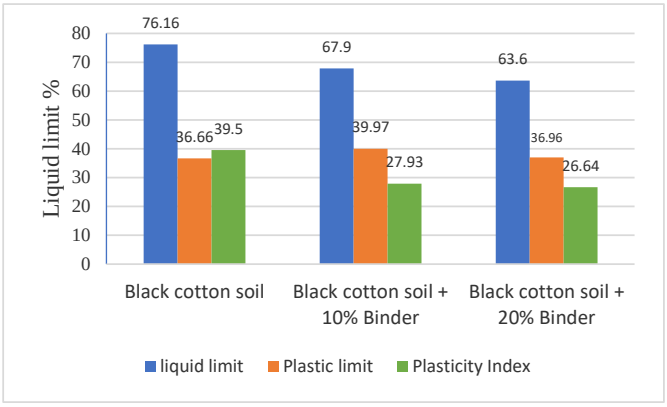

FIGURE 2: COMPARISON OF ATTERBERG LIMITS

As seen from Table 5 and Fig 2, the plasticity index of soil is 39.5 %, it is more than 30%. The index value can be reduced by addition of binder material in varying proportions. It was noted that 10% binder reduced the plasticity index value to 27.93%. Further addition of binder reduced the value to 26.64%.

B. Free Swell Index

Free swell index was conducted as per IS code 2720-Part 40. The free swell index of black cotton soil material was found to be 75.91 %. The degree of expansiveness of black cotton soil is high and keeps on decreasing of BC soil with 10% additive and 20% additive.

Fig 3 shows the variation of readings for different additive samples. As per IS: 1494 if the free swell index is between 50-100 % are said to be have high degree of expansion and marginal degree of severity.

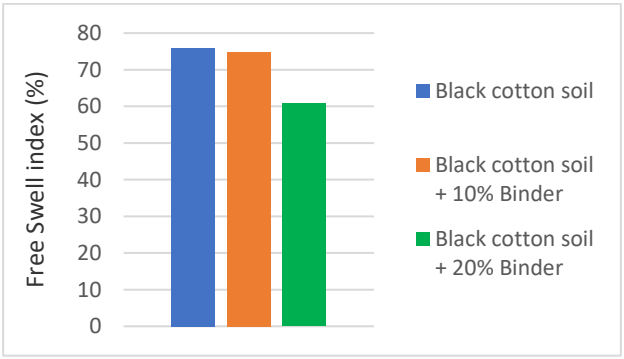

FIGURE 3: COMPARISON OF FREE SWELL INDEX

C. Compaction

The compaction characteristics mainly depend on Optimum Moisture Content (OMC) and Maximum Dry Density (MDD). The degree of compaction mainly depends on type of the soil, compaction energy and moisture content. The soil samples stabilize with cement and GGBS is shown in Plate, from this Plate the MDD values shows higher values at 10% dosage and 20% dosage.

Table VI

RESULTS OF COMPACTION TEST

Particulars	MDD (g/cc)	OMC (%)
Black cotton soil	1.57	21.80
Black cotton soil + 10% additive	1.73	15.3
Black cotton soil + 20% additive	1.69	17.1

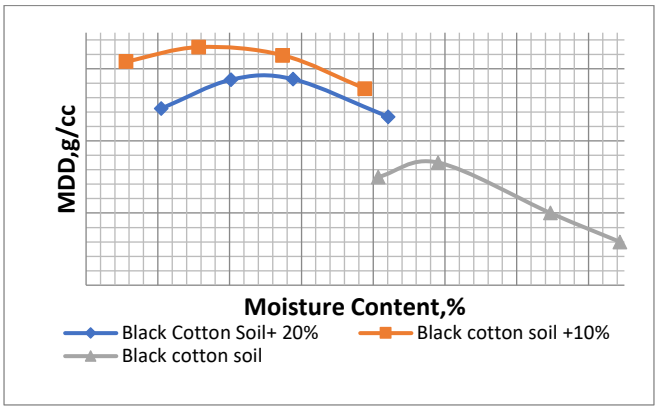

FIGURE 4: COMPARISON OF MDD AND OMC

It is observed that MDD value increased and OMC value decreased with increasing in additive content. This result indicates that addition of GGBS - Cement has drastically effect on compaction characteristics. The compaction tests done on the different mixes the following values were obtained for MDD and OMC which are given in Table VI and Fig 4.

D. Unconfined Compression Strength

Table VII

RESULTS OF UNCONFINED COMPRESSION STRENGTH TEST

Particulars	UCS kg/cm²		
	7 days	14 days	28 days
Black cotton soil	4.18	4.18	4.18
Black cotton soil + 10% additive	7.28	8.67	9.34
Black cotton soil + 20% additive	8.38	11.17	12.38

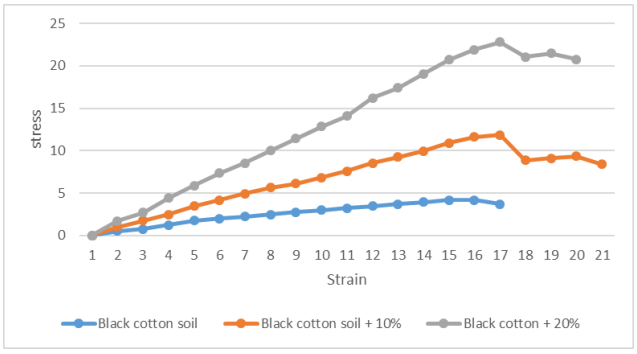

FIGURE 5: STRESS STRAIN CURVE FOR 28 DAYS

As seen from Table VII and Fig 5, when 10% of additive was added to the soil, the strength (7, 14, and 28 day) increased by 75%,107%, and 125% respectively when compared to the non-stabilized BC soil. Also, it was found that when 20% of additive was added, the strengths increased by 100%, 167% and 196 % respectively when compared to the non-stabilized BC soil.

As per MORTH specifications the required UCS strength of & days cured sample should be in the range of 0.75 to 1.5 MPa for use in Stabilized sub-base. In pavement for deciding bound layer UCS plays an important role. The UCS of two types of stabilized soil mixes for 7days cured samples are found to be 7.28 and 8.38 for 10% and 20% additive soil mix, UCS for

14 days cured sample it showed 8.67 and 11.17 and UCS for 28days curing it showed 9.34 and 12.38. The above results we can say that both 10 % and 20% additive soil can be used subgrade and sub-base layers in pavement of any roads. The required UCS for cementitious base is 4.5 to 7 MPa for 28days but we have found the value satisfying then requirement hence type can be used for base layer of all types of roads.

E. California Bearing Test

To evaluate the strength of stabilized soils, CBR is one of the common tests is used. CBR value is widely used for design purpose. The Table 8 shows the CBR value of 20% additive soil sample after 7 days of curing was 88.15% higher than natural black cotton soil. The CBR value of 20% additive soil sample increased by 29.04% after 28 days of curing.

Table VIII

RESULTS OF CALIFORNIA BEARING TEST

Type of soil	CBR, %	
	7 Days	28 Days
Black cotton soil	2.01	2.01
Black cotton soil + 10% Additive	6.70	16.67
Black cotton soil + 20% Additive	16.97	24.04

F. Wetting and Drying Test

As per recommendation for the use of stabilization layer the loss of weight shall not be more than 14% but soil specimen with 10% binder got collapsed within 2 cycles and soil specimen with 20% binder fails at 3 cycles as shown in Table IX. Hence it does not satisfy required criteria.

Table IX

RESULTS OF WETTING AND DRYING TEST

No. of Cycles	Percentage weight loss			
	Black cotton soil + 10% binder		Black cotton soil + 20% binder	
	Wetting	Drying	Wetting	Drying
1	4.6	-12.2	3.75	-10.35
2	4.2	-15.3	3.41	-12.6
3	-	-	3.1	-13.2

G. Fatigue test

The result obtained from Table X was observed that both 10% and 20% additive sample withstood a minimum of 10000 cycles for 10%, 20% and 30% loading which is derived from Unconfined compression test, so that it can be said that soil samples are strong enough to withstand the effect of the repeated wheel load applied on Black cotton soil stabilized using GGBS and cement. Both soil samples show high endurance limit.

Table X

RESULTS OF FATIGUE TEST

Soil Type	No. of Cycles	Deformation, mm	
		V1	V2
BC+10% additive	10000+	0.81	0.88
BC+20% additive	10000+	0.91	0.96

H. Cost Analysis

Cost analysis for this present study is done to determine the variations in cost of the pavement structure upon addition of suitable dosage of stabilizer because the cost of the project is the main factor in determining the choice of soil improving method to be adopted. Accordingly, design of the pavement is done to find the thickness of each layer to be considered, for both stabilized and un-stabilized soils

Traffic considered: 10 msa

CBR for the un-stabilized sub-grade soil (BC): 2.01%

CBR for the stabilized+ 10% additive used in sub-grade soil (BC): 16.67%

CBR for the stabilized+ 20% additive used in sub-grade soil (BC): 24.04%

Table XI

PAVEMENT DESIGN ACCORDING TO IRC 37-2012 [13]

Pavement layers	Pavement thickness (mm)		
	Un-stabilized	Stabilized+10 % additive	Stabilized+20 % additive
Bituminous concrete	40	40	40
Dense bituminous macadam	90	60	50
Wet mix macadam	250	250	250
Granular Sub-base	380	230	200
Sub-grade	500	500	500

IV. CONCLUSION

It is found that there is no change in Gradation of soil sample when treated with additives about 20%, the Atterberg limit value has been decreased when compared to natural black cotton soil. When increase in the additive content, the free swell index value of the black cotton soil decreased significantly which means that soil has not been subjected to volumetric changes with the addition of additives.

The CBR value of black cotton soil with 20% additive gives increment of 89% with curing period of 28 days when compared to natural black cotton soil which can be used for subgrade of the pavement layers and it is more sufficient for design criteria. Based on the UCC test results, the soil with 20% additives gives higher strength for 28 days. When the period of curing increases, the strength of the soil improves.

Durability test it is specified that the stabilized soil is not durable as the percentage of weight loss are not within the prescribed limits. The Fatigue test results indicated that the black cotton soil stabilized with cement and GGBS will have good fatigue life and withstood more than 10000 cycles of repeated traffic load when subjected to fatigue test conditions.

This method of stabilization proved to be economical considering the cost of materials, construction. Hence, this method helps in saving the natural resource to some extent.

V. ACKNOWLEDGEMENT

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Experimental Study on Utilization of Recycled HDPE Aggregate as A Partial Replacement for Coarse Aggregate in Conventional Concrete

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ABSTRACT

Reuse and recycled plastic materials in concrete mix as an environmentally friendly construction material has drawn attention of researchers in recent times, and a large number of studies reporting the behavior of concrete containing waste and recycled plastic materials have been published.
In present study trash bags plastics are used as polymer wastes HDPE for preparation of Recycled Plastic Aggregates (RPA). The ambition of this work is to study the properties and behaviour of RPA in the concrete as a replacement to Natural Coarse Aggregate (NCA). The RPA are produced under a controlled temperature 160°C to 190°C and crushed to 20 mm downsize aggregates. Develop the M25 grade concrete as per IS 10262-2019. Then partially replace the NCA by RPA by its weight (0,15%,20%, 25%, 30%, 35%, & 40%). The wide range parametric study was carried out to find the effects of RPA on the workability and strength of the concrete. The results shows that up to 15% of RPA is suitable for structural concrete and remaining is best for non-structural usage.
Keywords: IS 10262-2019, Plastic material, Recycled Plastic Aggregates.

I. INTRODUCTION

Managing of discarded plastic is very puzzling for municipalities to handle because the waste plastic is not efficiently decomposable even after long-period of landfill action. Finding a new way to dispose of the plastic in concrete would enhance the understanding on how to incorporate the plastic in greater engineering usage [1].
Recycled plastic considered as a new material which can be adopted in the production of concrete. This leads to solve the disposal problem of large quantity of recycled plastic. The best feasible option considered in the concrete industry is re-use of plastic application [1]. The natural aggregates can be replaced with the recycled plastic aggregates. It is important to emphasize the cost, re-using of discarded plastic or waste should be economical.
The major constituents in Municipal solid waste (MSW) is plastic, it is non-biodegradable and cause a severe difficult in landfill. Around 3% to 7% of plastic content in MSW (July 16, 2012, DHNS). At the disposal zones landfill includes the buried plastic with other materials, it leads to ground water pollution due to seepage in landfill spread in large area of land, sometimes risks factor is also more due to emission of hazardous gas and explosion (July 16, 2012, DHNS).

Around 700 tons of the city's waste (July 16, 2012, DHNS) is disposed of on a regular basis at the Mandur garbage dump yard, The Palike is diverting the garbage to Mandur and Terrafirma on Doddaballapur Road, (July 16, 2012, DHNS).

The waste materials were collected by the Municipal solid waste (MSW) department, or by the approved body. The MSW were collected from residential, institutional, industrial, and commercial sources. MSW contains plastic carry bag, milk bag, bottles, food packaging, clothing, office papers and plastics film etc.

The different types of plastics in MSW are PET, HDPE, LDPE, PP, PS etc. The main consumers of plastic are packing industries, building construction, industries, electrical and electronic, automotive, agriculture and other uses. The Table I provides some detail about percentage of plastic in MSW.

TABLE I. DETAILS OF PERCENTAGE OF PLASTIC IN MSW

Percentage of plastic in MSW (Zoorob and Suparma, 2000)	
LDPE	23%
HDPE	17.3%
PP	18.5%
PS	12.3%
PVC	10.7%
PET	8.5%
other	9.7%

Plastic exhibits many good features and are, versatility, hardness, lightness, and good chemical resistance. For the concrete production these are the suitable qualities. And plastic is not a biodegradable hence its thought that plastic can exploited as inert material in the cement matrix. Plastic can also be used for a partial replacement to natural coarse aggregate.

Publish literature shows the usage of HDPE fibers in concrete [2]. They conducted a study on usage of HDPE fibres of dia 0.25 mm and 0.40 mm with 0.40%, 0.75% and 1.25% by volume with concrete were subjected to compressive, flexural and ductility tests. The results indicate HDPE fibres exhibits more almost same compressive strength than the plain concrete, but greater improvement in tensile strength and flexural strength.

Herki et al., [3] conducted an experiment on concrete with partial replacement of SPS as fine aggregate and fly ash as cement. The density of the mix decreased due to the increase in the replacement of SPS aggregates. The 28-days compressive strength was found to be 16 MPa for control mix and it was reduced to 8 MPa for 60% SPS with 20% fly ash. Also, 28-days, the control mix resulted in 4 km/s of pulse velocity and 60% SPS with 20% FA pulse velocity reduced to 3.2 km/s. It was concluded that proper manufacture of SPS aggregate and suitable mix design may result in production of light weight concrete.

Lei Gu et al., [4], conducted a review on use of recycled plastic aggregate (PA) and plastic fibres (PF) in concrete.

Praveen Mathew et al., [5] conducted a study on Partial replacement of Recycled plastic as coarse aggregate in the concrete. The study done on M-20 grade of concrete by varying percentage of plastic coarse aggregate (PCA) by replacing to the natural coarse aggregate (NCA).

Youcef Ghernouti et al.,[6] conducted a study on recycled plastic material replaced the fine aggregate in the ratio of 10, 20, 30 & 40 % of sand in the concrete construction. It was observed that the apparent density, specific gravity, fineness modulus was 1.45 g/cc, 2.56, and 2.5 for sand: 0.53 g/cc, 0.87, and 4.7 for the recycled waste.

Batayneh et al., [7] investigated on use of waste material in concrete mixes. He studied the effect partial replacement of plastic aggregates to the fine aggregates of ground plastic of concrete in different proportion of 0%, 5%, 10, and 20% by keeping cement content as 446 kg/m^3, water content as 252 l/m^3, and coarse aggregate as 961 kg/m^3. Keeping constant w/c ratio as 0.56.

Zainab Z Ismail et al., [8] conducted a study on concrete with partial replacement of sand by plastic wastes in the ratio of 0, 10, 15 and 20% respectively. Many researchers investigated on recycling of plastic; some are concentrated in the behaviour of concrete containing recycled plastic as aggregate in the concrete industry.

In present study replace the natural coarse aggregate by recycled plastic aggregate (RPA) by 0%, 15%, 20%, 25%, 30%, 35% and 40% by weight.

II. EXPERIMENTAL WORK

A. Materials

The material properties are tabulated in Table II. The Fig 1 shows the methodology of production of the recycled plastic aggregate and made them readily usable to produce concrete. The processed RPA were sieves through 20 mm sieve and 10mm downsize were used.

TABLE III. MATERIAL PROPERTIES

Sl. No.	Materials	Properties
1	Cement	Ordinary Portland Cement of 53 grade conforming to IS 12269-2013. Specific gravity = 3.15. Specific surface = 285 m^2/kg.
2	Fine aggregate	Manufactured Sand confirming to Zone-II. (IS 383-2016) Specific gravity = 2.65. Water absorption = 2.0%.
3	Coarse aggregate	MSA = 20mm Specific gravity = 2.76. Water absorption = 1.25%.
4	Superplasticizer	Poly carboxylic ether base Specific gravity = 1.08.
5	Recycled plastic aggregates	MSA = 20 mm Specific gravity = 0.90 Water absorption = 0.05%
6	Water	Potable Drinking water confirming to IS: 456-2000.

Collection of plastic

Segregation of plastic

Plastic Extruder machine

Plastic shredding machine

Plastic aggregate

FIGURE 1. PROCESS OF RECYCLED PLASTIC AGGREGATES (RPA)

B. Methodology

M 25 grade of concrete mix was developed as per IS 10262-2019. The primary objective being replace the natural coarse aggregate by recycled plastic aggregate (RPA) by 0%, 15%, 20%, 25%, 30%, 35% and 40% by weight. Details of mix proportion for various combinations of concrete are given in the Table III. Many trial mixes were carried out to get a medium workability of 50 to 75 mm using the superplasticizer (SP). The developed concrete mixes were tested for workability by slump test method as per IS-1199-1959. The curing of the specimen is done by immersion in water and tested. The cube (150mm) and cylinder (150 x 300mm) compressive strength of concrete mixes tested at 7, 28 and 56 days as per IS: 516-1959. Then also specimens are tested for flexural strength (100 x 100 x 500mm) and split tensile strength test and determine the modulus of elasticity as per Indian Standards.

TABLE III. DETAILS OF MIX PROPORTIONS (BY MASS)

Mix	Ce	fa	Ca	RPA (kg/m³)	Water (l/m³)	SP (%)	w/c
M1	335	749	1245	0 (0%)	148	0.40	0.44
M2	335	749	1058	73 (15%)	148	0.40	0.44
M3	335	749	995	98 (20%)	148	0.40	0.44
M4	335	749	933	122 (25%)	148	0.40	0.44
M5	335	749	870	146 (30%)	148	0.40	0.44
M6	335	749	808	171 (35%)	148	0.40	0.44
M7	335	749	746	195 (40%)	148	0.40	0.44

Note: Ce-cement in kg/m³; fa-fine aggregate in kg/m³; Ca- coarse aggregate in kg/m³

III. RESULTS AND DISCUSSION

A. Workability of Concrete

The workability of concrete determines by standard slump test method. The obtained slump values are presented in Table IV.

Table IV. SLUMP VALUES OF CONCRETE MIXES

Mix	w/c	Slump (mm)
M1	0.44	85
M2	0.44	65
M3	0.44	60
M4	0.44	55
M5	0.44	50
M6	0.44	40
M7	0.44	30

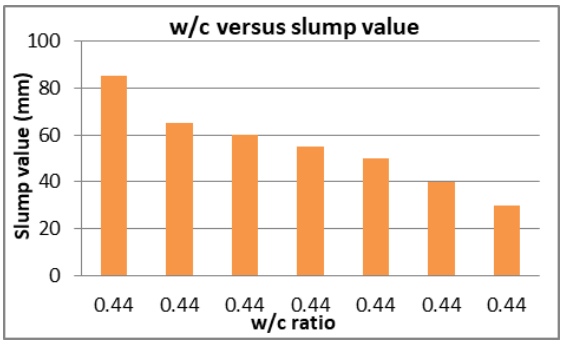


FIGURE 2: SLUMP VALUES VERSUS W/C RATIO

Fig 2 show that as percentage of replacement of RPA increases slump values decreases. This is due to frictional force between the aggregate and paste. As an RPA content increases, the inter-particle friction between aggregate and paste is increases it tend to slump value decreases.

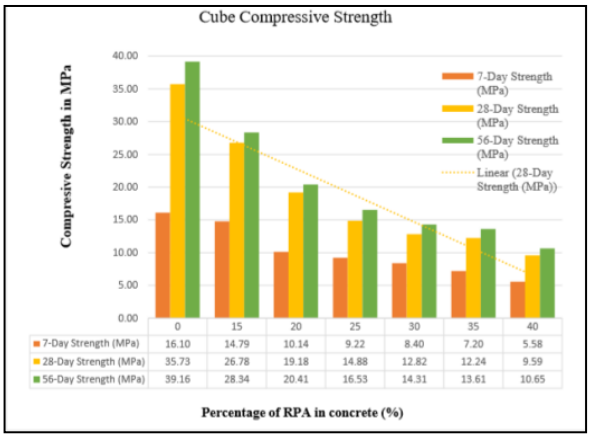
B. Compressive Strength of Concrete

The compressive strength for different proportion percent of plastic added concrete and conventional concrete were testes at end of curing periods as 7, 28 and 56 days, in a compressive testing machine. The test was conducted as per IS:516–1959. The compressive strength of concrete is found by testing both cube specimen (150 x 150 mm) and cylinder

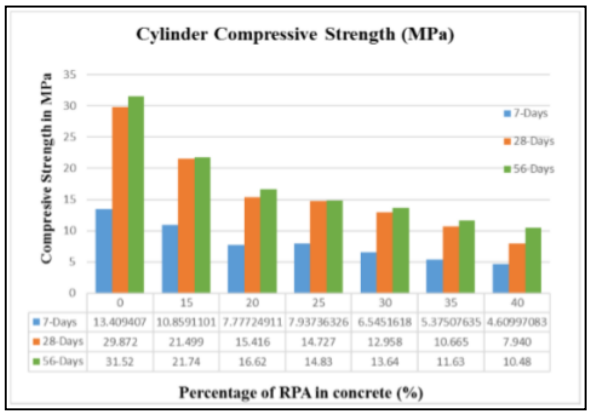
specimen (150 x 300mm). The values are tabulated in Table V.

Table V. AVERAGE COMPRESSIVE STRENGTH OF CONCRETE

Mix	w/c	Average Compressive strength (MPa)					
		Cube			Cylinder		
		7	28	56	7	28	56
M1	0.44	16	35	39	13	29	31
M2	0.44	15	26	28	11	21	22
M3	0.44	10	20	21	8	15	16
M4	0.44	9	14	17	7	14	15
M5	0.44	8	13	14	6	12	13
M6	0.44	7	12	13	5	10	11
M7	0.44	5	9	11	4	7	10



(a) Cube compressive strength in MPa



(b) Cylinder compressive strength in MPa.

FIG 3. COMPRESSIVE STRENGTH OF CONCRETE AT 7,28 AND 56 DAYS

Fig 3 (a) shows comparison bar diagram for cube compressive strength on vertical axis of the 7, 28, and 56 days. As percentage of RPA in the concrete mix increases the strength factor also reduces. The results were determined by testing nearly 100 specimens at the age of 7, 28, and 56 days. Fig 3(b) shows bar chart diagram of compressive strength of cylinder comparison for 7, 28, and 56 days. This also shows that as decrease in compressive strength with increases in of percentage of RPA.

C. Split Tensile Strength of Concrete

The test was conducted as per IS:5816–1999. The results of the test are presented in Table VI.

Table VI. AVERAGE SPLIT TENSILE STRENGTH OF CONCRETE

Mix	w/c	Split tensile strength (MPa)		
		7 days	28 days	56 days
M1	0.44	16	35	39
M2	0.44	15	26	28
M3	0.44	10	20	21
M4	0.44	9	14	17
M5	0.44	8	13	14
M6	0.44	7	12	13
M7	0.44	5	9	11

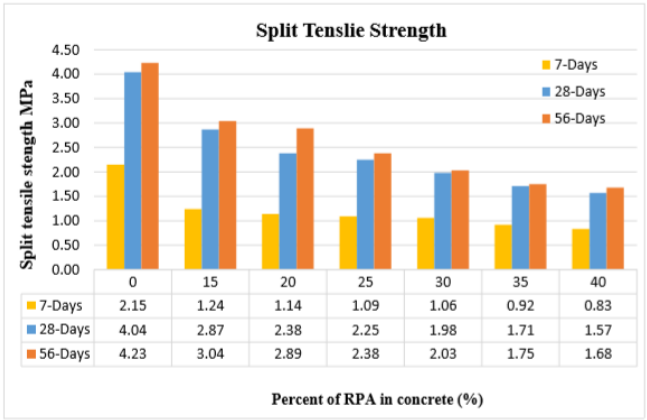


FIGURE 4: SPLIT TENSILE STRENGTH OF CONCRETE AT 7,28 AND 56 DAYS

D. Flexural Strength of Concrete

Specimens of size 100 x 100 x 500mm were tested under two points loading in accordance with IS 516 - 1959. The results of the test are shown in Fig 5.

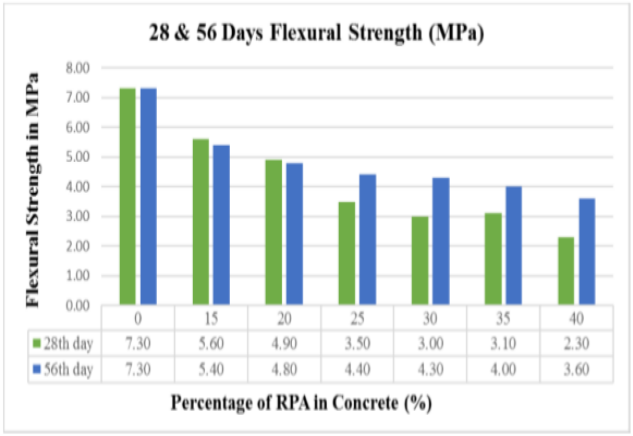


FIGURE 5: FLEXURAL STRENGTH OF CONCRETE AT 28 AND 56 DAYS

E. Stress and Strain Behavior of Concrete

In the present work, the stress strain behavior of the concrete was carried out to study the behavior of conventional and RPA added concrete under compression at 28 days. The Fig 6 shows the stress and strain behavior of concrete.

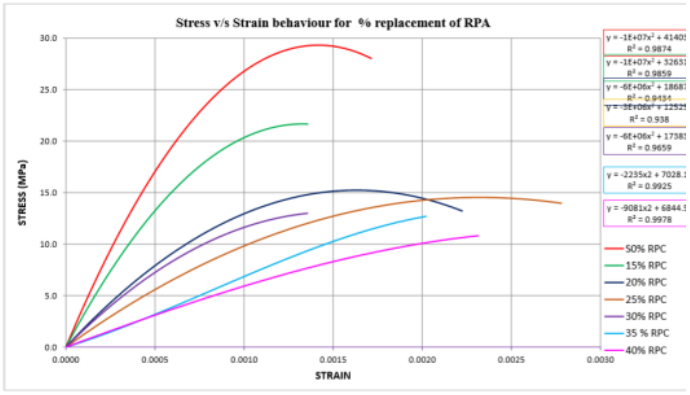


FIGURE 6. STRESS AND STRAIN BEHAVIOR OF CONCRETE AT 28 DAYS

Fig 6 show the concrete containing 0% of RPA shows minimum strain with maximum stress level. The stress-strain relationship varies as the percentage of plastic content in the concrete. At 15% of RPA in the mix the slope is little like the conventional one, but 20% of RPA and after the strain value increases the slope curve falls.

IV. CONCLUSIONS

Based on observations from experiments, following conclusions can be made. The concrete containing RPA exhibits lower slump value than the normal conventional concrete. The higher the dosage of RPA in the concrete results less workable that is stiff and difficult to handle. This happened due to the rough texture and water absorption of the aggregate. The concrete consists of RPA lower will be the density than the conventional concrete. The density is indirectly related to the percentage of dosing of RPA in concrete. Higher the substitution of RPA gives lower will be the density. The compressive strength is also varying with the RPA substitution.

V. ACKNOWLEDGEMENT

The authors would wish to acknowledge Lab Technicians and Management of RASTA-Center for Road Technology, Bengaluru for their help in conducting the experiments.

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An Experimental Study on the Determining the Bingham Parameters for Fresh Self-Compacting Concrete Mix using Concrete Shear Box Method

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ABSTRACT

In the present study, the determining the Bingham parameters of self-compacting concrete (SCC) by using the shear box method under static condition. The SCC mixes were developed by absolute volume fraction method. The developed SCC mixes were tested for both empirical methods as per EFNARC guidelines and rheological method by using concrete shear box. The results show that the concrete shear box test can be used as an instrument for finding the Bingham parameters of fresh SCC mixes under static condition.

Keywords: Bingham Parameter, Concrete Shear Box, Plastic Viscosity, Rheology, Self-compacting concrete, Yield Stress, Volume Fraction Method.

I. INTRODUCTION

Concrete rheology is new material science approach methodology for flow characterization of fresh concrete. It is deals with the "study of flow and deformation of complex fluid under applied force" [1]. The main aim of rheology is predicting the complex fluid flow that would be produced due to applied forces [2-4]. Basically, the concrete is a heterogeneous material, and it exhibits complex behaviour in fresh state [5]. To predict the flow behaviour of such complex fluid is not possible in existing empirical test methods [6,7]. There are more than 40 test methods are existed for characterizing the fresh SCC [6,7]. Among the test methods, the slump flow test in more commonly used and accepted test method [8]. Unfortunately, the slump flow test does not indicate the any small variations in mix proportioning can lead to problems with workability of SCC mixes [8]. Furthermore, these test methods are all empirical in nature [8] and their results are based on either time or distance. Such methods called as single point methods [8]. These single point methods do not provide a comprehensive flow characterization of SCC. For better understanding and measuring the workability of fresh SCC by rheological test method [8].

In rheological test method, fresh SCC is considered as a non-Newtonian complex fluid [9-12]. In rheological test method, the flow of SCC is characterized by two parameters viz: yield stress and plastic viscosity [9-12]. The yield stress is related to concrete slump and the resistance to the flow or speed of the flow represent plastic viscosity of the fresh concrete [9-12]. Generally, yield stress and plastic viscosity were measured using rheometers through Bingham model [13-15]. Majority of rheometers measure the dynamic

yield stress, and few rheometers measure the static yield stress [16,17]. There are various rheometers are available and each having its own advantages and limitations [16,17].

Many authors and researchers have attempted several experimental and analytical studies to measure the rheological properties of fresh concrete other than rheometers. These include using numerical simulation, analytical finite element models. Based on this they have developed the correlation between slumps, slump flow, Vebe and flow test to rheological values [18].

In 1956 L'Hermite and Tournon [19] used direct shear box to measure the shearing strength of fresh concrete. They found that the normal stress is linearly increasing with shear stress up to 0.18 MPa and 0.16 MPa for fresh concrete mixes having w/c ratio of about 0.55 and 0.65 respectively. The direct shear box test was used to assess the cohesive shear strength of fresh concrete and the test results were not assessed in-terms of rheological properties.

In 2009, Girish et al., [20] extending the L'Hermite work. They developed a new unique procedure to find the rheological properties of normal concrete and SCC mixes by using the direct shear box test with low shear rate. The results show that the obtained rheological properties are higher than rheometers values, but trend was like rheometer results.

Chung-Ho Huang et al., [21] developed new Active Rheometer (ARM) for flowable concrete for measuring the rheological properties. The test results show that ARM rheometer has better reliability and accuracy than the standard Brookfield viscometer test results. They conclude that ARM is sensitive enough to measure the rheological properties of flowable concrete.

Tanigawa and Mori [22] investigated the flow and deformation of fresh concrete by simulation method and carried out experimental work for validation.

Ahmet Bilgil [23] investigated the rheological properties of fresh concrete by numerical mathematical model. They developed the relationship between the workability and rheological properties during placing conditions into formwork with and without admixture. The results show that, with admixture, mixes have higher slump and less aggregate segregation when compared to without admixture for the same mix ingredients. They concluded that slump decreases as yield stress increases for both concrete mixes.

Gonzalez-Taboada Iris et al., [24], studied the rheological properties of self-compacting recycled concrete (SCRC) by using workability box method. The results show that workability box is a much more effective instrument to design a SCRC mix with a suitable fresh behaviour than the usual empirical tests.

It may be observed that, 2015, Girish and Santhosh [25-27] carried out studies on rheological properties of normal concrete. In their limited study, the findings show that concrete shear box can be used for finding the rheological properties of fresh concrete and the results show good repeatability and reproducibility of the results.

In 2018, Girish, Ajay et al [28,29] carried out the investigation on determining the rheological properties of fresh normal concrete using direct shear box.

In recent year, Girish and Ajay [30,31] carried out the studies on rheological properties of fresh concrete using concrete shear box method.

In the present study focus on determine the Bingham parameters or rheological properties of SCC using concrete shear box through Bingham model under static condition.

II. EXPERIMENTAL WORK

Materials

The characteristics of the materials used are shown in Table I.

TABLE I

MATERIAL PROPERTIES

Materials	Specific Gravity	Specific surface (m^2/kg)	Water absorption (%)	Remarks
Cement – OPC 53 Grade	3.10	280	-	Conforming to IS: 12269-2013 [32].
Fine aggregate –River Sand	2.6	-	2.0	Conforming to Zone-II as per IS: 383-2016 [33].
Coarse aggregate	2.7	-	0.9	Crushed angular aggregates.
GGBS	2.8	425	-	Conforming to IS:12089 [34]
Superplasticizer (SP)	1.08	-	-	Confirming to IS: 9103[35]
Water	1.0	-	-	Confirming to IS: 456-2000 [36]

Mix Design

In the present work, six different SCC mixes were developed by absolute volume fraction method [37,38]. Two different volumes of pastes of 0.38 and 0.42 were chosen. The water contents of 170 and 190 l/m^3 and cement contents of 300, 375, and 450 kg/m^3 along with filler (slag) were used. The mix proportion details are presented in Table II. Through the marsh cone test optimize the dosage of SP and kept constant throughout the experimental program. A modified mixing procedure was adopted to achieve the mixes [38].

TABLE III

DETAIL OF MIX PROPORTION FOR SCC MIXES (IN KG/M3)

Mix	Cement	GGBS	Powder	fa	Ca	Water	Vp	SP (%)
S1	300	322	622	806	821	170	0.38	1.2
S2	375	252	627	806	821	170	0.38	1.1
S3	450	182	632	806	821	170	0.38	1.0
S4	300	375	675	754	768	190	0.42	0.90
S5	375	308	683	754	768	190	0.42	0.85
S6	450	238	688	754	768	190	0.42	0.80

Legend: fa = fine aggregate, Ca = Coarse aggregate

Testing Procedures

The fresh SCC mixes were tested for rheological properties by concrete shear box test (Fig.1) and empirical tests as per EFNARC guidelines [39]. The working principle of concrete shear box is like direct shear box, that is, applying the normal stresses and displacement rate to the concrete sample (150mm x 150mm x 150 mm) and measure the shear resistance force (kN) and displacement (mm). The details of the experimental methodology are shown in Fig.2.

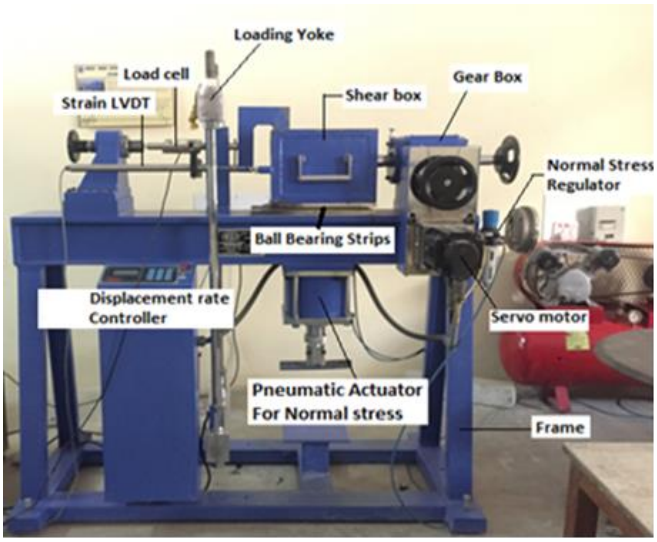


Figure 1: Concrete Shear box [31]

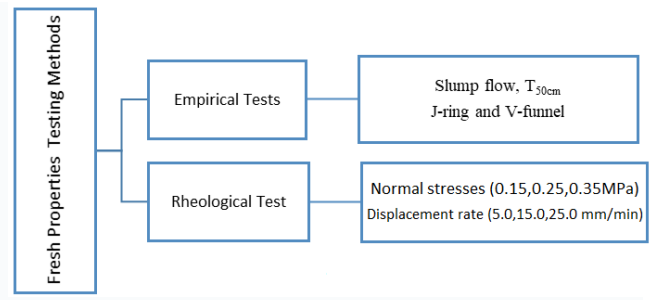
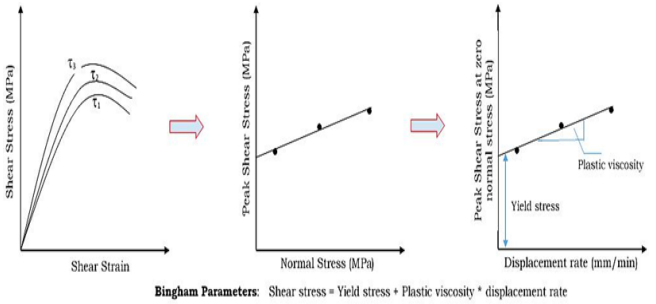


Figure 2: Experimental Methodology Adopted for Testing the Fresh Properties of SCC mixes

Determination of Bingham Parameters of SCC mixes

The methodology followed to determine the Bingham parameters of SCC mixes using shear box was based on previous studies [31]. Fig.3 shows the procedure for finding the rheological properties of SCC mixes. Two mix proportions were used in this study.



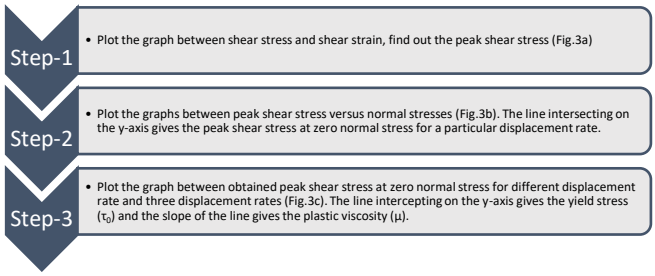


Figure 3: Procedure for Finding the Bingham parameters of Fresh Concrete [31]

III. RESULTS AND DISCUSSION

TABLE III

EMPIRICAL TEST RESULTS OF SCC

Mix	**Powder** (kg/m^3)	**Water** (lt/m^3)	**Vp**	**SP** (%)	**Slump flow** (mm)	**T50 (sec)**	**J-ring** (mm)	**V-funnel** (min)	
								0	**5**
S1	622	170	0.38	1.2	600	4.0	6.0	8.0	8.0
S2	627	170	0.38	1.1	625	4.5	5.0	8.5	8.9
S3	632	170	0.38	1.0	640	3.5	4.0	7.0	7.2
S4	675	190	0.42	0.90	660	3.2	7.0	6.0	6.4
S5	683	190	0.42	0.85	680	3.0	6.0	6.4	6.8
S6	688	190	0.42	0.80	700	2.7	3.0	5.5	5.8

As seen from Table III, the slump flow values varied from 600 mm to 700 mm; T50 values are varies from 2.7 sec to 4.5 sec; J-ring values from 3.0mm to 7.0mm and V-funnel values varies from 5.5 sec to 8.0 sec for different Vp, aggregate and water contents. These values are within the EFNARC guidelines ranges [39]. As powder content or Vp increases, the slump flow values increase. This is possible due to better coating of aggregates at higher powder or paste which in term reduces the inter-particle friction. Also increase in Vp

implies less aggregate content, thus more space between the aggregates.

The Fig.4,5,6 shows, typical graph for finding the rheological properties of SCC mixes (mix S1), similarly calculated the yield stress and plastic viscosity for SCC mixes. The values are tabulated in Table IV.

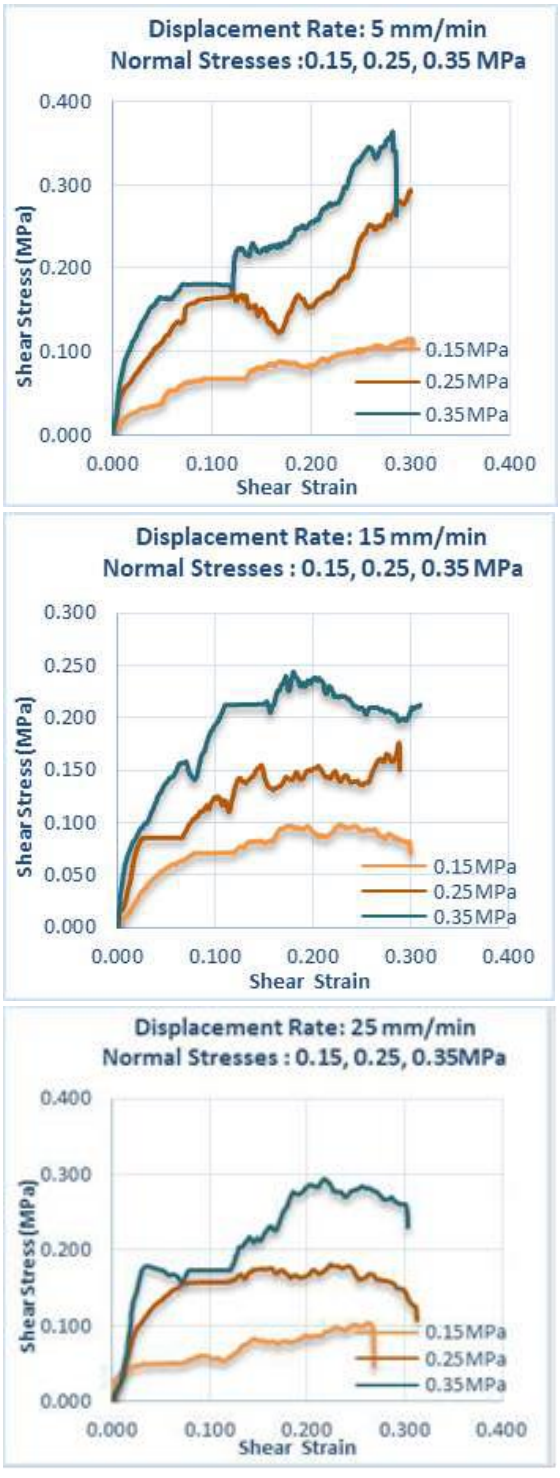


Figure 4: Shear Stress Versus Shear Strain

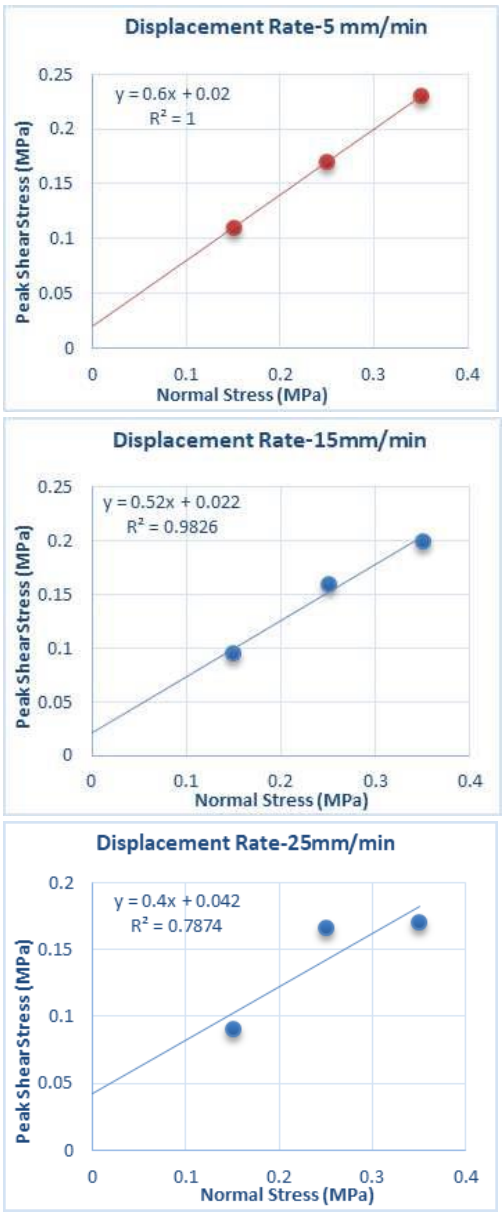


Figure 5: Peak Shear Stresses Versus Normal Stresses

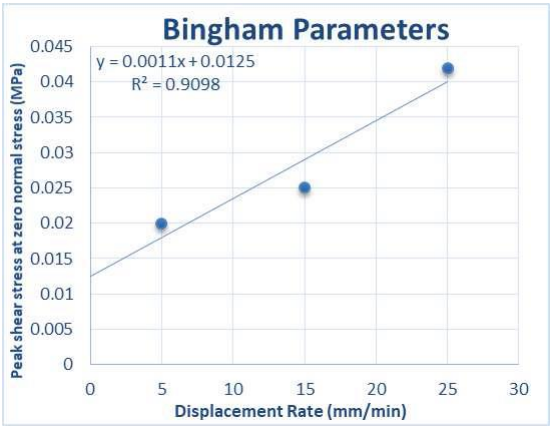


Figure 6: Bingham parameters of mix S1

TABLE IV

RHEOLOGICAL TEST RESULTS OF SCC

Mix	Powder (kg/m³)	Water (lt/m³)	Vp	SP (%)	Yield stress (MPa)	Plastic viscosity (MPa-sec)
S1	622	170	0.38	1.2	12500	10.0
S2	627	170	0.38	1.1	10500	9.5
S3	632	170	0.38	1.0	9500	8.0
S4	675	190	0.42	0.90	8500	4.7
S5	683	190	0.42	0.85	5500	3.6
S6	688	190	0.42	0.80	3500	3.0

As seen from Table IV, the values of yield stress and plastic viscosity obtained in this study are termed as relative since the values are not absolute. It can be observed from the table that for a given cement and water content, as the volume of paste is increased, the value of relative yield stress decreases. At low paste contents the inter-particle friction dominates resulting in higher relative yield stress which is clearly brought out by the concrete shear box test.

Many researchers have reported correlation between the yield stress and slump flow [40]. They found that the yield stress and plastic viscosity decreased as slump flow increased. Fig.7 and Fig.8 shows the correlations between slump flow versus yield stress and plastic viscosity.

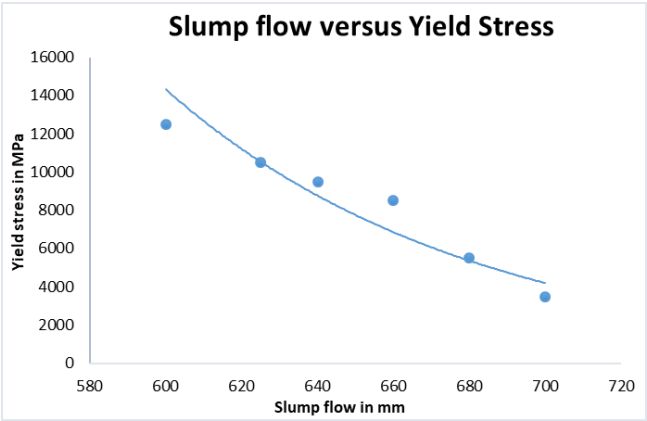


Figure 7: Correalation between Slump Flow and Yield Stress

As seen from Fig.7, the yield stress is more when the slump flow is less and vice versa. Similar relationship was observed by other researchers using different rheometers [40].

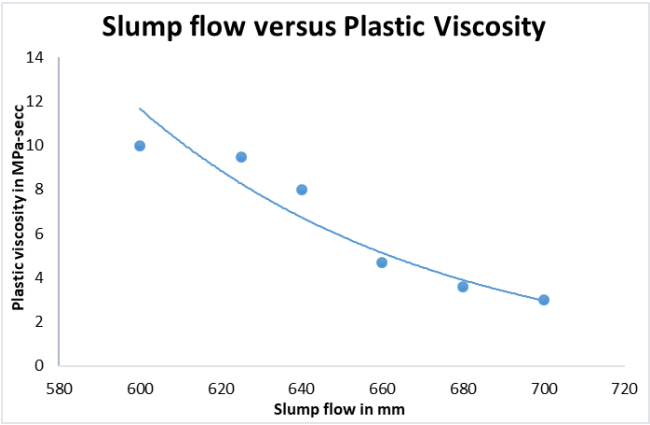


Figure 8: Correalation between Slump Flow and Plastic Viscosity

As seen from Fig.8, the plastic viscosity decreases as the slump flow increases for different Vp. Similar kind of observation was seen in the works of Murata and Kikukawa and Wallevick [40]. The results are based on test values using rheometers. Yield stress and plastic viscosity values and the result of T50 and V-funnel, do not show fair correlation and similar observations have been seen by other researchers [40].

IV. CONCLUSION

The results of this experimental study have shown the effective use of concrete shear box in determining the

Bingham parameters of fresh SCC. This study validates the application of the Bingham model to SCC in general for finding the yield stress and plastic viscosity of the mix.

V. ACKNOWLEDGEMENT

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The Comparative Study of Fly Ash & RBI Grade 81 on Lateritic Soil

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ABSTRACT

In most of the failure cases, the soil does not have sufficient strength & bearing capacity to sustain under traffic load, natural disasters (earthquake, heavy rain, flood, landslides), structure. So, attempt is to modify & improve the properties of Lateritic Soil by adding fly ash, RBI Grade 81, bottom fly ash etc.Fly ash & RBI Grade 81 materials are used where fly ash is industrial waste or byproduct & RBI-81 stand for Road Building International which is a soil stabilizer. To check the influence of fly ash & RBI-81 on index & engineering properties, we have performed laboratory tests regarding core cutter method, oven dry method, sieve analysis, density bottle test, liquid limit, plastic limit also MDD, compaction test, triaxial test, CBR tests with the help of available laboratory equipments. RBI-81 & Fly Ash are used in varying percentages from 1% to 5% by weight at optimum percentage of water.Hence, we concluded that the 4% of fly ash, 3% of RBI Grade 81 and 2% of combined sample fly ash & RBI Grade 81 are found to be appropriate in order to achieve the objectives of our project i.e. to improve properties and bearing capacity of locally available lateritic soil. In present investigation, we have obtained optimum percentages of fly ash and RBI Grade 81 required for sub-base regarding IRC recommendation.From graphical representation, Fly Ash sample gives increment in CBR value by 13.62% than untested soil sample, whereas RBI-81 shows 26.49% & combination sample gives 24.69% increment in CBR value. By observation, it can be concluded that addition of RBI-81 has found to be greater in % of improvement value than fly ash and combination sample. Therefore, RBI-81 is more suitable than Fly ash & combination sample (fly ash+RBI-81). From above summary, we can conclude that addition of Fly Ash & RBI Grade 81 on lateritic soil has improved its properties resulting improvement in soil's bearing capacity.

Index Terms : Bearing capacity, CBR, Fly ash, Lateritic soil, MDD, RBI Grade 81, stability.

I. INTRODUCTION

Soil is fundamental element to build any structure. It gets changes in its properties from region to region due to weathering actions; hence, it is necessary to adopt suitable type of methodology & technology at the time of construction. It possesses index and engineering properties which are responsible for its nature & behavior under certain action of load. In many failure cases, soil is unable to sustain after its maximum bearing capacity is utilized.

Lateritic soil has very low plasticity, high moisture content and high permeability due to which it formsdifficulties in construction. Hence, it is necessary to modify or stabilize its properties. It can be strengthened or improved by adding supplementary materials or stabilizers. Fly ash & RBI Grade 81 are used as supplementary materials to get improvement in bearing capacity of lateritic soil;

whereas, fly ash isindustrial waste product.In India, it is produced in tons per year. However, the disposal problem offly ash is covered.

To check the effects of fly ash & RBI-81 on lateritic soil suitable experimental work is required.But following the title of study, results are needed to be compared, concluded and represented on the basis of improvement & economical aspect.

II. MATERIALS USED

A. lateritic soil:

Commonly considered to have formed in hot and wet tropical areas develop by intensive and prolonged weathering of the underlying parent rock. Found in Karnataka, Kerala, Tamil Nadu, Madhya Pradesh and the hilly areas of Orissa, Assam and Konkan region etc.

B. Fly Ash:

It is generated during the combustion of pulverized coal in the thermal power plants and waste product of chemical industry. Here, F-class fly ash is used.

C. RBI Grade 81:

It is eco-friendly, inorganic,powderbased soil stabilizer which is non-UV degradable& inert. It is a road construction material patented worldwide. It is a cementitious powder material form which is grey in color, also acts as waste binding.

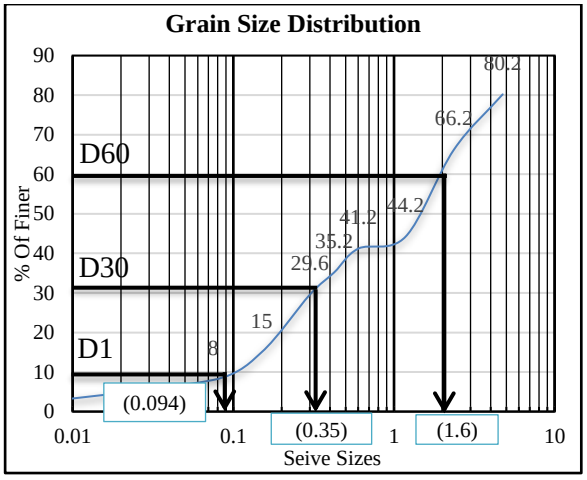
III. METHODOLOGY

The soil sample having undisturbed properties was collected from site. The soil sample was subjected to go under various tests for further analysis regarded by IS-code:2720 for selection of methodology. We have done some experimental work; the assembly is as follows:

A. Core Cutter Method:
This method was used to determine the dry density of sample (lateritic soil). Density is defined as the mass per unit volume of soil. For present sample, procedure was followed as per recommendations mention in IS-code:2720, Part 5 and dry density of locally available soil was resulted.

B. Oven Drying Method:
This method was used to determine moisture content of sample (lateritic soil). For present sample, procedure was followed as per recommendations mention in IS-code:2720, Part 4 and moisture content of locally available soil was resulted.

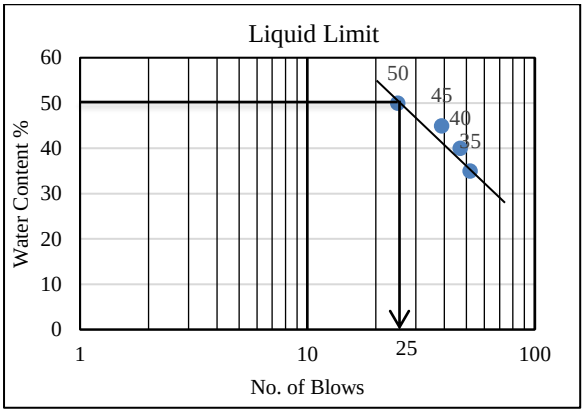
C. Grain Size Distribution:
Sieve analysis was done to identify the classification of soil whether it is well graded or poorly graded soil. As per IS-code:2720-Part 6, we have made a analysis & plotted a grain size distribution curve showing gradation of soil where the result is depending upon the value of coefficient of curvature and uniformity coefficient. The grain size distribution curve is represented as follows:



D. Density Bottle Method:
This method was used to calculate specific gravity of soil, procedure followed by IS-code:2720, Part 7.

E. Liquid Limit:
This testwas used to determine the liquid limit of sample (*lateritic soil*).This is the limiting moisture content at which the cohesive soil passesfrom liquid state to plastic state. This was found by following IS-code:2720, Part 11.

Here is an analytical graph as follows:



F. Plastic Limit:

The plastic limit test of a soil was used to determine the moisture content, expressed as a percentage of the weight of the oven dry soil procedure followed by IS-code:2720, Part-11.

G. CBR Test:

The California Bearing Ratio (CBR) test is a penetration test used to evaluate the subgrade strength of roads and pavements followed by IS-code:2720, Part 16. This test is done on the *lateritic soil* with addition of fly ash & RBI grade 81, combination of both and without addition of both materials. A standard metal rammer (IS:9198-1979) is used for compaction.

Preparation of Sample :

i. Lateritic Soil Sample :

1. Take about 3.2 kg of lateritic soil and mixed with the 17% of water.
2. Fix the extension collar and the base plate to the mould. Insert the spacer disc over the base. Place the filter paper on the top the spacer disc.
3. Compact the mix soil in the mould using light compaction. For light compaction, compact the soil in 3 equal layers, each layer is being given 56 blows by 2.48 kg rammer remove the collar and trim off soil.
4. Turn the mould upside down and remove the base plate and the displacer disc. Weight the mould with compacted soil (collar side) and clamp the perforated base plate on to it.
5. Place the mould assembly with the surcharge weights on the penetration test machine. Seat the penetration piston at the center of the specimen with full contact of the piston on the sample is established. Set the stress and strain dial gauge to read zero.
6. Apply the load on the piston so that the penetration rate is about 1.25 mm/min. Records the load readings at penetrations of 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 & 5.0 mm.

ii. Lateritic soil + Fly Ash Sample:

1. Take about 3.2 kg of lateritic soil and 1% of Fly ash in addition of 17% of water content; mix them well.
2. Follow 2,3,4,5,6 steps for further procedure.
3. Follow above procedure for 2%, 3%, 4%, 5%.

Above procedure was followed for Lateritic soil+RBI-81 samples where for combination sample(lateritic soil+fly ash+RBI-81) rest of procedure remains same excepts % of water that becomes 15% and there is contribution of 1% from fly ash and RBI-81 each.

H. Proctor Compaction Test (MDD):

This method covers the determination of the relationship between the moisture content and density of soils compacted (2.5kg rammer dropped from a height of 30cm). MDD was determined as per IS-code:2720, Part 8.

I. Triaxial Shear Test:

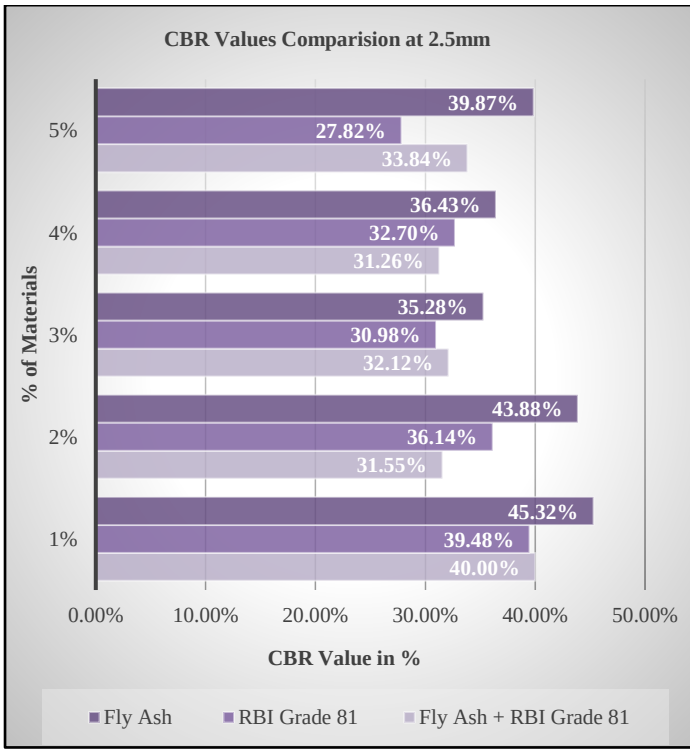
The triaxial compression test is more commonly used in laboratory for determination of shear strength. Test is followed by IS-code:2720, Part 11.

On the basis of experimental work, all the result summery is represented in table no.1 & 2 also, the comparative representation is done for analysis purpose as follows:

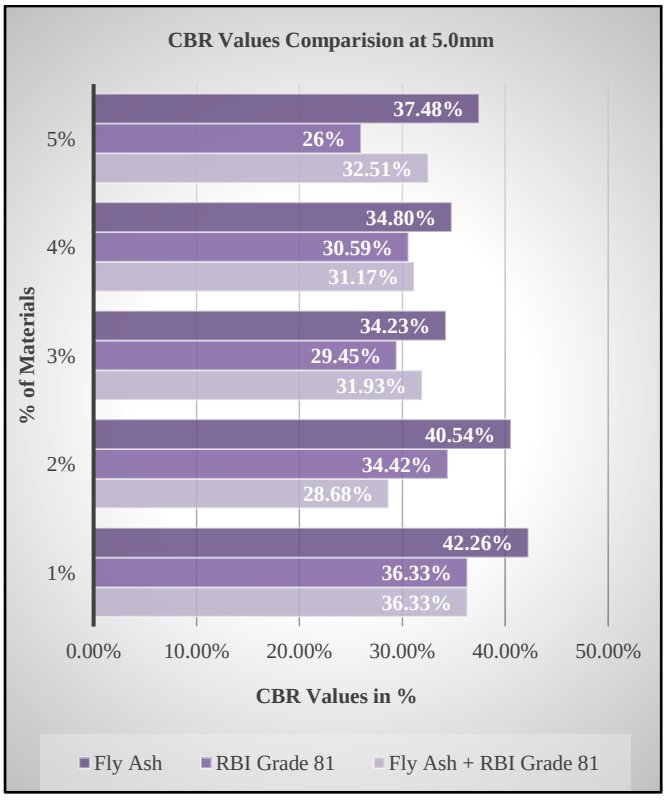
Graphical Analysis:

Graph no.1: Corresponding bar chart shows comparative representation of CBR values in

percentages from 1% to 5% of each three samples tested at 2.5mm penetration,



Graph no.2: Corresponding bar chart shows comparative representation of CBR values in percentages from 1% to 5% of each three samples tested at 5.0mm penetration,



IV. RESULT

From all experimental work, a tabular summery is as follows which consists of two tables corresponding results from index properties. The remark claims conditions or description of output.

Table1:Results for Index Properties(a)

Sr. No.	Particulars	Quantities with units	Type of method	Remark	IS Codes
1.	Dry Density of Soil (γ_d)	1.26 gm/cc	Core Cutter Method	-	IS 2720 Part 5
2.	Moisture Content (W)	33.33 %	Oven Dry Method	-	IS 2720 Part 4
3.	Grain Size Distribution	C_c = 0.81 C_u = 17.02	Sieve Analysis	It is well graded medium uniform sandy soil group sand.	IS 2720 Part 6
4.	Specific Gravity (G)	2.11	Density Bottle Method	-	IS 2720 Part 7
5.	Liquid Limit	50 %	Liquid Limit Test	-	IS 2720 Part 11
6.	Plastic Limit	33.33 %	Plastic Limit Test	-	IS 2720 Part 11

In following table, CBR results are finalized on basis of IRC recommendation or on specific conditions from all of samples of varying percentages compared in bar representation in statistical analysis.

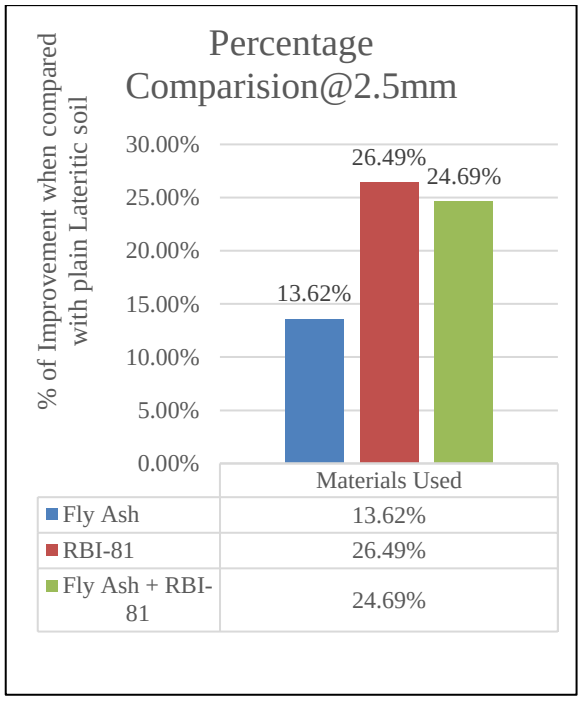
Table2:Testing Result based on Engineering Properties(b)

7.	CBR	2.5mm	5.0mm	CBR Test	Soil range without addition of material	IS 2720 Part 16
	a) Laterite only	40.44 %	37%			
	d) Laterite + Fly ash	36.43 %	34.80 %		Here, swelling effect is considered.	
	c) Laterite + RBI Grade 81	30.98 %	29.45 %		CBR values between 20% -30 % are accepted here as per IRC recommendation for sub-base.	
	c) Laterite + Fly ash + RBI Grade 81	31.55 %	28.68 %			
7.	Maximum Dry Density (MDD)	1.856 gm/cc		Proctor Compaction Test	-	IS 2720 Part 8
8.	Triaxial Shear Test	C=6.8 KN/m^2 Ø=29^0		Triaxial Shear Test	-	IS 2720 Part 11

Comparative Representation of Results:

Graph 3:PercentageComparision@2.5mm

It is a Graphical representation of samples Fly Ash, RBI Grade 81 and combination of fly ash & RBI Grade 81 based on difference of percentages at which composition is found to be most improved from 1% to 5% taken at 2.5mm; in which Fly Ash has CBR value improved by 13.62% than plain soil sample, whereas RBI-81 shows 26.49% & combination sample gives 24.69% as shown by following graph,



V. DISCUSSION

From all results obtained by performing laboratory test, we can successfully aim objectives of ourproject. We areable to compare CBR values and find out which sample has comparatively more improved % of CBR value which shows bearing capacity ofsoil has improved. We have studied effect of fly ash and RBI-81 on lateritic soil. We can say that,properties of lateritic soil are improved.

VI. CONCLUSION

1. From above test results, we can conclude that the mixing of Fly Ash & RBI Grade 81 in lateritic soil has improved its properties.
2. In present investigation, we have obtained optimum percentages of fly ash and RBI Grade 81 required for sub-base regarding IRC recommendation.
3. From the CBR results, optimum value for fly ash is recorded to be 35.28% for 4% @2.5mm penetration when compared to results at 1%, 2%, 3%, 4%, 5%.
4. From the CBR results, optimum value for RBI Grade 81 is recorded to be 30.98% for 3%

@2.5mm penetration when compared to results at 1%, 2%, 3%, 4%, 5%.

5. From the CBR results, optimum value for combined sample Fly ash & RBI Grade 81 is recorded to be 31.55% for 2% @2.5mm penetration when compared to results at 1%, 2%, 3%, 4%, 5%.
6. Hence, we concluded that the 4% of fly ash, 3% of RBI Grade 81 and 2% of combined sample fly ash & RBI Grade 81 are found to be appropriate in order to achieve the objectives of our project i.e. to improve properties and bearing capacity of locally available lateritic soil.
7. From graphical representation, Fly Ash sample gives increment in CBR value by 13.62% than untested soil sample, whereas RBI-81 shows 26.49% & combination sample gives 24.69% increment in CBR value. By observation, it can be concluded that addition of RBI-81 has found to be greater % of improvement value than fly ash and combination sample.
8. Therefore, RBI-81 is more suitable than Fly ash & combination sample(fly ash+RBI-81).

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Construction of Low Cost Less Time (LCLT) Houses by using Wood

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ABSTRACT

Most common problem of the countries is the post-sovient space is the low availability of housing. A rather large number of houses annually become obsolete, destroyed as a result of natural disaster. Therefore this project deals with the modern trend of housing construction in wood and is reoriented to the market of low-rise construction and durability. The number of days for construction of the building in wood is 31 days and the cost for construction of wood houses need is 491374 as per the plan which is referred to deal this project. This leads to the application of earthquake resistant structures.

Keyword : Low Cost House, Less Time Construction, Wood, Tests on Wood.

I. INTRODUCTION

Wood has been used and adapted by humans since the earliest recognition that they could make use of the materials they found around them. As they used it to meet a varying array of human needs, in peace and in war, in farming and in industry, people gradually came to understand something of the unique nature of wood. Its properties were first understood by experience, more recently by systematic research and refined observation. Wood is still essential to human life, but has evolved over the ages from a simple, readily available natural material to a modern industrial and engineering material, with a unique ability to contribute to human life both as a material for use and as a key element in the natural world of the forest.

Figure 1. Wood

II. TESTS ON WOOD

- Bending test
- Absorption test
- Compression test

2.1 BENDING TEST

TABLE 1. Dimensionality Test of Different Woods

Types of woods	1(inch)	2(inch)	2.5(inch)
Silver wood	0.15	0.32	0.45
Teak wood	0.33	0.53	0.72
Neem wood	0.29	0.50	0.64

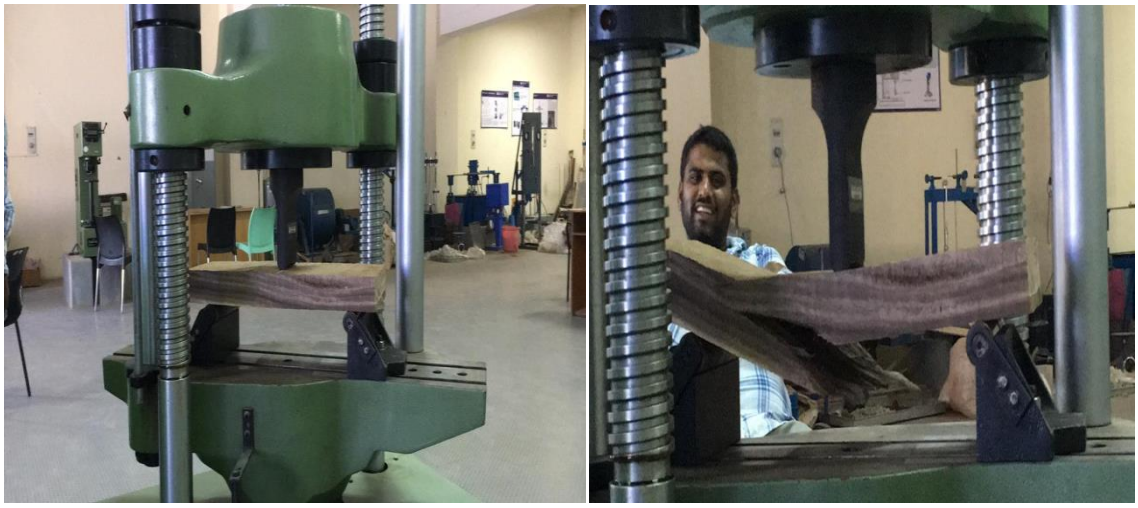

Figure 2. Bending test of wood

2.2 ABSORPTION TEST

Table 2. Absorption Test of Different Woods

Wood Names	Thickness Of Wood (Inches)	Initial Weight W1 (K G)	Final Weight W2 (K G)	Moisture Content (%)
Silver wood	2 ½	2.55	2.71	6.27
Teak wood	2	2.51	2.63	4.78
Neem wood	1	0.84	0.92	9.52

Figure 3. Water Absorption Test of Wood

2.3 COMPRESSTION TEST

Length:-49.5mm
Height:-54.5mm

Table 3. Compressive Strength Test of Different Woods

WOOD NAMES	THICKNESS OF WOOD	AREA (MM^2)	LOAD (N)	COMPRESSION STRENGH (N/MM^2)
Silver wood	2 1/2	2697.75	89000	32.99
Teak wood	2	2697.75	183000	67.83
Neem wood	1	2697.75	115000	42.62

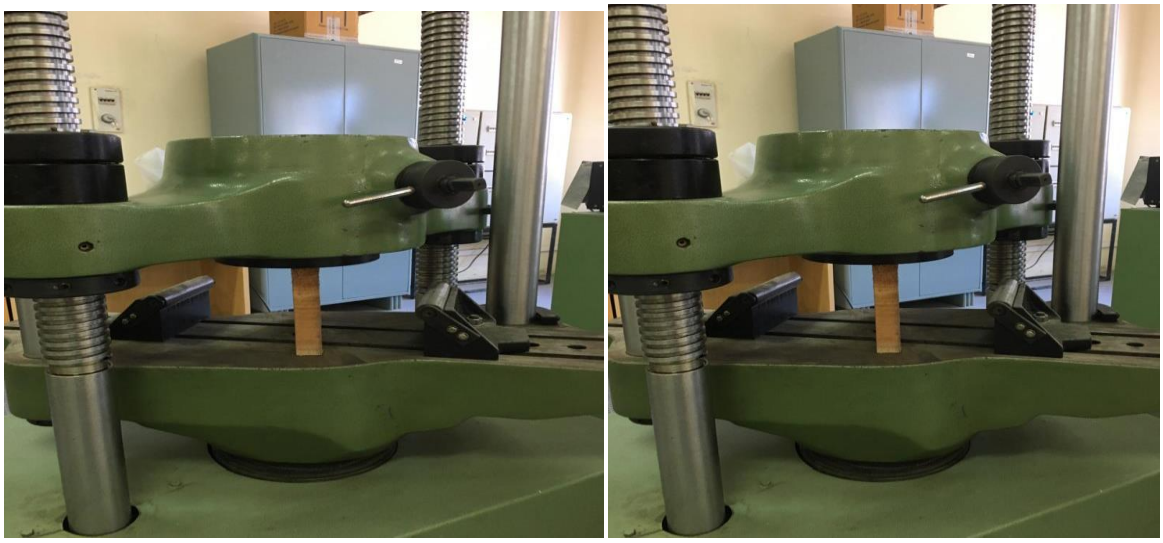

Figure 4. Compressive Strength of Wood

IV. RESULTS & DISCUSION

4.1 Estimation of a conventional building

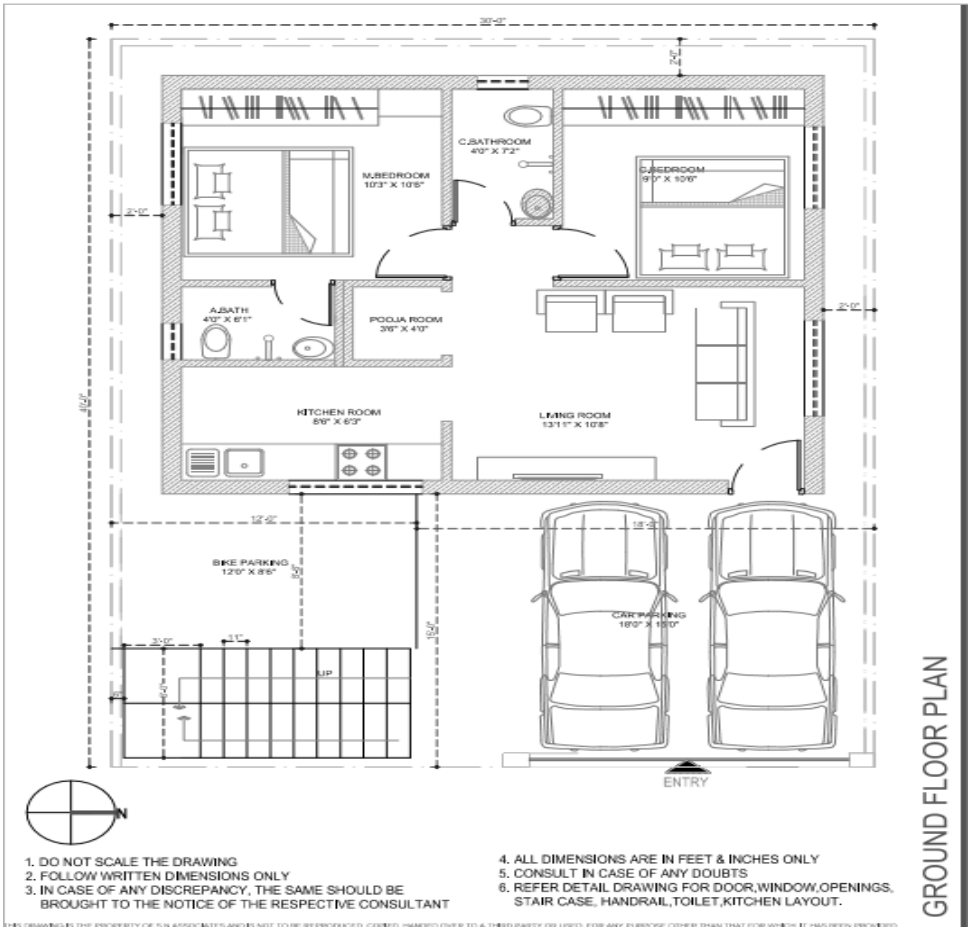

Figure 5. Plan of a Conventional Building

Table 5. Estimation of Conventional Building

SL/NO	PARTICULATERS	NO	LENGHT	WIDTH	HIGHT	QUANTITY	REMARKS
1	Brickwork						
	30cm wall	1	94	1	10.5	987	
	20cm wall	1	76.84	0.66	10.5	537.82	
					Total=	1524.82 cu ft	
	Deduction						
	30cm wall						
	D	1	4	6.9	1	27.6	
	W	4	6.9	4	1	110.4	
	V	2	1.5	1.5	1	4.5	
	20cm wall						
	D	2	4	6.9	0.67	36.98	
	D1	2	3.3	6.6	0.67	29.19	

	D2	2	3	6.23	0.67	25.05	
					Total=	233.72 cu ft	
	Lintel					25.74 cu ft	
	Columns					88.57 cu ft	
	Beams					72.74 cu ft	
					Total=	420.77 cu ft	
			Total brick work =			1524.82 cu ft	
				Total deduction=		420 cu ft	
				net brick work =		1104.05 cu ft	
2	Concrete work RCC Roof	1	30	40	0.5	600	(600-staircase)
						600-(6x12x0.5)	
					Total=	528.5 cu ft	
2.1	Lintel						
	30cm wall	1	94	1	0.5	47	
	20cm wall	1	76.84	0.67	0.5	25.74	
					Total=	72.74 cu ft	
2.2	Columns						
	30cm wall	1	11	1	10.5	115.5	
	20cm wall	1	0.66	0.66	10.5	4.57	
					Total=	120.07 cu ft	
2.3	Beams						
	Walls	1	94	0.5	1	47	
	Formica	1	60	1	1	60	
	Walls	1	76.84	0.5	0.67	25.74	
					Total=	132.74 cu ft	
	Total concrete required		(528.5+25.74+120.07+132.74)			807.05 cu ft	
3	Plastering						
	Outside	2	23	0.083	14.5	55.36 cu ft	
		2	26	0.083	14.5	62.58 cu ft	
	Inside					182.83 cu ft	
	Roof					93.61 cu ft	
				Total plastering=		394.39 cu ft	
	Deduction						
	D	3*2	4	0.083	6.9	13.77 cu ft	
	D1	2*2	3.3	0.083	6.6	7.23 cu ft	
	D2	2*2	3	0.083	6.23	6.2 cu ft	
	W	4*2	6.9	0.083	4	4.25 cu ft	
	V	2*2	1.5	0.083	1.5	0.75 cu ft	
					Total=	32.2 cu ft	
			net quantity=(394.39-32.2)			360.19 cu ft	

4	Flooring					400.88 sq ft	
	Parking floor					372 sq ft	
5	Steel work					3 tonne	
6	Distemper wash	(same as plastering area)				2940.27 sq ft	
7	Paint	(same as plastering area)				2940.27 sq ft	
8	weather proofing on the top of roof			(30*40)-(6*12)=		1128 sq ft	

4.2 Total Quantities for Superstructure

Table 5. Total Quantities for Superstructure

SL. NO.	DESCRIPTIONS	QUANTITY
1	Concrete	25 cub m
2	Bricks	18000 no's
3	Plastering	10.21 cub m
4	Distemper wash	274 sq m
5	Paint	274 sq m
6	Weather proofing on the top of roof	105 sq m
7	Inside flooring	38 sq m
8	Parking flooring	35 sq m
9	Steel	tonne

4.3 Rate per Quantity as per SR Report 2018-19 (Bangalore)

Table 6. Rate per Quantity as per SA Report

SL. NO.	DESCRIPTIONS	QUANTITY
1.	Concrete (M20)	4110.17 INR per cu m
2.	Table Moulded bricks	678 INR per 100 no's
3.	Mortar (1:2)	5308 INR per cu m
4.	Distemper primer	67.8 INR per L
5.	Whitening	18.64 INR per k g
6.	Wall paint	169.5 INR per L
7.	Weather proofing agent	216 INR per L
8.	20mm thick red granite	1624 INR per sq m
9.	Cement concrete tiles	191 INR per sq m
10.	Sealer foe tiles	1.7 INR per sq m
11.	Mild steel bars	33899 INR per tonne
12.	Shuttering and centering cost	215 INR per sq m

13.	Car painter (class 1)	466 INR per day
14.	Mason	467 INR per day
15.	Painter (class 1)	500 INR per day

4.4 Rate Analysis of Conventional Building

Table 7. Rate Analysis of Conventional Building

Sl. No.	Descriptions	Quantity
1.	Concrete (25*4110.17)	102754.25 INR
2.	Mason charge (12*25000)	300000 INR
3.	Bricks (18000*6.78)	122040 INR
4.	Plastering (10.21*5308)	54194.68 INR
5.	Distemper wash (274*67.8)	18577.2 INR
6.	Whitening (500*18.64)	9320 INR
7.	Paint 2 coat (2*274*169.6)	92940.8 INR
8.	Labour charge (2*20*395)	15800 INR
9.	Weather proofing on the top of roof (105*216)	22680 INR
10.	Inside flooring (38*1624)	61712 INR
11.	Labour (38*580)	22040 INR
12.	Parking flooring (35*191)	6685 INR
13.	Labour (35*50)	1750 INR
14.	Steel (3*33899)	101697 INR
15.	Binding wire (15*56)	840 INR
16.	Total =	933030.93 INR

4.5 Time Estimation for Conventional Building by Using Bar Chart

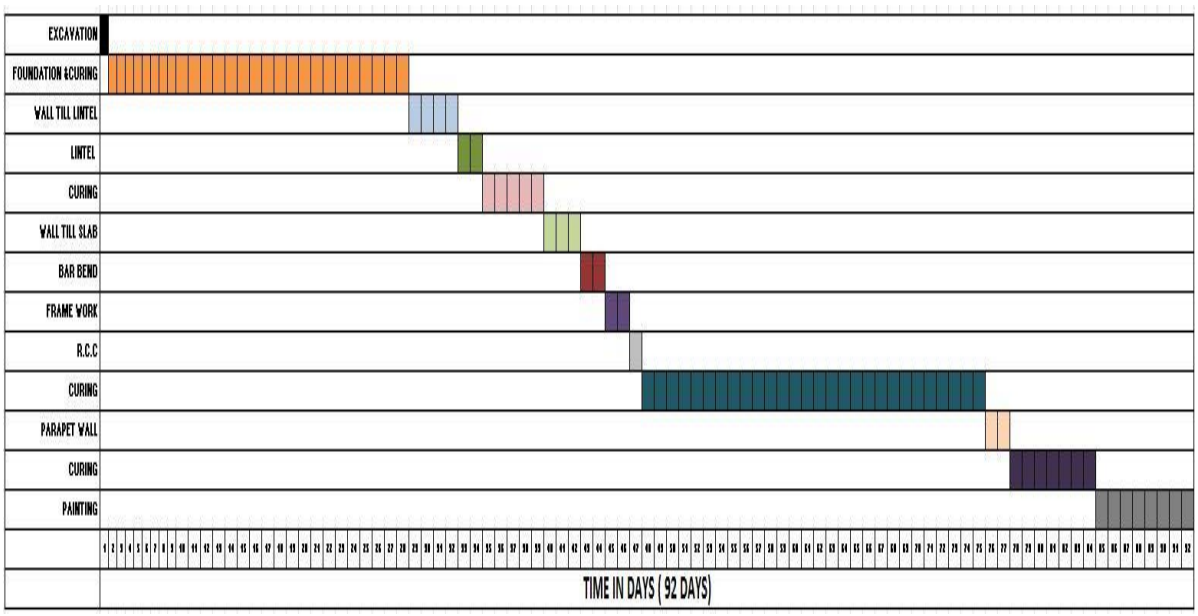

Figure 6. Bar Chart for Building Time Estimation (Total 92 Days)

4.6 Rate Analysis of Wood

Total quantity of wood required =2045 sq ft or 190 sq m
Hard wood cost per sq m is 1636 INR.
To fix 1 sq m it will cost around 473 INR.

Table 8. Rate Analysis of Wood House

Sl. No.	Descriptions	Quantity
1.	Total cost for wood (190*1636)	310840 INR
2.	Total fixing cost will be (190*473)	89770 INR
3.	Painting cost	23052 INR
4.	Flooring	67712 INR
5.	Total	**491374 INR**

Difference between wood estimation and building estimation
933030.93-491374 = **441656.93 INR**

4.7 Foundation estimation for wooden houses

Table 9. Foundation Estimation for Wooden Houses

Sl. No.	Particulars	No	Length	Breadth	Depth	Quantity
1.	PCC					
2.	30cm	1	101.522	3.936	1.64	655.328
3.	20cm	1	81.27	3.936	1.64	524.600
						1179.928
4.	Stone work	2	183	1.31	1.31	628.09
5.	Brick work	2	183	1	1	366

Table 10. Cost of the foundation

Sl. No.	Descriptions	Quantity
1	Total quantity of concrete required	33.5 cu m
2	Cost of the concrete required	4110.17*33.5 =137690.695 INR
3	Total quantity of bricks required	5200 no's
4	Cost of bricks	5200*6.8 =35800 INR
5	Total quantity of stone required	17.8 cu m
6	Cost of the stone	17.8*2918 =51940 INR
	Total cost of the foundation	**225430.690**

4.8 Treatment Required for the Wood

Termite - Borate treatment @ 5:1 ratio
Water proofing - Linseed oil
Walnut oil
Tung oil
Fire proofing - Fire retardant cable coating paint

4.9 Cost of Treatment Required for the Wood

Table 11. Cost of Treatment Required for the Wood

Sl. No.	Description	Quantity
1.	Termite	29189
2.	Water proofing	73695
3.	Fire proofing	32000
	Total cost =	**134884**

4.10 Total Cost of Wooden House

Table 12. Total Cost of Wooden House

Sl. No.	Descriptions	Quantity
1.	Stone	51940
2.	Brick	35880
3.	Wood (superstructure)	513414
4.	Wood roof	125183
	Total cost	**726417**

4.11 Time Estimation for Wood by Using Bar Chart

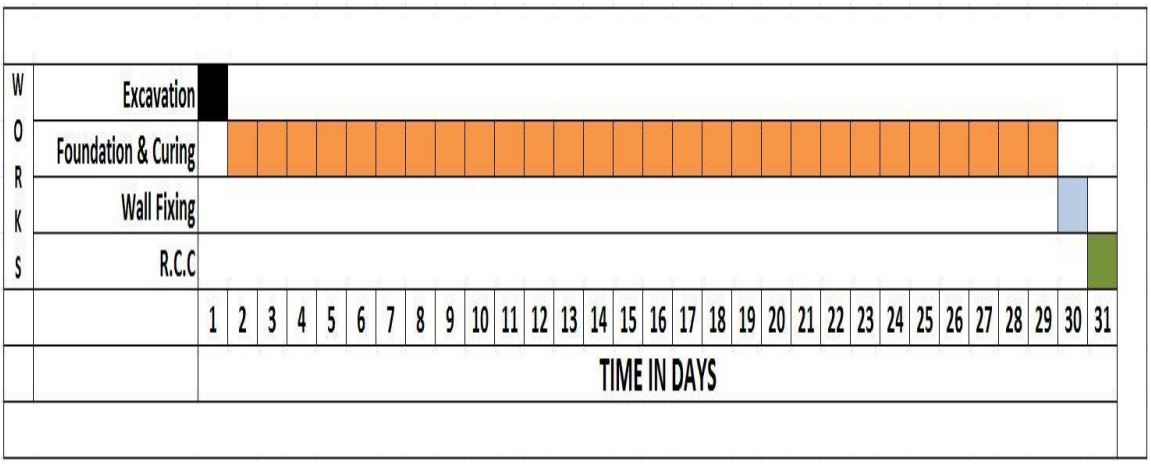

Figure 7. Bar Chart for Wood Estimation (Total 31 Days)

III. CONCLUSION

The optimum days for constructing wood building are 31days for ground floor compared to the conventional building. The cost of the constructing material is vulnerably less as compared to normal building materials. As wood bending capacity is good; it is applicable to the earthquake resistant areas.

IV. FUTURE SCOPE

In future the construction Cost and Time of wood house will get reduced if the foundation is designed with the selected wood which gives more strength with fewer prices.

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Water Requirement and Irrigation Scheduling of Major Crops Under Tungabhadra Command Area in Ranebennur and Haveri Taluka of Haveri District, Karnataka State using CROPWAT 8.0

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ABSTRACT
The study is carried out to determine the crop water requirement of cotton, maize sugarcane of Ranebennur Taluk and Ground nut and Tomato of Haveri Taluk in commanded area of Tungabhadra under upper Tunga Project (UTP) and reference crop evapo-transpiration (ET0) is determined using the FAO Penman Monteith method, considering the past 15 years meteorological data of the study area using CROPWAT 8.0 (2009) software The study shows that for both cotton and maize crops in rabi season effective rainfall is not sufficient to fulfil the crop water requirement but for the same crops in kharif season effective rainfall is enough to for water requirement The irrigation requirement and scheduling for the crops is prepared for major crops based on water requirement.
Keywords: Cropwat 8, Penman – Monteith, Evapotranspiration, Irrigation scheduling

I. INTRODUCTION

The purpose of irrigation is to supply of water to the soil at the right time to meet crop evapo transpiration in specific climatic condition to raise crop till harvesting. Hence assessing irrigation water requirements is necessary for irrigation project planning and water management at water users cooperative societies (WUCS) in command area to accomplish effective irrigation.
CROPWAT is computer model used for the estimation of crop evapo transpiration, irrigation warabandhi scheduling for different cropping patterns for irrigation planning and management.

II. LITERATURE REVIEW

Nithya K B et. al., (2016) "Study on Water Requirement of Selected Crops under Tarikere Command Area using CROPWAT" The study shows that reference evapo transpiration (ET_0) varies from 2.5 to 3.36 mm / day for the area and the gross water requirement was 342.42 mm/year with an application efficiency of 70% and the entire crop area of 4466 ha requires 16 MCM the dam can conveniently supply the water required for irrigation in the area.
Muhammad Nazeer et.al., (2009). "Simulation of Maize Crop under Irrigated and Rain fed Conditions with Cropwat Model" The simulation results analysis suggests that in both condition (rain fed and irrigated), the largest yield reduction occurred in the stage three (developmental stage) due to increasing of soil moisture deficit (SMD) than readily available moisture (RAM), irrigation at this stage can reduce the chance of yield reduction appropriately
R. Ganesh babu, G. Ravi babuand H.V. Hema kumar, et.al. (2015) "Estimation of crop water requirement, effective rainfall and water requirement for vegetable crops using CROPWAT" the average effective rainfall

was estimated for the study area as 769.3 mm out of 1060.3 mm annual rainfall. Reference evapo transpiration was estimated during period and found that the average peak monthly ET_0 was observed to be 8.09 mm/day for the month of June and followed by the 7.55 mm/day for the month of May. Minimum ET_0 was observed as 3.85 and 3.92 mm/day in the months of December and January respectively. The crop water requirement (ET_c) and irrigation water requirement were estimated for vegetable crops during Rabi season in the study area (Bapatla) as 516.3 mm and 470.4 mm respectively.

III. METHODOLOGY

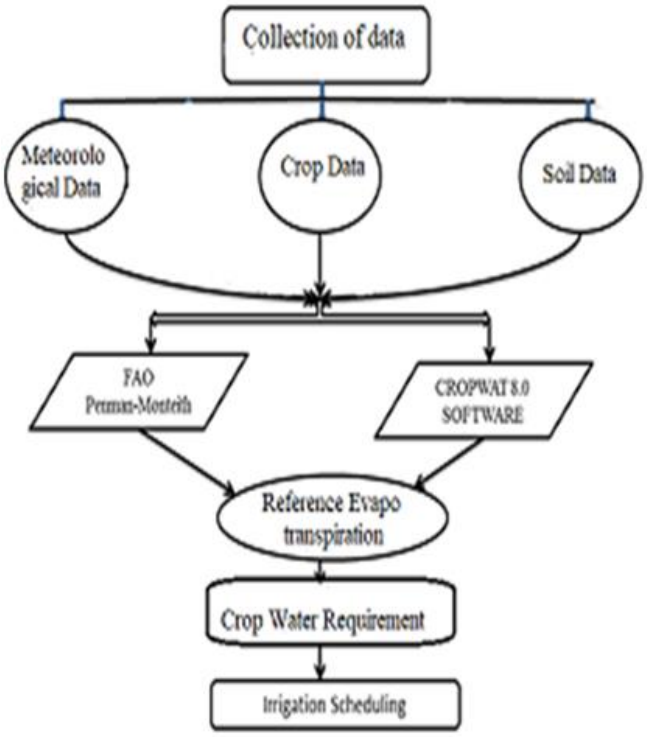


Fig 3.1: Flowchart of Crop Water Requirement

IV. STUDY AREA AND DATA COLLECTION

Taluka Place	Lat.	Long.	Area (km^2)	MSL (m)	Rainy season
Ranebennur	14.67° N	75.67° E	42.32	604.000	June-Oct 86 days
Haveri	14° 80°N	75° 40° E	51.35	572.000	

Fig 3.2 : Location of Haveri District Karnataka State

The Indian cropping seasons are

i) Kharif cropping seasons (July to October during the south-west monsoon)
ii) Rabi cropping is season (October-March).
iii) The crops grown between March and June are summer crops.

Meteorological data such as Maximum and Minimum temperature, Sunshine hours, Relative humidity, wind speed & Rainfall data are collected from River Gauging Sub Division Dharawd for period of past 15 years. Crop and soil details are collected from Agricultural Research Station Motebennur Ranebennur Taluk

V. CROPWAT 8.0

CROPWAT is a computer program which uses the FAO Penman-Monteith procedure for the estimation of reference crop evapo transpiration (ET_o), crop evapotranspiration (ET_c) and irrigation scheduling (FAO 1992). Major input parameters of the program are Meteorological data, crop growth data & soil data which include,

VI. FAO PENMAN- MONTEITH PROCEDURE

The crop Evapo transpiration (ETc) is also estimated by FAO Penman-Monteith Equation:

$$ET_o = 0.408\Delta (R_n - G) + \gamma \left[\frac{900}{T+273}\right] u_2 \frac{(e_s - e_a)}{\Delta + \gamma(1+0.34u_2)} \quad \ldots (1)$$

$$ET_c = K_c (E\ T_o) \quad \ldots (2)$$

ETo= Reference evapo-transpiration [mm/day]

Rn= Net radiation at the crop surface [MJ m^{-2} day^{-1}]

G= Soil heat flux density [MJ m^{-2} day^{-1}]

T = Mean daily air temperature at 2m height [°C]

u2 = Wind speed at 2 m height [m s^{-1}]

E = Actual vapour pressure [K Pa]

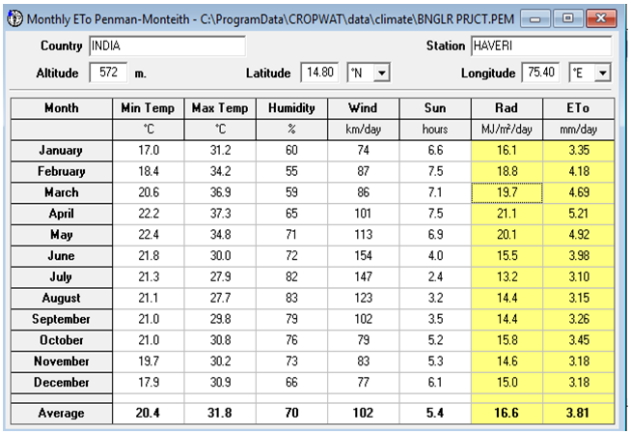
es- ea= Saturation vapour pressure deficit [KPa]

D = Slope vapour pressure curve [K Pa C^{-1}]

G = Psychometric constant [K Pa C^{-1}]

4.1 Reference Crop Evapo transpiration is calculated from Crop wat 8 Module and Penman Monteith method as below

Table 4.1: Reference Crop Evapo transpiration



Month	Min Temp	Max Temp	Humidity	Wind	Sun	Rad	ETo
	°C	°C	%	km/day	hours	MJ/m²/day	mm/day
January	17.0	31.2	60	74	6.6	16.1	3.35
February	18.4	34.2	55	87	7.5	18.8	4.18
March	20.6	36.9	59	86	7.1	19.7	4.69
April	22.2	37.3	65	101	7.5	21.1	5.21
May	22.4	34.8	71	113	6.9	20.1	4.92
June	21.8	30.0	72	154	4.0	15.5	3.98
July	21.3	27.9	82	147	2.4	13.2	3.10
August	21.1	27.7	83	123	3.2	14.4	3.15
September	21.0	29.8	79	102	3.5	14.4	3.26
October	21.0	30.8	76	79	5.2	15.8	3.45
November	19.7	30.2	73	83	5.3	14.6	3.18
December	17.9	30.9	66	77	6.1	15.0	3.18
Average	20.4	31.8	70	102	5.4	16.6	3.81

VII. RESULT AND DISCUSSION

Table 4.2: month wise reference crop evapo transpiration (mm/day) of Renebennur

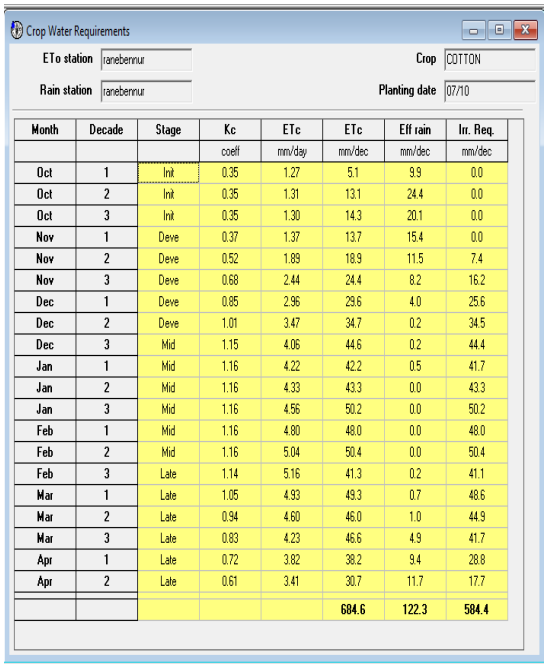
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cropwat 8	3.72	3.34	4.89	5.55	5.47	4.12	3.40	3.52	3.40	3.75	3.64	3.44
FAO Penman-Monteith	4.81	5.10	5.2	5.58	5.34	4.14	3.37	3.57	3.46	4.25	4.41	4.46

Table 4.3: Month wise reference crop evapo transpiration (mm/day) of Haveri

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cropwat 8	3.35	4.18	4.69	5.21	4.92	3.98	3.10	3.15	3.26	3.45	3.18	3.18
FAO Penman-Monteith	4.30	4.93	5.04	5.24	4.88	3.92	3.07	3.21	3.43	3.91	3.91	4.12

4.2. Crop Water Requirement, Effective rainfall and Irrigation Requirement (Ranebennur Taluka)

Table 4.4: Crop Water Requirement of cotton

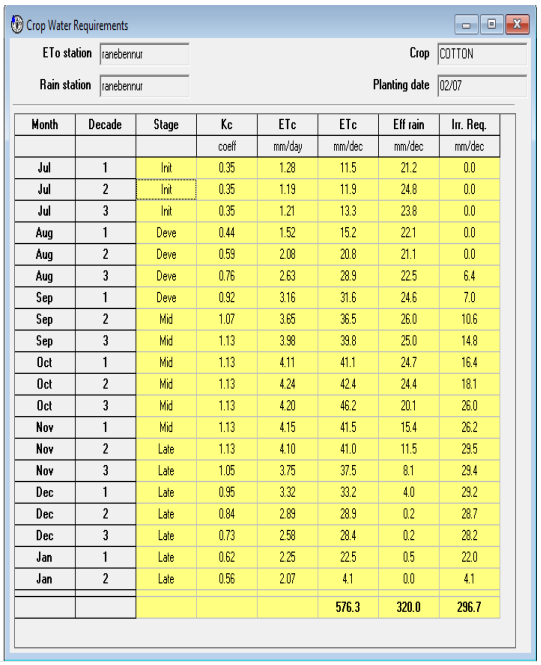


Crop Water Requirements

ETo station: ranebennur | Crop: COTTON

Rain station: ranebennur | Planting date: 07/10

Month	Decade	Stage	Kc	ETc	ETc	Eff rain	Irr. Req.
			coeff	mm/day	mm/dec	mm/dec	mm/dec
Oct	1	Init	0.35	1.27	5.1	9.9	0.0
Oct	2	Init	0.35	1.31	13.1	24.4	0.0
Oct	3	Init	0.35	1.30	14.3	20.1	0.0
Nov	1	Deve	0.37	1.37	13.7	15.4	0.0
Nov	2	Deve	0.52	1.89	18.9	11.5	7.4
Nov	3	Deve	0.68	2.44	24.4	8.2	16.2
Dec	1	Deve	0.85	2.96	29.6	4.0	25.6
Dec	2	Deve	1.01	3.47	34.7	0.2	34.5
Dec	3	Mid	1.15	4.06	44.6	0.2	44.4
Jan	1	Mid	1.16	4.22	42.2	0.5	41.7
Jan	2	Mid	1.16	4.33	43.3	0.0	43.3
Jan	3	Mid	1.16	4.56	50.2	0.0	50.2
Feb	1	Mid	1.16	4.80	48.0	0.0	48.0
Feb	2	Mid	1.16	5.04	50.4	0.0	50.4
Feb	3	Late	1.14	5.16	41.3	0.2	41.1
Mar	1	Late	1.05	4.93	49.3	0.7	48.6
Mar	2	Late	0.94	4.60	46.0	1.0	44.9
Mar	3	Late	0.83	4.23	46.6	4.9	41.7
Apr	1	Late	0.72	3.82	38.2	9.4	28.8
Apr	2	Late	0.61	3.41	30.7	11.7	17.7
					684.6	122.3	584.4



Crop Water Requirements

ETo station: ranebennur | Crop: COTTON

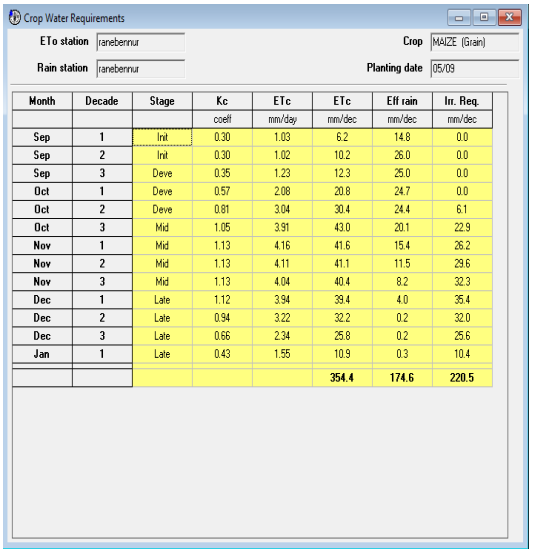
Rain station: ranebennur | Planting date: 02/07

Month	Decade	Stage	Kc	ETc	ETc	Eff rain	Irr. Req.
			coeff	mm/day	mm/dec	mm/dec	mm/dec
Jul	1	Init	0.35	1.28	11.5	21.2	0.0
Jul	2	Init	0.35	1.19	11.9	24.8	0.0
Jul	3	Init	0.35	1.21	13.3	23.8	0.0
Aug	1	Deve	0.44	1.52	15.2	22.1	0.0
Aug	2	Deve	0.59	2.08	20.8	21.1	0.0
Aug	3	Deve	0.76	2.63	28.9	22.5	6.4
Sep	1	Deve	0.92	3.16	31.6	24.6	7.0
Sep	2	Mid	1.07	3.65	36.5	26.0	10.6
Sep	3	Mid	1.13	3.98	39.8	25.0	14.8
Oct	1	Mid	1.13	4.11	41.1	24.7	16.4
Oct	2	Mid	1.13	4.24	42.4	24.4	18.1
Oct	3	Mid	1.13	4.20	46.2	20.1	26.0
Nov	1	Mid	1.13	4.15	41.5	15.4	26.2
Nov	2	Late	1.13	4.10	41.0	11.5	29.5
Nov	3	Late	1.05	3.75	37.5	8.1	29.4
Dec	1	Late	0.95	3.32	33.2	4.0	29.2
Dec	2	Late	0.84	2.89	28.9	0.2	28.7
Dec	3	Late	0.73	2.58	28.4	0.2	28.2
Jan	1	Late	0.62	2.25	22.5	0.5	22.0
Jan	2	Late	0.56	2.07	4.1	0.0	4.1
					576.3	320.0	296.7

The above Table 4.4 shows the crop water requirement of cotton in the Rabi season. The crop in first and II decade of initial stage (November) effective rainfall is enough to compensate crop water requirement. But in III decade of initial stage (November) and in the development and middle stage effective rainfall is less so irrigation is needed

In the Kharif season in Initial and development stage during the III decade of August first, II, III, decade of September of middle stage and first and II decade of October of middle stage effective rainfall is enough hence irrigation not required . At late stage effective rainfall is less requiring extra irrigation.

Table 4.5 : Crop Water Requirement of maize in Rabi season

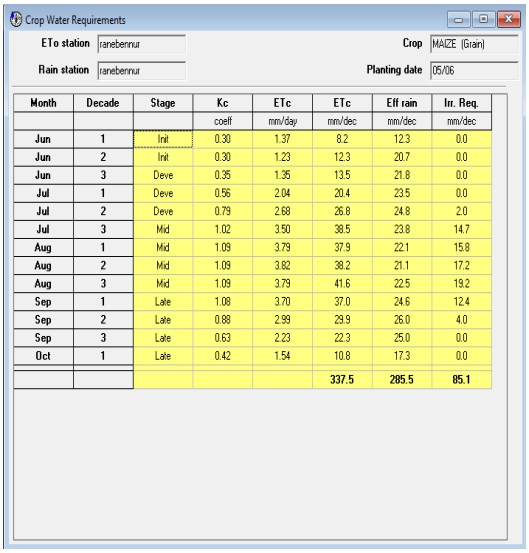


Crop Water Requirements

ETo station: ranebennur | Crop: MAIZE (Grain)

Rain station: ranebennur | Planting date: 05/09

Month	Decade	Stage	Kc	ETc	ETc	Eff rain	Irr. Req.
			coeff	mm/day	mm/dec	mm/dec	mm/dec
Sep	1	Init	0.30	1.03	6.2	14.8	0.0
Sep	2	Init	0.30	1.02	10.2	26.0	0.0
Sep	3	Deve	0.35	1.23	12.3	25.0	0.0
Oct	1	Deve	0.57	2.08	20.8	24.7	0.0
Oct	2	Deve	0.81	3.04	30.4	24.4	6.1
Oct	3	Mid	1.05	3.91	43.0	20.1	22.9
Nov	1	Mid	1.13	4.16	41.6	15.4	26.2
Nov	2	Mid	1.13	4.11	41.1	11.5	29.6
Nov	3	Mid	1.13	4.04	40.4	8.2	32.3
Dec	1	Late	1.12	3.94	39.4	4.0	35.4
Dec	2	Late	0.94	3.22	32.2	0.2	32.0
Dec	3	Late	0.66	2.34	25.8	0.2	25.6
Jan	1	Late	0.43	1.55	10.9	0.3	10.4
					354.4	174.6	220.5



Crop Water Requirements

ETo station: ranebennur | Crop: MAIZE (Grain)

Rain station: ranebennur | Planting date: 05/06

Month	Decade	Stage	Kc	ETc	ETc	Eff rain	Irr. Req.
			coeff	mm/day	mm/dec	mm/dec	mm/dec
Jun	1	Init	0.30	1.37	8.2	12.3	0.0
Jun	2	Init	0.30	1.23	12.3	20.7	0.0
Jun	3	Deve	0.35	1.35	13.5	21.8	0.0
Jul	1	Deve	0.56	2.04	20.4	23.5	0.0
Jul	2	Deve	0.79	2.68	26.8	24.8	2.0
Jul	3	Mid	1.02	3.50	38.5	23.8	14.7
Aug	1	Mid	1.09	3.79	37.9	22.1	15.8
Aug	2	Mid	1.09	3.82	38.2	21.1	17.2
Aug	3	Mid	1.09	3.79	41.6	22.5	19.2
Sep	1	Late	1.08	3.70	37.0	24.6	12.4
Sep	2	Late	0.88	2.99	29.9	26.0	4.0
Sep	3	Late	0.63	2.23	22.3	25.0	0.0
Oct	1	Late	0.42	1.54	10.8	17.3	0.0
					337.5	285.5	85.1

The above Table 4.5 shows the crop water requirement of maize in the Rabi season. In initial stage maize has sufficient effective rainfall to compensate crop water requirement. During the III decade of November first decade of December of development stage during the II decade of December and during middle and late stage, effective rainfall is less to compensate crop water requirement so, it requires irrigation.

In the Kharif season, during the initial and development stage during III decade of July first decade of August in the middle season sufficient effective rainfall to compensate crop water requirement and in II ,III decade of August in the middle stage and during the first ,II decade of September in late stage available effective rainfall is less to compensate crop water requirement so, it requires irrigation but in III decade of September and I decade of October in late season the maize has sufficient effective rainfall to compensate crop water requirement.

Table 4.6 : Crop Water Requirement of Sugarcane

Crop Water Requirements

ETo station: ranebennur | Crop: Sugarcane (Ratoon)
Rain station: ranebennur | Planting date: 05/07

Month	Decade	Stage	Kc	ETc	ETc	Eff rain	Irr. Req.
			coeff	mm/day	mm/dec	mm/dec	mm/dec
Jul	1	Init	0.70	2.54	15.3	14.1	0.0
Jul	2	Init	0.40	1.36	13.6	24.8	0.0
Jul	3	Init	0.40	1.38	15.2	23.8	0.0
Aug	1	Deve	0.44	1.52	15.2	22.1	0.0
Aug	2	Deve	0.56	1.98	19.8	21.1	0.0
Aug	3	Deve	0.70	2.44	26.8	22.5	4.4
Sep	1	Deve	0.84	2.89	28.9	24.6	4.3
Sep	2	Deve	0.97	3.30	33.0	26.0	7.1
Sep	3	Deve	1.10	3.88	38.8	25.0	13.8
Oct	1	Mid	1.19	4.32	43.2	24.7	18.5
Oct	2	Mid	1.19	4.46	44.6	24.4	20.2
Oct	3	Mid	1.19	4.41	48.5	20.1	28.4
Nov	1	Mid	1.19	4.37	43.7	15.4	28.3
Nov	2	Mid	1.19	4.32	43.2	11.5	31.7
Nov	3	Mid	1.19	4.24	42.4	8.2	34.3
Dec	1	Mid	1.19	4.17	41.7	4.0	37.6
Dec	2	Mid	1.19	4.09	40.9	0.2	40.7
Dec	3	Mid	1.19	4.20	46.2	0.2	46.0
Jan	1	Mid	1.19	4.31	43.1	0.5	42.7
Jan	2	Mid	1.19	4.42	44.2	0.0	44.2
Jan	3	Mid	1.19	4.67	51.4	0.0	51.3
Feb	1	Mid	1.19	4.91	49.1	0.0	49.1
Feb	1	Mid	1.19	4.91	49.1	0.0	49.1
Feb	2	Mid	1.19	5.16	51.6	0.0	51.6
Feb	3	Mid	1.19	5.37	43.0	0.2	42.8
Mar	1	Mid	1.19	5.58	55.8	0.7	55.1
Mar	2	Mid	1.19	5.80	58.0	1.0	56.9
Mar	3	Mid	1.19	6.07	66.7	4.9	61.8
Apr	1	Late	1.16	6.18	61.8	9.4	52.4
Apr	2	Late	1.11	6.15	61.5	13.0	48.5
Apr	3	Late	1.05	5.83	58.3	15.3	43.0
May	1	Late	1.00	5.58	55.8	18.1	37.7
May	2	Late	0.95	5.30	53.0	20.8	32.1
May	3	Late	0.89	4.55	50.1	20.9	29.2
Jun	1	Late	0.84	3.83	38.3	20.5	17.9
Jun	2	Late	0.79	3.24	32.4	20.7	11.6
Jun	3	Late	0.73	2.85	28.5	21.8	6.6
Jul	1	Late	0.70	2.54	10.2	9.4	0.0
					1513.6	489.9	1049.9

The above Table 4.6 shows the crop water requirement of sugarcane, as the crop is perennial during the, first decade of November in the initial stage the sugarcane has sufficient effective rainfall to meet irrigation requirement but in III decade of November in initial stage available effective rainfall is less, to meet irrigation requirement. During the development stage, available effective rainfall is not sufficient it needs more irrigation. From first decade of February to first decade of June in middle irrigation is required due to effective rainfall is less. From II decade of June to III decade of July in middle stage the effective rainfall is sufficient for irrigation requirement. During the first decade of August first decade of November in late stage effective rainfall is enough to irrigation requirement.

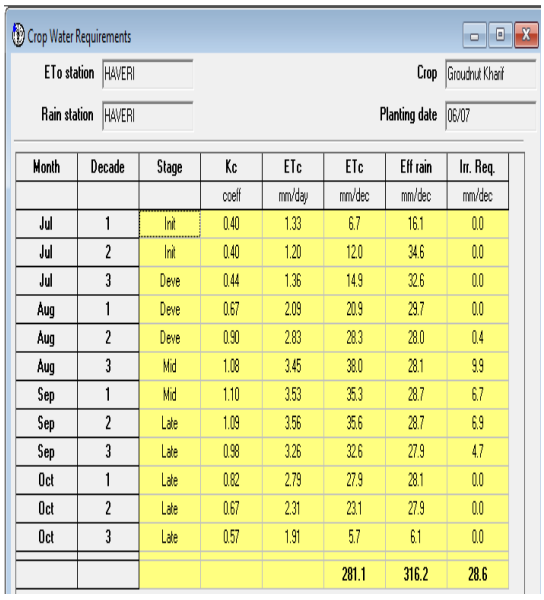
Table 4.7 : Crop water Requirement, Effective Rainfall, Irrigation Requirement.

Sl.No	Crops	Season	Crop Water Requirement (mm)	Effective Rainfall (mm)	Irrigation Requirement (mm)
1	Cotton	Rabi	684.6	122.3	584.4
		Kharif	576.3	320.0	296.7
2	Maize	Rabi	354.4	174.6	220.5
		Kharif	337.5	285.5	85.1
3	Sugarcane	Perennial	1513.6	489.9	1049.9

Table 4.7 shows the season wise crop water requirement, effective rainfall and irrigation requirement for each of the crop in Ranebennur taluka of Haveri dist.

4.3. Crop Water Requirement, Effective rainfall and Irrigation Requirement (Haveri Taluk)

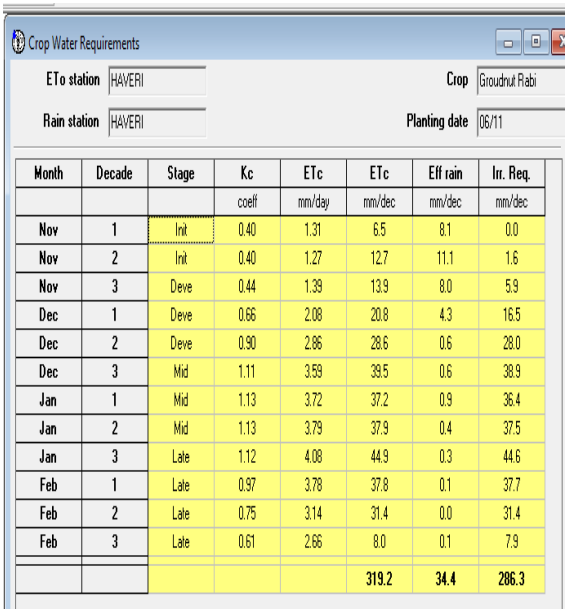
Table 4.8 : Crop Water Requirement of Groundnut in Rabi season


Crop Water Requirements

ETo station: HAVERI — Crop: Groudnut Kharif

Rain station: HAVERI — Planting date: 06/07

Month	Decade	Stage	Kc	ETc	ETc	Eff rain	Irr. Req.
			coeff	mm/day	mm/dec	mm/dec	mm/dec
Jul	1	Init	0.40	1.33	6.7	16.1	0.0
Jul	2	Init	0.40	1.20	12.0	34.6	0.0
Jul	3	Deve	0.44	1.36	14.9	32.6	0.0
Aug	1	Deve	0.67	2.09	20.9	29.7	0.0
Aug	2	Deve	0.90	2.83	28.3	28.0	0.4
Aug	3	Mid	1.08	3.45	38.0	28.1	9.9
Sep	1	Mid	1.10	3.53	35.3	28.7	6.7
Sep	2	Late	1.09	3.56	35.6	28.7	6.9
Sep	3	Late	0.98	3.26	32.6	27.9	4.7
Oct	1	Late	0.82	2.79	27.9	28.1	0.0
Oct	2	Late	0.67	2.31	23.1	27.9	0.0
Oct	3	Late	0.57	1.91	5.7	6.1	0.0
					281.1	316.2	28.6


Crop Water Requirements

ETo station: HAVERI — Crop: Groudnut Rabi

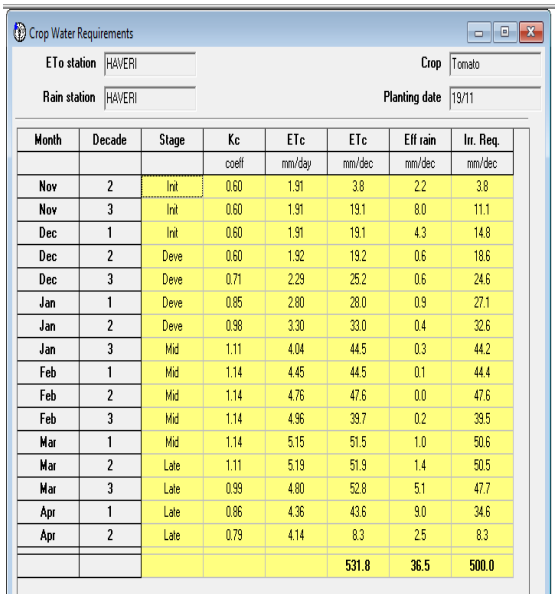
Rain station: HAVERI — Planting date: 06/11

Month	Decade	Stage	Kc	ETc	ETc	Eff rain	Irr. Req.
			coeff	mm/day	mm/dec	mm/dec	mm/dec
Nov	1	Init	0.40	1.31	6.5	8.1	0.0
Nov	2	Init	0.40	1.27	12.7	11.1	1.6
Nov	3	Deve	0.44	1.39	13.9	8.0	5.9
Dec	1	Deve	0.66	2.08	20.8	4.3	16.5
Dec	2	Deve	0.90	2.86	28.6	0.6	28.0
Dec	3	Mid	1.11	3.59	39.5	0.6	38.9
Jan	1	Mid	1.13	3.72	37.2	0.9	36.4
Jan	2	Mid	1.13	3.79	37.9	0.4	37.5
Jan	3	Late	1.12	4.08	44.9	0.3	44.6
Feb	1	Late	0.97	3.78	37.8	0.1	37.7
Feb	2	Late	0.75	3.14	31.4	0.0	31.4
Feb	3	Late	0.61	2.66	8.0	0.1	7.9
					319.2	34.4	286.3

The above Table 4.8 shows the crop water requirement of Ground nut in the Rabi season. In first decade of initial stage the crop has sufficient effective rainfall to compensate crop water requirement. During II decade of Initial stage and the III decade of November and first decade and II decade of December of development stage and during the III decade of December during middle and late stage effective rainfall is less to compensate crop water requirement, hence it requires irrigation.

In the Kharif season during the Initial and III decade (July) and first decade (August) of development stage the crop has sufficient effective rainfall. During II decade of August in middle stage and II and III decade of September of late stage and also during first, II, III decade of October in the late stage available effective rainfall is sufficient to compensate crop water requirement.

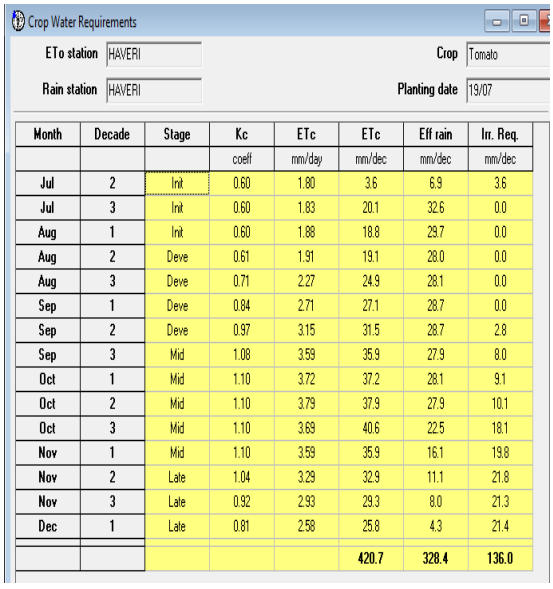
Table 4.9 : Crop water requirement of Tomato in Rabi season



Crop Water Requirements

ETo station: HAVERI | Crop: Tomato | Rain station: HAVERI | Planting date: 19/11

Month	Decade	Stage	Kc	ETc	ETc	Eff rain	Irr. Req.
			coeff	mm/day	mm/dec	mm/dec	mm/dec
Nov	2	Init	0.60	1.91	3.8	2.2	3.8
Nov	3	Init	0.60	1.91	19.1	8.0	11.1
Dec	1	Init	0.60	1.91	19.1	4.3	14.8
Dec	2	Deve	0.60	1.92	19.2	0.6	18.6
Dec	3	Deve	0.71	2.29	25.2	0.6	24.6
Jan	1	Deve	0.85	2.80	28.0	0.9	27.1
Jan	2	Deve	0.98	3.30	33.0	0.4	32.6
Jan	3	Mid	1.11	4.04	44.5	0.3	44.2
Feb	1	Mid	1.14	4.45	44.5	0.1	44.4
Feb	2	Mid	1.14	4.76	47.6	0.0	47.6
Feb	3	Mid	1.14	4.96	39.7	0.2	39.5
Mar	1	Mid	1.14	5.15	51.5	1.0	50.6
Mar	2	Late	1.11	5.19	51.9	1.4	50.5
Mar	3	Late	0.99	4.80	52.8	5.1	47.7
Apr	1	Late	0.86	4.36	43.6	9.0	34.6
Apr	2	Late	0.79	4.14	8.3	2.5	8.3
					531.8	36.5	500.0



Crop Water Requirements

ETo station: HAVERI | Crop: Tomato | Rain station: HAVERI | Planting date: 19/07

Month	Decade	Stage	Kc	ETc	ETc	Eff rain	Irr. Req.
			coeff	mm/day	mm/dec	mm/dec	mm/dec
Jul	2	Init	0.60	1.80	3.6	6.9	3.6
Jul	3	Init	0.60	1.83	20.1	32.6	0.0
Aug	1	Init	0.60	1.88	18.8	29.7	0.0
Aug	2	Deve	0.61	1.91	19.1	28.0	0.0
Aug	3	Deve	0.71	2.27	24.9	28.1	0.0
Sep	1	Deve	0.84	2.71	27.1	28.7	0.0
Sep	2	Deve	0.97	3.15	31.5	28.7	2.8
Sep	3	Mid	1.08	3.59	35.9	27.9	8.0
Oct	1	Mid	1.10	3.72	37.2	28.1	9.1
Oct	2	Mid	1.10	3.79	37.9	27.9	10.1
Oct	3	Mid	1.10	3.69	40.6	22.5	18.1
Nov	1	Mid	1.10	3.59	35.9	16.1	19.8
Nov	2	Late	1.04	3.29	32.9	11.1	21.8
Nov	3	Late	0.92	2.93	29.3	8.0	21.3
Dec	1	Late	0.81	2.58	25.8	4.3	21.4
					420.7	328.4	136.0

The above Table 4.9 shows the crop water requirement of Tomato in the Rabi season. During the Initial stage, development stage, middle and late stage effective rainfall is less to meet irrigation requirement

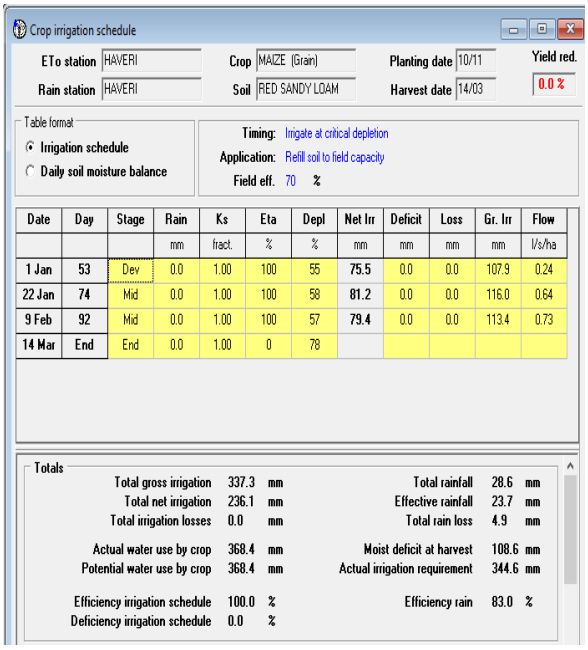
In the Kharif season during the II decade of July of Initial stage effective rainfall is which requires irrigation. III decade of July and first, II and III decade of August, first decade of September in development stage the crop gets sufficient effective rainfall which does not require extra irrigation. During II decade of September, middle and late stage, effective rainfall is less which requires extra irrigation.

Table 4.10 : Crop water Requirement, Effective Rainfall, Irrigation Requirement.

Sl.No	Crops	Season	Crop Water Requirement (mm)	Effective Rainfall (mm)	Irrigation Requirement (mm)
1	Maize	Rabi	343.70	29.60	584.40
		Kharif	312.80	363.10	37.40
2	Groundnut	Rabi	319.20	34.40	286.30
		Kharif	281.10	316.20	28.60
		Karif	420.70	328.40	136.00
3	Tomato	Rabi	531.80	36.50	500.00

Table 4.10 shows the season wise crop water requirement, effective rainfall and irrigation requirement for crops in Haveri taluka of Haveri dist.

5. IRRIGATION SCHEDULINGTable 5.1: Irrigation scheduling of Cotton in Rabi season



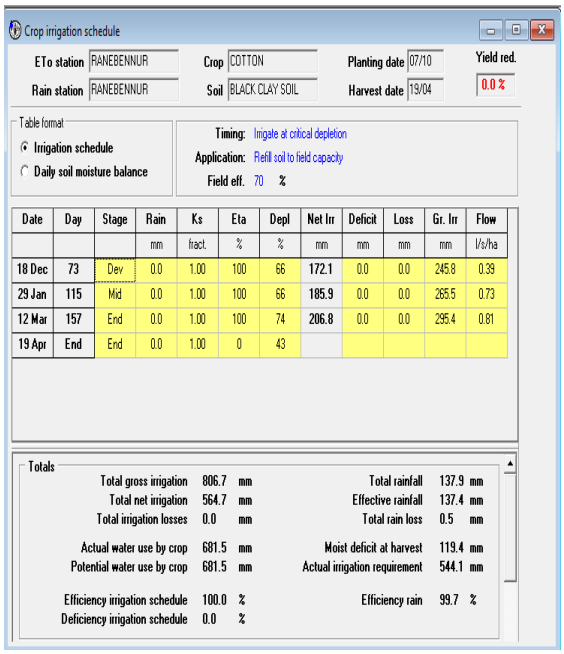


Table 5.2 : Irrigation scheduling of cotton, maize and sugarcane for Ranebennur Taluk

Crops	Sugar Cane		Cotton					Maize			
Season	Perinal		Karif		Rabi			Karif		Rabi	
Stage	M	E	M	E	D	M	E	M	E	M	E
Net irrigation	200.8	-	183.0	-	171.2	185.9	-	111.7	-	113.6	-
Gross Irrigation	286.8	-	261.4	-	245.8	265.5	-	159.6	-	162.2	-
Flow (Ltrs/sec/ Hact.)	0.90	-	0.23	-	0.39	0.73	-	0.23	-	0.26	-

Table 5.3: Irrigation scheduling of Groundnut and Tomato for Haveri Taluk

Crops	Maize			Ground nut						Tomato					
Season	Rabi			Karif		Rabi				Khari		Rabi			
Stage	D	M	E	I	E	I	D	M	E	M	E	I	D	M	E
Net irrigation	75.5	79.4	-	32.2	-	32.2	60.6	75.0	78.5	57.1	-	24.3	47.0	60.5	62.3
Gross Irrigation	107.9	113.4	-	46.0	-	46.0	86.5	107.1	112.2	81.6	-	34.7	67.2	86.5	89.0
Flow (L/S/Ha)	0.24	0.73	-	5.33	-	5.33	0.29	0.62	0.65	0.08	-	0.27	0.49	0.83	0.79

I- Initial stage, D- Development stage, M- Mid stage, E- End stage

The above Table 5.2 to 5.3 shows the irrigation scheduling of different crops of Ranebennur and Haveri taluka of Haveri District which gives the guide lines for irrigation managers and stake holders in in the command area of Tungabhadra River project

VIII. CONCLUSION

Ranebennur Taluka

Cotton (Kharif and Rabi)**:** In the Kharif season effective rain fall is enough to compensate the crop water requirement to meet irrigation required and in the Rabi season, available effective rainfall is less which requires irrigation and from irrigation scheduling the it requires flow in Rabi season during the development and mid stage, but during the end stage it does not requires any flow

Sugarcane (Perennial) first decade of November in the initial stage the crop gets sufficient effective rainfall to meet its irrigation requirement. In III decade of November in initial stage available effective rainfall is less hence it requires irrigation. During the development stage effective rainfall is not sufficient to meet irrigation. From first decade of February to first decade of June in middle season irrigation is required due to effective rainfall is less to compensate crop water requirement and from II decade of June to III decade of July in middle stage the sugarcane has sufficient effective rainfall to meet the irrigation requirement. During the first decade of August first decade of November in late stage effective rainfall is enough to meet irrigation requirement.

Table 4.7 shows the season wise crop water requirement, effective rainfall and irrigation requirement for each of the crop and Table 5.2 shows the irrigation scheduling of different crops of Ranebennur of Haveri District

Haveri Taluka

Maize (Kharif and Rabi): In the Kharif season effective rain fall is enough to meet irrigation required. Rabi season, effective rainfall is less compensate water irrigation. From irrigation scheduling the maize in Rabi season during the development and mid stage it requires flow but during the end stage it does not requires any flow.

Groundnut (Kharif and Rabi): In the Kharif season effective rain fall is less hence, additional irrigation required. From irrigation scheduling in Kharif season during the initial stage it requires flow but during the end stage it does not requires any flow.

In the Rabi season also effective rain fall is less to meet irrigation requirement. From irrigation scheduling the maize in Rabi season during the initial, development, mid stage it requires flow but during the end stage it does not requires any flow.

Tomato: In the Kharif season available effective rain fall is less hence, additional irrigation is required. From irrigation scheduling the Tomato in Kharif season during the mid stage it requires flow but during the end stage it does not requires any flow.

In the Rabi season effective rain fall is less hence, additional irrigation required. From irrigation scheduling the Tomato in Rabi season during the initial, development, mid stage and it requires flow but during the end stage it does not requires any flow.

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Experimental study of a Gate Valve for Improvement in its Hydraulic Efficiency in Laboratory Channels

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ABSTRACT

The principle types of valves are classified based on operation of the movable valve element. In conventional gate valve, the valve element descends perpendicularly across the flow stream as the valve is closed. The resistance of various types of valves depends upon valve geometry, surface resistance of valve material, position of valve element, direction of flow and Reynolds number. The main pressure drop is obtained when valve is in fully opened position and the resistance of the valve will increase as the valve is closed.

Depending upon the pressure difference, discharge and Reynold's numberfor a 12.70mm,19.05mm and 25.40mm valve is studied experimentally for partial openings and valve is compared with the full valve opening. The research paper is aimed to understand the hydraulic performance of the gate valve normally used in the hydraulics laboratory. The experiments are conducted on check valves and sector valves. The hydraulic characteristics are studied with various angles of openings; corresponding pressure drops are obtained for various flow rates and compared with theoretical values.

Keywords: Valve, Pressure, Flow, Gate, Losses, Pipe, Size, Reynold, Laboratory

I. INTRODUCTION

Recently, the industry fields have been using variety of the control valves for effective control of a flow rate. Valve is a fluid device for the control of the fluid characteristics such as flow rate, direction, pressure and temperature [1]. It basically performs four functions such as on-off, throttling, non-return and overpressure. In general, a variety of control valves such as the butterfly valve, the ball valve, the globe valve and the gate valve are used.

A **gate valve**, also known as a **sluice valve**, is a valve that opens by lifting a round or rectangular gate/wedge out of the path of the fluid. The distinct feature of a gate valve is the sealing surfaces between the gate and seats are planar, so gatevalves are often used when a straight-line flow of fluid and minimum restriction is desired[2]. The gate faces can form a wedge shape or they can be parallel. Because of their ability to cut through liquids, gate valves are often used in the petroleum industry. On opening the gate valve, the flow path is enlarged in a highly nonlinear manner with respect to percent of opening. This means that flow rate does not change evenly with stem travel. Also, a partially open gate disk tends to vibrate from the fluid flow. Most of the flow change occurs near shutoff with a relatively high fluid velocitycausing disk and seat wear and eventual

leakage if used to regulate flow. Typical gate valves are designed to be fully opened or closed. When fully open, the typical gate valve has no obstruction in the flow path, resulting in very low friction loss.Gate valves are operated entirely by the obstruction of circular area operated by a movable valve element. The Gate valve utilizes a flap/disc of same diameter as bore of the pipe, which angles down to obstruct the flow. Any reverse in the flow due to the obstruction will cause it to slam against the seat and stop the flow going back. In general, the minimum pressure drop is obtained in the valve design which allows the flow to pass unobstructed when the valve is in fully open position. There is a significant uncertainty in the resistance of valves because of wide variety of valve design, lack of geometrical similarity within various sizes and paucity of data which taken into account the downstream influence of the valve. The resistance of a valve will increase as the valve is closed.

The Gate valves are normally used in the hydraulics laboratory to control the flow rate in pipes and pumping systems[5]. A predetermined partial opening of the valve is required for control purposes, in order to have good control characteristics of the Gate valve. The objective of the experiment is to understand static performance of existing gate valves in the laboratory and suggest improvement for their hydraulic performance.

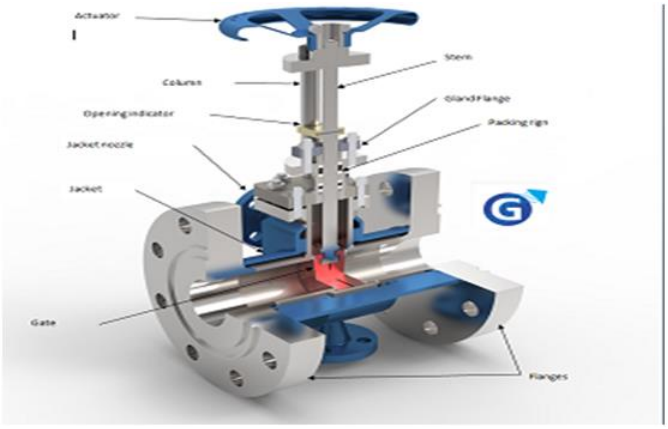


Fig.1: A Typical Gate Valve

II. THEORY

Head lossesin gate valves [3,4,6], in addition to minor losses are encountered in laboratory channels. The pressure drop in gate valves are mainly due to eddy formation generated in the fluid at the fitting. In the case of long pipelines of several kilometres, these local losses may be negligible, but for short pipelines they may be greater than the straight pipe frictional losses

2.1 REYNOLD'S NUMBER

The Reynolds number is defined as the ratio of momentum forces to viscous forces and consequently quantifies the relative importance of these two types of forces for given flow conditions. Reynolds numbers frequently arise when performing scaling of fluid dynamics problems, and as such can be used to determine dynamic similitude between two different cases of fluid flow. They are also used to characterize different flow regimes within a similar fluid, such as laminar and turbulent flow:

$$Re = \frac{V \times D}{0.00903}$$

where V=flow velocity in cm/s;
D=dia of the pipe in cm

III. METHODOLOGY

The experimental study is planned at the Hydraulics Laboratory[7] A pump of 1.5 HP with a recirculating arrangement is installed with a 5" manifold at the entry of the pipe. The pipe lines of 1", ¾' and ½" diameter, made of Galvanized Iron are connected with a flow meter, pressure gauges and control valve as shown in the schematic diagram below.

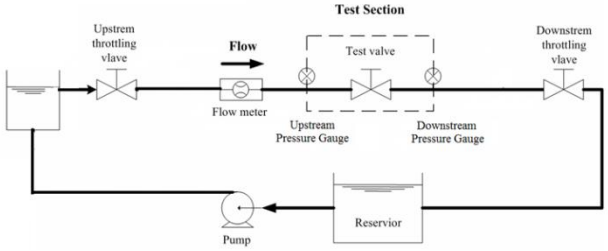


Fig: 3 Schematic Experimental Setup

Fig:3.1 Experimental Setup at SET-JU

The temperature of water is recorded at the beginning and end of each set of experiments. A total of 3 sizes (25.4mm, 19.05mm and 12.7mm) are tested at various flow rates and line pressures. Water is allowed to pass through the experimental setup shown above, at various positions of the valve and their corresponding pressure difference across the valve and discharge values are noted down.The Reynolds Number based on the diameter and mean velocity of flow is obtained for all the readings.

IV. DATA ANALYSIS

The experimental data is collected for all the three different size valves for various discharges and configuration.

TABLE:1 Variation of Pressure Drop of Gate Valve (Size 1.27cm) with Flow rate and Pipe Diameter

Re	Δp(bar) (1.27cm)	Re	Δp(bar) (1.905cm)	Re	Δp(bar) (2.54cm)
4137.57	1.25	4236.37	1.25	11008.19	1.325
8758.52	1.2	17821.04	1.1	16215.87	1.25
11538.68	1.05	23685.38	0.9	24740.3	1.1
17646.24	0.8	30001.18	0.65	32000.05	0.9
20000.79	0.65	35295.51	0.35	36925	0.7
21428.11	0.55	39999.29	0.15	40676.48	0.5
22641.11	0.45	41862.11	0	43634.49	0.4

TABLE:2 Variation of Pressure Drop of Gate Valve (Size 1.905cm) with Flow rate and Pipe Diameter

Re	Δp(bar) (1.27cm)	Re	Δp(bar) (1.905cm)	Re	Δp(bar) (2.54cm)
2693.52	1.25	3075.82	1.35	3769.72	1.35
4266.77	1.15	6153.91	1.2	5861.3	1.25
5441.77	1	8247.02	1.1	10257.28	1.1
7619.39	0.8	10390.29	1	12850.48	1
8743.32	0.7	13559.59	0.7	15920.98	0.8
9524.62	0.5	15383.64	0.45	18079.45	0.6
10667.7	0.3	16667.32	0.25	20125.43	0.35

TABLE:3 Variation of Pressure Drop of Gate Valve (Size 2.54cm) with Flow rate and Pipe Diameter

Re	Δp(bar) (1.27cm)	Re	Δp(bar) (1.905cm)	Re	Δp(bar) (2.54cm)
2225.35	1.3	3363.1	1.2	7153.34	1
2546.08	1.2	4897.59	1.1	7803.92	0.9
3414.02	1.1	6087.79	0.9	8968.28	0.8
4766.87	0.7	8046.37	0.6	9536.78	0.7
5270	0.6	8835.28	0.3	10014.07	0.5
6391.8	0.3	9195.53	0.2	10357.6	0.4
6828.05	0.15	10014.07	0.1	11552.36	0.25

TABLE:4 Variation of Pressure Drop of Gate Valve (Size 1.905cm) with Flow rate and Pipe Diameter 1.27cm

DISCHARGE IN CM3/SEC	Δp (bar)
76	1.15
163	0.7
178	0.5
231	0.1

TABLE:5 Variation of Pressure Drop of Gate Valve (Size 2.54cm) with Flow rate and Pipe Diameter 1.907cm

DISCHARGE IN CM3/SEC	ΔP (bar)
76	1.2
104	1.1
132	0.9
172	0.6
202	0.2
227	0.1

TABLE:6 Variation of Pressure Drop of Gate Valve (Size 2.54cm) with Flow rate and Pipe Diameter 2.54cm

DISCHARGE IN CM3/SEC	ΔP (bar)
81	1.2
170	0.4
200	0.15

V. DISUSSION OF RESULTS (GRAPHS)

Fig.4 Variation of pressure drop (bar) with flow rate observed when 1.905cm valve connected to 1.27cm pipe

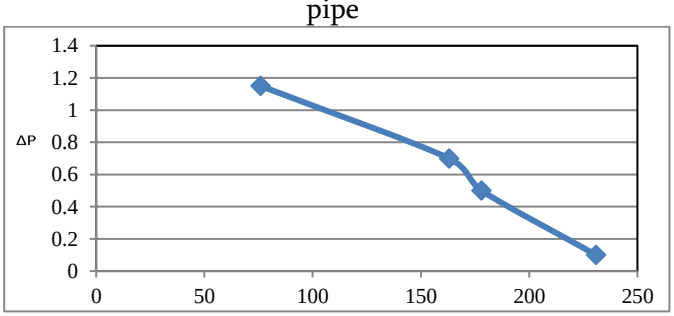


Fig.5 Variation of pressure drop (bar) with flow rate observed when 2.54cm valve connected to 1.905cm pipe

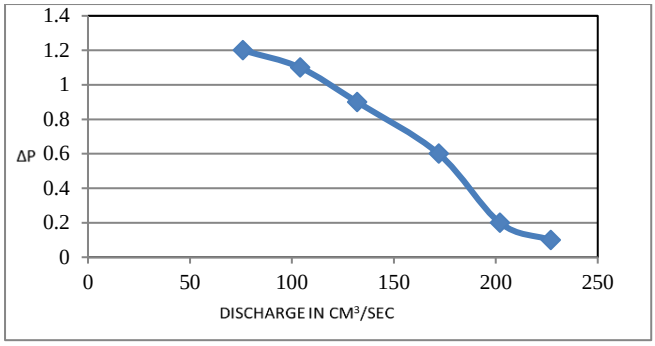
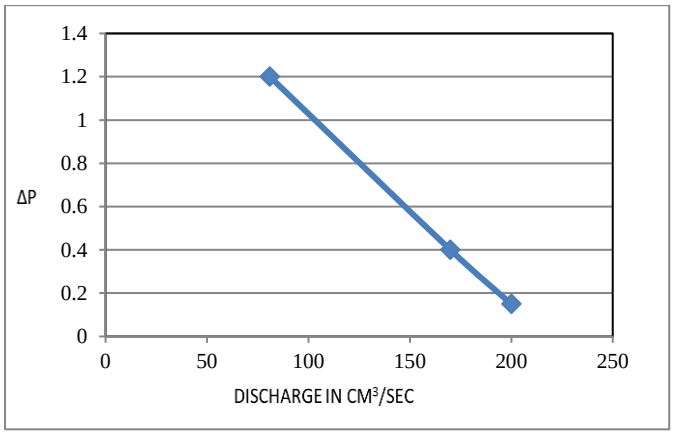


Fig.6 Variation of pressure drop (bar) with flow rate observed when 2.54cm valve connected to 2.54cm pipe



From the above graphs i.e. the discharge v/s pressure difference for the uniform discharge. The 1.905cm valve is performing better for the 1.27cm pipe because as we can observe from the graph the pressure drop is less compare to other diameter pipes. Similarly 2.54cm valve is performing better for the 1.907cm pipe as well as for the 2.54cm pipe.

VI. CONCLUSION

- The characteristics of Gate Valves are understood in laboratory conditions (Fig.4,5, and Fig.6) with different combination of gate valve sizes with difeferent pipe lines.
- The 1.907cm valve is performing better for the 1.27cm pipe with the better accuracy and less pressure drop.
- Similarly 2.54cm valve is performing better for the 1.907cm pipe as well as for the 2.54cm pipe with a better accuracy and less pressure drop.
- It is recommended to use 1.907 Gate valve with 1.27cm pipe and 2.54cm gate valve with 2.54cm for attaining higher hydraulic efficiencies in the laboratory

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Investigation on Various Land-Use Factors that Influence Trip Attraction

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ABSTRACT

Transportation planning plays a major role in upgrading the transportation system, which includes identifying the travel demand and implementing plans accordingly. Travel demand models are used for forecasting the response to transportation demand of changes both in the attributes of the transportation system and the people using the transportation system. More specifically, travel demand models are used to predict travel characteristics and usage of transport services under alternative socio-economic scenarios and land-use configurations. The very first step in traditional travel demand modeling is the trip generation which is classified into trip production and trip attraction. Among this, it is important to find out trip attraction rate as infrastructure development, activity center, and settlement causes disturbance to the smoothness of traffic and safety. The trip attraction modeling capture influence of land use factors like accessibility, land use mix, number of employees, floor area, type of commodity sold, distance from residence, etc on trip attraction. Urban centers play a pivotal role in attracting various trips. As the trip attraction rate increases, it results in urban transportation problems which can be rectified with the help of the trip attraction model. The present paper aims to investigate the trip attraction rates for the different regions and developing countries and the methodology adopted by researchers to develop trip attraction models.

Keywords: Trip Attraction, Socio-Economic, Travel Demand, Land Use Factors, Regression Analysis

I. INTRODUCTION

Transportation plays a vital role in the growth and economy of a nation. Due to the fast-growing population and travel development for a country like India, there should be an efficient transportation system and infrastructure. So for the design of transportation facilities and services, transportation planning is a very essential process that relies on travel demand forecasting. Planning is highly related to demand modeling. Travel demand modeling had trip-based four-step modeling as its pioneer, which was developed in the late 1950s. That period was characterized by a rapid increase in car use followed by major investments in new road infrastructure. To assess the impact of these investments, models that could be used to predict travel demand, in the long run, where needed. This resulted in the development of trip-based models, which predicted traffic flows between traffic zones, i.e. aggregate models. These models are also known as four-stage models. The travel was assumed to be the result of four subsequent decisions, i.e. trip generation, trip distribution, mode choice, and route choice. Trip generation is the first step in travel demand forecasting which is classified into trip production and trip attraction. Trip

production is defined as the number of trips produced by households in the trip analysis zone whereas trip attraction aims at predicting the total number of trips attracted to each zone of the study area.

Trip attraction modeling plays a pivotal role in the planning area. Several studies carried out found that trip attraction has shown a strong correlation with the land use types and its activities such as land use distribution, floor area, number of employees, number of shops, number of schools, and school enrollment rates, number of employees in the commercial node, number of offices in the commercial node, number of employment opportunities, number of stores in the shopping centers, the volume of retail sale, number of parking lots and land use parameters like accessibility and entropy. Land use parameter like accessibility refers to a measure of the ease of reaching and interacting with destinations or activities distributed in space around a city or count associated with a place of origin. A place with high accessibility is one from which many destinations can be reached, or destinations can be reached with relative ease in this case trip attraction rate increases. Whereas trip attraction rate decreases with low accessibility which implies that relatively few destinations can be reached for a given amount of time, effort, cost or that reaching destinations is more difficult or costly from that place.

Land use mix is the other factor affecting trip attraction which enables a range of land uses including residential, commercial, industrial, and institutional to be co-located in an integrated way that promotes sustainable forms of transport such as public transport, walking, and cycling, and increases neighborhood amenity. Mixed land use developments can improve the economic vitality and perceived security of an area by rising the number of people on the street and in public spaces. The need for greater land use mix, and in particular the closer integration of residential development with commercial, civic, and recreational uses, has been adopted as the conventional wisdom among urban planners as well as public health professionals. The benefits of mixed-land use include promoting active travel, increasing the viability of transportation alternatives, reducing private vehicle use and its associated impacts, raising property values, and helping to build a sense of place for local communities where trip attraction rate increases in different zones of a city. As a result of deviation in the above factors, urban centers are developing at a rapid pace and consequently, the majority of infrastructure projects may increase the number of trips attracted which causes transportation problems and traffic impacts. Formulating a trip attraction model helps in foreseeing the number of trips attracted to the study area.

A. Objectives

- To identify the various land-use factors that influence trip attraction
- To find the relationship between various land use factors and the rate of trip attraction.

II. METHODS AND MATERIALS

Different journals have huge information regarding the subject which is mandatory that helps in gaining a clear idea about trip attraction modeling, surveys, variables considered, how sampling can be done, how the analysis of the obtained data can be done, etc. Study area delineation is one of the most important tasks. The study area has been fixed based on the simple criteria that it should be easily accessible. Based on the data obtained from the secondary survey on the population and the total dwelling units in the premises of the CBD area, the study area has been finalized and after this sampling is done. The main problem in every survey is that the survey can't carry out for the whole study area due to limitations of funds as well as human power. Due to this problem, the alternative way is to go for sampling. Sampling enables us to collect and analyze data for a smaller portion of the population (sample) which must be representative of the entire population and then apply

the results to the whole population. It permits us to conclude very complex situations. Adequate care needs to be taken when selecting the sample because if the sample is not representative, the results being applied to the entire population will be misleading. The sample should be collected randomly. Next is the most important part which is the data collection. It can be done by the survey which is classified into two, secondary survey and primary survey. Here establishment survey is considered to be the Primary survey. Before the primary survey, it was essential to create a questionnaire form to collect the necessary details from the establishments which are done by interview survey using face to face technique. This questionnaire includes data set such as number of employees, floor area of establishment, number of offices in the commercial node, number of stores in the shopping centers, the volume of retail sale, number of parking lots, and land use parameters like accessibility and entropy. After the data collection, the next important step is the preliminary analysis which is carried out using Microsoft excel or with the help of the Statistical Package for Social Science (SPSS). This helps to give initial information regarding the obtained data that can be found out. Modeling is done after preliminary analysis. The main objective is to create a model with the help of data obtained from the survey. The studies use regression analysis to identify various land-use factors that influence trip attraction and to develop the trip attraction model.

III. TRIP BASED MODELS

Trip-based travel models have evolved over many decades. As their name suggests, trip-based models use the person trip as the fundamental unit of analysis. Trip-based models are widely used in practice to support regional, sub-regional, and project-level transportation analysis and decision making. Trip-based models are often referred to as “4-step” models because they commonly include four primary components. The first trip generation components estimate the numbers of trips produced by and attracted to each zone (these zones collectively represent the geography of the modeled area). The second trip distribution step connects where trips are produced and where they are attracted to. The third mode choice step determines the travel mode, such as automobile or transit, used for each trip, while the fourth assignment step predicts the specific network facilities or routes used for each trip.

IV.RELATIONSHIP BETWEEN VARIOUS LAND USE FACTORS AND TRIP ATTRACTION

B Yulianto, Setiono, Sugiyarto, S Purnomo, and R A Prasetyo (2020) studied to determine standard trip attraction models of various land uses including hotels and minimarkets in Surakarta City. The magnitude of traffic impact that occurs due to the building construction is influenced by the amount of trip generation and attraction made by the building activities. Modeling analysis requires data such as vehicle volume in and out of land use and land use parameter such as the number of rooms for hotels and size of building floor area for minimarket. The result showed that regression trip attraction models of 3-star hotels, 4 and 5-star hotels, and minimarket are valid models that give linear regression equations with a sufficient coefficient of correlation and coefficient of determination. For calculating values of land use trip attraction for consultants who conduct traffic impacts analysis the obtained trip attraction can be used.

Y Basuki, S Rahayu, and N W Rahmawati (2020) developed a trip attraction model in small scale commercial and service areas in road corridor in Sukun Road, Banyumanik, Semarang City. The trip attraction model in this was carried out using multiple linear regression with the backward method. Variables considered were number of visitors attracted by outlet, number of store employees, Area of the shop floor, Storehouse parking area, sales

income which were collected through interviews with store managers on outlets commercial and services. The result showed that the travel attraction in the small-scale trading area and services is influenced by socio-economic character, namely sales income in the total attraction of the visitor's car and motorbike and store areas, parking areas, sales income. This model can be used as input in planning and structuring trade areas and small-scale service to anticipate transportation problems because they contribute to the flow of traffic.

The changes in land use had a pivotal role to change trip attraction in terms of the number and characteristics of the visitor of the Cinde Traditional Market area. Variation in trip attraction before and after construction processes of the market area was studied by Marice Agustini, Erika Buchari, and Melawaty Agustien (2019). The questionnaire method was carried out to collect the data. The analysis method of the attraction used was multiple linear regression analysis with a stepwise method to generate a model of visitor attraction to the market. For travel zone-based, the linear regression analysis method will examine the correlation between criterion variables in the form of social-economic characteristics of the zone. The predictor variables in form of total traffic flow from the observed zone to the observed destination zone give the estimation number of trips from and to destination generated by the characteristics of the social-economic zone for zone-based travel. Analysis carried out showed that more influenced trips attraction visitors to this market area are profession, transportation mode, and retail item and found a significant change in trip attraction rate after construction processes.

Henny Indriyani Abulebu, Bleiser Tanari, and Muhammad Isran Ramli (2018) aimed to define significant factors that influence people in obtaining their choice of frequency. Variables considered were socio-demographic, properties of the trip to shopping centers, nature of selecting a trip time, and ways to travel. They attempt to develop a trip attraction model of the central market in Poso City for Visitor Movement Attraction on Holiday and workday. Sampling size adopted based on Slovin's formula. Multiple linear regression models were developed in both cases. The findings showed that on holiday, no variable has a significant influence on the trip attraction of visitor movement at the Poso Central Market, while on the workday, shopping cost has become the most influential variable.

Trip Generation and Attraction Models for Hyderabad Metropolitan Development Authority Area to estimate the horizon year trips was developed by Bollini Prasad and Dr. Kumar Molugaram (2018). Data collected regarding population, employment potential, vehicle ownership, number of students, and the number of earning-members. Multiple linear regression analyses were carried out to develop trip production and trip attraction model. The result showed trip generation model developed for the data shows that the trips attracted to a zone and produced from a zone depend on population, employment, and registered number of vehicles in the zone. The gravity model is developed for estimating the trip inter-changes, with a less RMSE value and error between the calculated and observed percentage trips for an average travel time was found to be less for passenger vehicles and goods vehicles.

The study aimed to estimate trip attraction by using connectivity, local integration, and global integration values as endogenous variables with an acceptable level of accuracy. The centrality values were derived from the road network using Space syntax tools, and a GIS-based kernel density estimation method was carried out by Amila Jayasinghe, Kazushi Sano, and Kasemsri Rattanaporn (2017). The method can be utilized as a suitable modeling tool particularly in developing countries where transport models are severely constrained by the virtual lack of land use data. Results revealed that among the four centrality parameters, global integration has a very high correlation, while local integration and connectivity have a strong correlation with trip attraction density

values, centrality values have a strong exponential relationship with trip attraction density values compared to a linear relationship. Thirdly, the model with the global integration and local integration as explanatory variables gives a fair estimation of the trip attractions at the aggregate level in TAZs, and finally, the study noted estimation errors due to the influence of industrial zone, special education and development restricted land uses. Researchers suggested that further study can be made to investigate possible methods to improve accuracy while eliminating errors.

Md. Shamim Al Razib and Faysal Ibn Rahman (2017) estimated trip attraction rates of the shopping centers at Uttara Road, Uttara area of Dhaka by using the trip rate analysis method. Few behaviors were considered such as for shopping, fitness centers, and other services for the people and vehicles attracted to the shopping centers when they visit the particular building. The surveyed data deals with the relationship between trip attraction rates of the shopping center as a whole. The result revealed the maximum and a minimum number of people and cars enter the shopping centers during the peak hour. The main demerit of the study was a limited number of data and they considered only physical features of tip attraction rate of shopping centers. It will create complication if two shopping centers with different composition of stores exists similarities in physical features.

Imma Widyawati Agustin and Budi Sugiarto Waloeya (2017) created a trip attraction model of land use for industrial areas. The study aimed to determine the effect of industrial vehicle movement on the road's level of service in an industrial area. The variables considered for developing the trip attraction model for Malang city include the number of movement, building area, number of employees, number of shifts, frequency of delivery, and visitor counts. Sampling carried out is stratified random sampling. Correlation analysis to determine the influence variables and multiple linear regression analysis were applied to identify the trip attraction model of land use. The results showed that the most affected variables of the industrial vehicle movement are the number of employees and the delivery frequency.

Karuturi Sasidhar, Yeluri Vineeth, Vineethreddy, and S. S. V. Subbarao (2016) analyzed the trip attraction rates of commercial land use in different cities of Andhra Pradesh and Telangana states. Various variables considered were area, parking spaces, number of employees, number of stores, number of people attracting. Due to the variations in the trip attraction rates the complexity of analysis is increased. By observing overall statistics, it can be concluded that weekend trip attraction rates of shopping areas are more than the weekday trip attraction rates. Further, male trip rates are more when compared to female and children on both weekdays and weekends. The major limitation of this study is the limited number of commercial areas. By considering more number of the commercial area the accuracy of this analysis can be improved.

Radial Basis Function Neural Networks (RBFNN) method is used in modeling trip attraction in Palembang by Joni Arliansyah and Yusuf Hartono (2015). It gives the shortage of ANN models which take a long time to achieve convergent conditions and can be trapped in the minimum local condition in selecting the optimal criteria during the learning procedure of the network. The study aimed at comparing the RBFNN modeling results with the regression analysis model was made using the SPSS statistical package. Independent variables considered are population size, number of schools, number of students, number of teachers, areas of school buildings, number of offices, and number of houses. The radial basis function neural network model trained to predict trip attraction using seven predictors performed better than the ordinary regression model using the least square approach. Violation of assumptions for the regression model, such as normality of error items and linearity, must be one of the reasons for the worse performance of

the regression model. However, the results from both models show that the number of students, number of teachers, total areas of school buildings, and number of offices are the most significant predictors for trip attraction.

W.Y. Szeto, Jonathan Yeung, Ryan C.P. Wong, and W.H. Yang (2015) modeled trip attraction, trip distribution, and mode split of columbarium trips during the traditional grave-sweeping festivals. Headcount survey and revealed preference questionnaire survey was carried out during the Ching Ming Festivals of 2013 and 2014. The variables considered were the number of niches and the number of days deviated from the festival date. This study calibrates and models non-linear regression models for trip attraction and joint logit model for trip production and mode split. The result revealed that the number of niches and the number of days deviated from the festival date significantly affect the number of visitors entering the columbaria. The model results indicated that the number of zones apart, the availability of direct feeder services, the total waiting and walking times, the in-vehicle travel time, and the out-of-pocket cost are the significant factors influencing the visitors' travel choices of interchange locations and the associated feeder transport modes.

The study by Pretina George (2013) aimed at giving a trip attraction model that can predict the trip attracted to any commercial nodes in the medium-sized towns in Kerala. Socio-economic and commercial land use characteristics variables were considered. A sample size of 10% of trips was randomly selected from each town. They carried out a combination of analytical and descriptive methods. A multiple linear regression model was developed using Microsoft excel. The higher correlation was given by the number of employees and percentage of office in the commercial node which gives a better estimation of trip attraction and other factors like total commercial area, the number of commercial establishment, percentage of shops where food items are sold, percentage of office and shop in the commercial node and percentage of commercial establishment with the year of operation between 5 to 10 years. The model developed will be useful for estimating the trips attracted to new or existing commercial centers and to assess the traffic impact of the commercial center on the geometric design of roadways in the surrounding area. It is mentioned that the accuracy of the model can be increased by considering more commercial nodes from different medium-sized towns in Kerala and more factors affecting trip attraction can be carried out as further research.

Partha Pratim Sarkar and Mallikarjuna (2013) attempted to understand the changes in socio-economic and land use characteristics and their impact on the travel pattern respective significance in the choice of non-motorized and private motorized vehicles while making different types of trips. Travel data, socio-economic and demographic data like age, gender, educational qualification, family size, vehicle ownership, driving license holding status, income, etc were collected by household survey and other land use data were collected with the help of GPS device. ArcGIS 10 Software has been used to digitize land use data. Based on land use, functional and spatial complimentary area index was framed. For all the trips like work trips, shopping trips, and all other trips several binary choice models were prepared. Model output findings showed that socio-economic variables were showing significance influencing utilities of the modes. Land use parameters and intersection were found to show a significant effect. More effective significance was found in socio-economic parameters than land use parameters. Land use parameters when added with socio-economic variables showed significant improvement in models.

V. CONCLUSION

The studies reported on trip attraction variations with numerous land-use factors, software used, types of approaches and techniques used for modeling, and limitations faced by researchers have been presented. The studies focused on determining standard trip attraction models of various land uses including hotels and minimarkets, variation in trip attraction before and after construction processes of the market area, to define significant factors that influence people in obtaining their choice of frequency, trip attraction rates of the shopping centers, to determine the effect of industrial vehicle movement on the road's level of service in an industrial area, the relative importance of socio-economic and land use factors on trip attraction, to predict the trip attracted to any commercial nodes in the medium-sized towns, etc. The relationship between the number of visitors attracted by the outlet with the store area, store parking area, and sales income is very influential. The findings showed that on holiday, no variable has a significant influence on the trip attraction of visitor movement while on the workday, shopping cost has become the most influential variable. More influenced trips attraction visitors to this market area are profession, transportation mode, and retail item and found a significant change in trip attraction rate after construction processes. The most affected variables of the industrial vehicle movement are the number of employees and the delivery frequency. Weekend trip attraction rates of shopping areas are more than the weekday trip attraction rates. Further, male trip rates are more when compared to female and children on both weekdays and weekends. Land use parameters like accessibility, retail floor space, and employment opportunity have a significant contribution to trip attraction along with the socio-economic characteristics. Land use mix effect on trip attraction played a minor role. The major limitation of the studies is the limited number of commercial areas and by considering more number of the commercial area the accuracy of analysis can be improved, the limited number of data and researchers considered only physical features of tip attraction rate of shopping centers where it will create complication if two shopping centers with different composition of stores exists similarities in physical features, etc. Providing neighborhood infrastructures that increase the comfort of accessibility to neighborhood amenities can lead to higher shares of sustainable transportation modes like walking, biking, or public transportation use where the rate of trip attracted increases and the choice of destination makes people travel less which in turn will be cost-effective practices for people living in the urban and rural area.

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Experimental Study on Partial Replacement of Cement with GGBS and Zeolite

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ABSTRACT

The history of cementing material is as old as the history of engineering construction. Some kind of cementing materials were used by Egyptians, Romans and Indians in their ancient constructions. It is believed that the early Egyptians mostly used cementing materials, obtained by burning gypsum. Not much light has been thrown on cementing material, used in the construction of the cities of Harappa and Mohenjadaro.Concrete is an essential material in the construction which plays major role in the research and development of constructionin thehigh raise structures, modern structures, involves use of huge cement. In another sense, cement is formed to the expense of its fixings which is scant and costly, this is prompting utilization of monetarily elective materials in its creation. The concrete mix design is the methodology of taking suitable material inthe concrete, thus discovering their relative sums with a target to introduce a new materialrequired,which helps concrete in strength,durability and functionality factors in an affordable way. This helps to the consideration of materials to find new replacementin cement. The current workis to search around examining qualities of cement with halfway supplanting of concrete with Ground Granulated Blast furnace Slag (GGBS) and Zeolite. In the innovation of utilizing zeolite helps in reducing CO2. Because of fast change in metrology, profound limiting emanation will be required in coming decades.Concrete with zeolite as halfway supplanting material with mean proportion is required to assimilate unsafe gases and invigorate high compressive strength, consequently being eco-accommodating. GGBS and Zeolite is supplanted with concrete in various extents fluctuating from 0% to 25%. The evaluation of cement is M30.Thus the tests are completed for 7, 14, and 28(days). The water concrete proportion was kept up at 0.50 for all mix proportions.

Keywords : Compressive strength, GGBS, M30 Grade Concrete, Zeolite.

I. INTRODUCTION

Creation of concrete is a vitality serious procedure, bringing about discharge of carbon dioxide gases which antagonistically sway on the earth. At the equivalent the expense of creation of new material introducing in cement is expanding step by step at huge rate and normal assets giving the crude material in the research. The utilization of by product material having cementious properties which help for the replacement of cement partially in concrete has become very important for the development of new material by the scientists. The fundamental spotlight now is on search of waste material, which can be used

as partialreplacement of cement in concrete, without settling on its ideal strength. The GGBS is a by productsubstance from the iron industry, which might be utilized as halfway substitution incement because of its cementious property. In the nation like India, where the infrastructure is undertakings, for example, enormous water system, street and building ventures are either being developed or in fulfillment of their arranging and configuration stage, sowaste material incorporating in cement partially will lead to help in green house effects.In addition will be the economical method leads to reduction of CO2 in atmosphere. Zeolite has been generally utilized in developments since in past years. Presently ,there are 50 common zeolite and 150 above zeolite are utilized in businesses. By utilizing zeolite may help in reducing the utilization of cement in concrete. It helps in diminishing of creation of CO2 in atmosphere.

zeolite is characterized by the formation of structural compound like structure which is having small pores. The strength and other attribute of cement relies upon the properties of its fixings, extent of cement, strategy for compaction and different controls during putting and restoring. For cements, a mix of mineral and concoction admixtures is consistently basic guarantee accomplishment for necessary strength. The compressive strength was estimated for 7, 14 and 28 days.

II. MATERIAL AND METHOD

GGBS will be formed in the extraction of iron thus measures of such material acquired are of a similar request. Iron ,limestone are taken care of into the combustionwith temperature of about 1500°C to 1600°C. This smooth particle is dried to the required size, which is known as GGBS. The GGBS takenfrom hightemperature steel plant. The GGBS will passes, 90% through 90ɱ sieve. The importance in present work is for the performance of partial replacement of cementconcrete mix containing GGBS and zeolite as replacement of OPC then to compare with the plain concrete mix for M30.

III. The chemical proportion of GGBS

is shown in Table – 1

Table – 1: Chemical proportion of GGBS

Constituents	%
SiO2	34.4
Al2 O3	21.5
Fe2 O3	0.2
CaO	33.2
MgO	9.5
K2 O	0.39
Na2 O	0.34
SO3	0.66

The zeolite consists of SiO4 and AlO4 tetrahedra, consolidated in courses through shared oxygen to form open precious stone which contains pores of sub-atomic atoms into which particles can infiltrate. Like most silicates the zeolites depend on TO4 tetrahedra, where T is an aluminum molecule. The huge 3-D systems consequence of each of 4 corners for the tetrahedra being shared, helps in low thickness small scale permeable membrane. Zeolite can be helpful in bonding with cement as the replacement partially.

Table-2: chemical Composition of zeolite

Materials Chemical Composition: wt.%	Zeolite
SiO2 (S)	64.44
Al2O3 (A)	8.3
Fe2O3 (F)	1.66
CaO	1.77
MgO	0.07
SO3	0.04
Na2O	2.3
K2O	2.24

The concrete comprises of fine, coarse materials required for experimentation therefore standard specification is tabulated in Table-3

Table – 3: Properties of OPC, Fine and Coarse Aggregate

Properties	values
(a) Cement	
Specific gravity	3.15
Initial setting time	75min
Final setting time	360min
(b) Fine Aggregate	
Specific gravity	2.65
Water absorption	1%
(c) Coarse Aggregate	
Specific gravity	2.68
Water absorption	0.50%

IV. EXPERIMENTAL PROCEDURE CARRIED OUT

The cement mix proportion of partially replacing is done as per the IS codal provision 10262:2009.For the optimal mixGGBS in concrete mix is considered, (from 10% to 25%) are prepared and compared with PCC with mix proportion of 1:1.504:2.669 are prepared as per the IScodalprvision. The replacement of OPC with GGBS is done based on optimum mix. The w/c ratio is taken 0.45% for all the mixes as per the Indian codel provision. The result of replacement of GGBS to the concrete is shown in Table -4.

The cement proportion mix is done as per IS codal provision 10262:2009.For optimummix zeolite in cement mix, replacement (from 5% to 20%) are prepared and compared with plain cementConcrete sitrengthfor the mix proportion of 1:1.499:2.659 are prepared. The partial replacement of OPC with zeolite done on trial and error method. The w/c ratio is taken 0.45% for all the mixes. The result of replacement of zeolite to the concrete is shown in Table –5

In this investigation 90 cubes specimen were tested. The mould size 150 x 150 x 150 mm is considered and is prepared different mixes to compare with compressive strength of concrete at the age of 7 days, 14days, and 28 days strength .then tested in CTM.

V. RESULTS AND DISCUSSION

The compressive strength of cement concrete containing various % of GGBS and zeolite at the age of 7, 14, and 28 are given in Table 4 and 5 respectively.

The result of replacement of GGBS to the concrete is shown in Table –4.

Block Nos	**Conventional**			**GGBS 10%**		
Day of testing	7	14	28	7	14	28
Maximum load (KN)	414	505	605	502	647	713
Compressive Strength (N/mm^2)	18.4	22.4	26.88	22.31	28.78	31.63

Block Nos	**GGBS 15%**			**GGBS 20%**		
Day of testing	7	14	28	**7**	**14**	**28**
Maximum load (KN)	437	599	725	**440**	**676**	**806**
Compressive Strength (N/mm^2)	19.45	26.61	32.35	**19.58**	**30.04**	**35.83**

Block Nos	**GGBS 25%**		
Day of testing	7	14	28
Maximum load (KN)	602	731	781
Compressive Strength (N/mm^2)	27.78	32.51	34.73

The result of replacement of zeolite to the concrete is shown in Table – 5

Block Nos	Conventional			Zeolite 5%		
Day of testing	7	14	28	7	14	28
Maximum load (KN)	414	505	605	454	576	649
Compressive Strength (N/mm^2)	18.40	22.44	26.88	20.20	25.61	28.85

Block Nos	Zeolite 10%			Zeolite 15%		
Day of testing	7	14	28	7	14	28
Maximum load (KN)	466	595	690	404	524	609
Compressive Strength (N/mm^2)	20.71	26.47	30.63	17.94	23.3	26.88

Block Nos	Zeolite 20%		
Day of testing	7	14	28
Maximum load (KN)	341	384	529
Compressive Strength (N/mm^2)	15.18	17.07	21.83

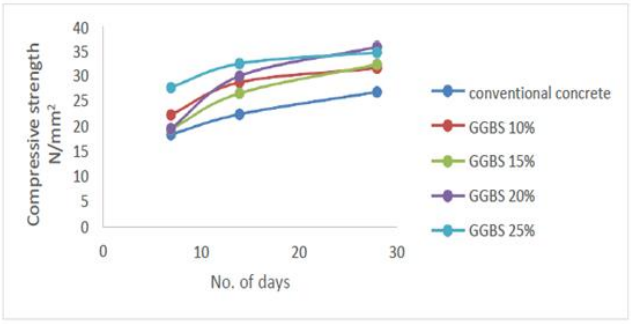

Figure 1 -BEHAVIOUR OF GGBS ON DIFFERENT PROPORTIONS

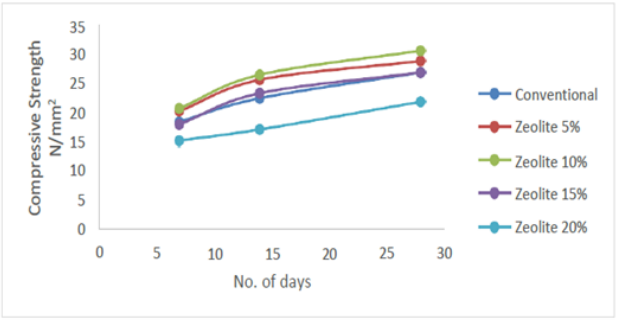

Figure 2 -BEHAVIOUR OF ZEOLITE ON DIFFERENT PROPORTIONS

VI. CONCLUSION

1. It is observed that the use of GGBS and Zeolite will give better strength compared to conventional concrete.
2. Use of zeolite will improve the performance of cement.
3. The optimum use of slag in the concrete is observed to be 20% of cement & it showshigher compressivestrength than OPC for 28 days strength.
4. The compressive strength was found more in 10% of zeolite of 28 days when compared with conventionalconcrete.
5. GGBS and zeolite helps in reduction of CO2 in atmosphere and also help in achieving better strength than conventional concrete.
6. In future if the combination of GGBS and zeolite are used will help in increasing the performance of concrete.

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A Review on High Strength Concrete using GGBS with Alccofine and GGBS with Silica Fume

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ABSTRACT

High strength concrete (HSC) is highly promising building material widely used in large scale concrete constructions that require high strength, high flow ability and high durability. Several studies have been carried out in past decades to identify the use of supplementary cementitious material in concrete. To increase the durability along with strength of concrete leads to the use of high-strength concrete which is more beneficial for environmental attacks on the structure. Various studies are performed on HSC with respect to workability, strength and durability. The addition of different mineral and chemical admixtures increases the strength and durability of HSC. The effect of SCM on strength durability of High Strength Concrete(HPC)using GGBS with Alccofine & GGBS with silica fume is studied.

Keywords : Highstrength concrete, Alccofine, GGBS, Silica Fume

I. INTRODUCTION

Nowadays huge quantity of concrete is consumed in construction industry to meet the increasing demand of infrastructure due to increase in population and urbanization. The continuous global demand for concrete indicates that, more aggregate and cement is required in the production of concrete, thereby leading to more extraction and depletion of deposits of natural gravel, and increased CO_2 emission. The conventional concrete is designed on the basis of compressive strength does not meet durability requirements .High strength concrete (HSC) aims to enhance strength and consequent advantages owing to improved strength,) is used in the majority of construction applications. HSC is a concrete possesshigh strength,workability, density and durability.

The concrete is generally classified according to strength as(a) conventional concrete, up to grade 60 MPa,(b) high strength concrete (HSC), grades 60 – 90 MPa,(c)very high strength concrete (VHSC), grades 90 – 130 MPa (d) reactive powder concrete (RPC), grades 200 – 800 MPa; (e) high performance lightweight concrete (HPLC) greater than 55 MPa. The use of high strength concrete in the construction industry has increased over the past years. This experimental study involves the use of mineral admixture such as alccofine 1203 and GGBS in enhancing the mechanical properties of high strength concrete. Silica fume is a by-product of the silicon smelting process which is apozzolanic material. Silica fume is usedin high-strength concrete in two different ways, as replacement for cement, and as an additive to improve properties of concrete. The main

advantage of mineral admixtures in high-strength concrete is to reduce the cement content, which results in economic and environmental benefits but also increases the compressive strength and durability.

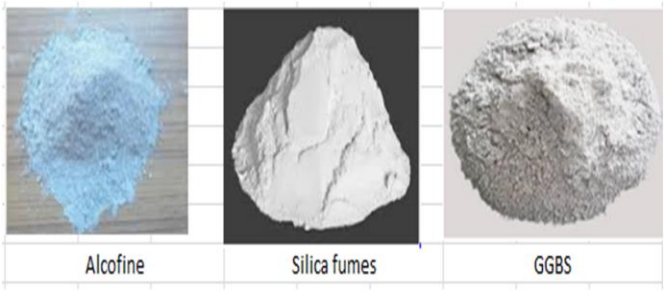
High Strength Concrete is required in engineering projects which has to resist high compressive loads.It is typically used in the construction of high rise structures for components such as columns , shear walls and foundations and . also used in the construction of highwaybridges.HSC also permits reinforced or prestressed concrete girders to span greater lengths than thenormal concrete girders. It also enables to build the super structures of long span bridges and to enhance the durability of bridge decks. The use of high strength concrete offers numerous advantages in the sustainable and economical design of structures.

Factors to be considered in thedesign of High Strength Concrete

The important factors that govern the strength of concrete are

Properties of cement paste
Properties of aggregate
Various chemical and mineral admixtures
Properties of the admixtures used
Proportions of the constituents to be used
Paste-Aggregate reaction
Mixing, Compaction and Curing

Admixtures used



Alccofine isa manufactured slag with high content of glass and high reactivity. The ultrafine particle of Alccofineimproves the workability and strength of concrete.It can be added directly with cement. Alccofine-1203 enhances the concrete properties. Because of its fine particle size water demand is reduced can be considered as a high range water reducer to improve the workability.

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Ground granulated blast furnace slag (GGBS) is a by-product given from the steel industry. Blast furnace slag is defined as “the non-metallic product consisting essentially of calcium silicates and other bases that is to be developed in a molten condition simultaneously with iron and blast furnace to use as a cementitious material the GGBSmust be ground as finer than the cement .The fineness of grind will determine how rapidly the slag will react in the concrete.

Silica fume, also known as micro silica, consists of ultrafine glassy spheres of silicon dioxide. It is a by-product of the metallic silicon and ferrosilicon alloy production at high temperatures with an average particle diameter of 150 nm. It is 50 to 100 times finer than the average size of cement and flash particles. Themicrosilica improves the early age strength, as it reacts fast in the first 3 days, also improves the consistency of the fresh concrete.

II. LITERATUREREVIEW

A. General:

In the present investigation, GGBS and alccofine 1203 and silica fume has been utilized to find the characteristics influencing the high strength concrete. Replacing some portion of cement with GGBS and alcidine 1203 and replacing some portion of cement with GGBS and silica fume where the varying proportions are fixed by reviewing the literatures.

B. Review of Literatures:

1) 1.Mazloom, (2004): This paper investigated the effect of binder system containing different levels of silica fume to improve the mechanical properties of concrete. Partial replacement of silica fume at an interval of 5% (0% to 15%).Maximum compressive strength obtained is 70 N/mm² at 15% which is the optimum percentage.
2) Ajeesha, Rohini & Nair (2015):This paper focused on the role of ultrafine slag (Alccofine 1203) in improving the properties of concrete. Alccofine 1203 is replaced at varying percentage of 0% to 12%. Optimum results were obtained at for interval of 8-10% by OPC with compressive strength of 55.77 N/mm², flexural strength of 9.08 N/mm² and split tensile strength of 3.75 N/mm² for 28 days curing.
3) Alok Kumar, OshinParihar & Rahul Chaudhary (2016):This paper studied the influence of alccofine 1203 as a mineral admixture in concrete when it is added in cement concrete. Partial replacement of 43 grade OPC by alccofine for varying percentage of 5% to 15% at an interval of 5% by total weight of OPC.
4) Darren Lim, Da Xu ,SabetDivsholi & Kondraivendhan (2011): In this paper studied the effect of Ground Granulated Blast-furnace Slag (GGBS) as a mineral admixture to improve the workability and reducing the strength of concrete. The specimens containing 30% of UFGGBS achieved higher compressive strength 109.8 N/mm² and also resistance to chloride penetration into the concrete
5) 5 PendhariAnkush (2016):This study has conducted with the varying the proportions of micro silica with cement and GGBFS added about 20%. Micro silica is used in different percentages from 0% to 10%. The maximum compressive strength of 66.43 N/mm² is achieved at for a combination of 10% micro silica, 20% GGBFS and 70% cement.
6) Revanth Jagana (2017): High strength concrete (HSC) has characteristic cube strength between 40 and 100 N/mm², although higher strengths have been achieved and used. Higher strength between 80 to 100 N/mm² is used for both precast and insitu works. High Strength Concrete is specified where reduction in weight is important or architectural considerations require smaller load carrying elements. The cost of reinforced cement concrete is found to be lesser for M60 grade concrete compared to M20 grade concrete.
7) Alaa M. Rashad (2014) This paper investigated the validity of producing high strength concrete (HSC) using moderate cement content to reduce the consumption of the binders. Cement content is reduced from 500 kg/m³ to 400 kg/m³. The reduction in amount of cement is compensated by adding fine limestone (LS) powder. The effect on characteristic strength of concrete such as compressive strength, flexural strength and split tensile strength is studied.

III. CONCLUSION

This paper reviews intensively about the great potential of biological method, using the bacteria capable of precipitating ncrete can produce cost effective strong or durable structures.

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Flexural Behaviour of RCC-Beam with Partial Replacement of Recycled Coarse Aggregate Obtained from Construction Demolished Waste

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ABSTRACT

The study carried out mainly on the strength viability of Recycled coarse aggregate of C&D waste used in concrete with partial replacement through different proportion with main focus on strength behavior of concrete cubes and RCC beam done by using this. The possible investigation on recycled aggregates mechanical properties on Natural aggregates and concrete cubes compressive strength, split tensile strength of cylinders, flexural strength of RCC beam are also carried out.

Partial replacement of recycled coarse aggregate with natural aggregates carried out with different proportion in percentage like 0%, 30%, and 60%. Mainly the flexural strength of beam of M30 carried out and results, conclusion through the strength viability of recycled coarse aggregate use in concrete and beam has been discussed with respect to Natural aggregate (NA)

The practical use of recycled coarse aggregate plays a vital importance in minimizing the depletion of natural resources and increase the scope of civil engineering in economic aspects, minimizes the problem of waste generation and disposal problems.

The overall study analysis strength wise shows that the use of recycled coarse aggregate is viable to use in concrete to a certain percentage of limits and with increase in percentage of proportion the strength is gradually decreasing in concrete and RCC beam.

Keywords : RCA, RCC, NCA, C&D, NA

I. INTRODUCTION

India is one of the developing country where the new social infrastructure, in which building construction plays a crucial role in all areas of civil field, is a significant contributor to the introduction in all possible ways to reach of the civil engineering theme. The use of recycled materials in the construction may solve the problem of depletion of capital source. The use of recycled coarse aggregate (RCA) by way of recycled materials used in the building sector to preserve natural capital for the future & saves electricity in all fields. The stock of soft artificial aggregates as recycled concrete rises and virgin aggregates are critically scarce. The use of RCA in construction conserves virgin aggregates, eliminates the impact of waste and energy use, and may minimise prices. Crushed inorganic particles recycled from materials used for construction and disposal waste are found in recycled aggregates. The properties

of concrete and recycled aggregates as an alternative to gross concrete aggregates are clearly shown in recycled structural cement applications.

The recycling and reuse of waste, together with the scarcity of natural aggregates, is viewed as an efficient alternative to the thousands of tonnes' disposal issues. The precious building material in science, ecology and economies appears to be recirculated concrete aggregates in all the way.

Waste generation is significant issue in the metropolitan cities. Global research and development programmes have been made to show their efficiency, economic viability, and productivity.

Concrete debris left unutilized as landfill problem

A study performed by EEC Environmental Services (1979) expecting an unprecedented growth in available volumes of waste from 55 million tonnes to 302 million tonnes by 2020, and the removal of concrete waste in EEC Member States. Protection and environmental requirements are rising in general. Demands are being made to develop the procedures and feasibility of recent processes of demolition. Specific demolition laws and legislation were also introduced in some countries, such as the UK, Holland.

Recycling of demolition waste has already begun in several heavily populated countries in Europe, where debris management is becoming extremely challenging. In 1992 numerous recyclation plants worked in Europe, including 60 in Belgium, 50 in France, 70 in the Netherlands, 120 in the UK, 220 in Germany, 20 in Danish and 43 in Italy, according to a 1992 European Demolition Association (EDA). Building and demolition waste recycling is quick and economic, anywhere mixed demolition and building schemes are concurrently taken up.

In the wake of a natural catastrophe or destruction of older buildings, recycle and re-use of building waste appears to be a potential option. This becomes extremely relevant for those states that impose guidance, fines, levies etc to domestic and municipal laws for storage of building and demolition waste.

environmental issues. Hence the negative impact on environment and also waste management can be handled simultaneously by adopting 3R's principle of sustainable approach in the construction industry.

Need of recycled coarse aggregate in Concrete

- There will be minimization of natural resource usage
- It is cost-effective
- Environmentally friendly reduces the pollution
- Decreases the conflicts regarding illegal landfills
- Effective use of this promotes the scope of Branch
- At certain proportional use gives best results
- Employment opportunity in recycling plant

OBJECTIVES

- The evaluation and description of the properties of concrete with recyclable aggregates is to determine Resistance Characteristics for Recycled Coarse Aggregates (RCAs) to function as a natural rough aggregate (NCA).
- The key purpose of this analysis would be to measure the compressive strength of concrete cubes and RCC beam's flexural potential and report on the feasibility of recycled rough aggregate usage in building.

- To equate RCA concrete's mechanical properties with NCA concrete used at various percentages
- To evaluate the force variance of the RCA substitute with NCA in specific cube cylinders in various proportions
- To do cost analysis and compare the economic factor and see if this can be adapted in reality
- In reality understanding the value of proper 3R application (reduction, recycling, reuse)

II. METHODS AND MATERIAL

This study includes a number of tests to assess the physical and mechanical features of concrete. Physical and mechanical properties were checked in order to classify the raw materials. M30 concrete was designed, and identified the few tests in depth and addressed the test results. I.e. The project work begins from casting to checking the components.

Our key aim was to analyze the details of the concrete characteristics as it is replaced with a coarse recycled aggregate. And the diverse properties of hardened concrete were recorded with different properties such as compressive and tensile strength, flexural strength of beam.

MATERIALS USED:

The following Materials have been used in the experiment:-

- Cement
- Fine aggregate
- Coarse aggregate
- Recycled coarse aggregate
- Water

Cement: is an element of fine powdered material in concrete. Different cement grades are available on the market; standard Portland cements are the most frequently used and are suitable for different grades: M33, M43 and M53. We used M53 grade cement

Fine aggregate:The sand was used for research and which locally availed with good properties

Coarse aggregate: analyses were conducted using locally available natural rough aggregates of up to 20 millimetres. The fundamental gravity of the tough aggregate was determined when we tested 2.80

Recycled coarse aggregate:These aggregates are usually obtained from collapsed concrete and the concrete is made from RCA is called as RCA concrete. C&D waste is usually recycled by to get RCA and we have purchased the waste from the recycling plant.

The RCA in the current study has been used for a nominal scale of 20 mm. the specific gravity is found to be 2.85.The RCA in usage has its own property and varies from the natural rough aggregate in its mechanical property.

Water:In preparing specimens and even for curing specimens, portable tap water was used for the entire work. The water delivered on campus is a regular drinking water of usual pH content.

TEST ON FRESH CONCRETE:

Tests carried out to find workability are as follows

- Slump test
- Compaction Factor test

SLUMP TEST:The concrete slump analysis or cone slump tests shall determine whether a concrete blend made at the laboratory or construction site during work is operable or durable. Stable concrete contents during processing are tested for batch slumps. While beginning resulted all types of slump but project is continued with proper slump value. The slump test is the simplest concrete workability test which automatically requires low costs

Slump test

COMPACTION FACTOR TEST:Compact factor controls are used in laboratory to test concrete workability. The compacting factor is the weight ratio between partly compressed and totally compact concrete. The Road Test Laboratory in the United Kingdom has been designed and is used to assess concrete workability.

The compact factor is defined as the proportion of weight between partly condensed cement and weight of fully compacted cement. Typically, the next second decimal place should be defined

Obtained compaction factor of the concrete is .95

Compaction factor test

TESTS ON HARDENED CONCRETE:

The inspection of hard concrete is the most critical factor when tracking and conforming to the quality of cement concrete workers. The rigorous and continuous testing of fresh and hard concrete materials forms part of any quality control programme, which allows the content used more durable and more effective, on the basis of its strength and durability. The primary value and purpose of measuring hardened concrete is to have the necessary target strength of the concrete used in or elsewhere on the premises. For some period after the hardening process of concrete, the true strength of the concrete cannot be known. This is one of the most critical disadvantages in a conventional test. Even if known late, results for the hard-concrete test help to demonstrate the strength of the concrete

COMPRESSION TEST:

The compressive force of the concrete cube measure gives a description of all the specific characteristics. One checks whether Concreting was carried out properly or not for this particular step. Compression regulation is the most common examination on armoured concrete in laboratories. Compressive concrete performance usually relies on various factors, including the usage of water mortar, cement strength, design accuracy, quality control, etc.The specimens were tested with a measuring compression device after seven days of therapy or 14 days, which healed for 28 days. Before the specimens fail, a load of 140 kg / cm2 should be eventually applied. The load on the failure divided by the area of the specimen provides compressive force to the concrete. Cast the cubes for 0 percent, 30%, 60 percent, each of three experiments and the findings and the chapter topic are covered in the report

Compression test of Cube

SPLIT TENSILE TEST: Concrete cylinders offer a method for calculating the strength of tensile concrete and concrete strength is one of the simple and essential properties affecting dramatically the size and the scale of the building crack. Concrete is pretty brittle under tension because of its delicate nature.. Concerning the tensiliary forces, concrete thus creates fractures. The concrete tensile strength would then be calculated to calculate the strain of the concrete parts. The findings of the report and chapter mentioned was casted for 0 percent, 30 percent and 60 percent, of which each

It can be calculated by using the formula

$T = 2P/\Pi DL$

Where, P = applied load

D = diameter of the specimen L = length of the specimen

Split tensile strength

TESTING OF RCC BEAMS:

Six RCC Beams, two for each % of replacement, two beams were casted with 0% replacement and other four beams casted with two beams for each 30% and 60% replacement of NCA with RCA.

The beams were only cast to check the strength features of RCA in beams of various sizes by measuring the flexural capacities of beams between the three different percentage replaced beams to ascertain the feasibility of the usage of RCA in building.

The test was performed after 7 days and 28 days, three different percentage beams such as 0 percent, 30% and 60 percent were tested each day. The loading frame method is used to test the beams under 200 KN.

Testing of RCC beam

III. RESULTS AND DISCUSSION

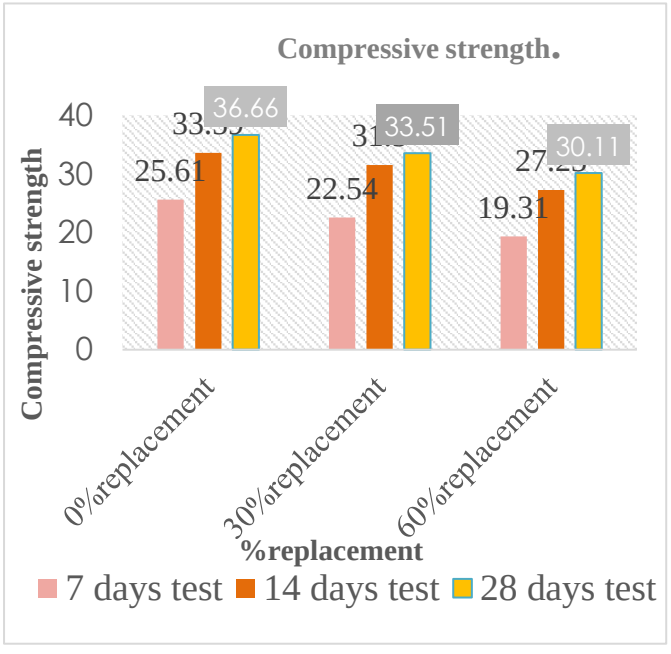
Comparison of Mechanical properties of RCA with NCA

Properties	Test Results		Difference in test Results
	NCA	RCA	
Specific Gravity	2.80	2.85	_
Water Absorption	1.01%	2.04%	1.03%
Crushing Value	15.06%	23.78%	8.72%
Impact Value	25.55%	29.3%	3.75%
Los Angeles Abrasion value	25.8%	30.2%	4.4%

Table 1 comparison of NCA with RCA

COMPARISON OF COMPRESSION STRENGTH:

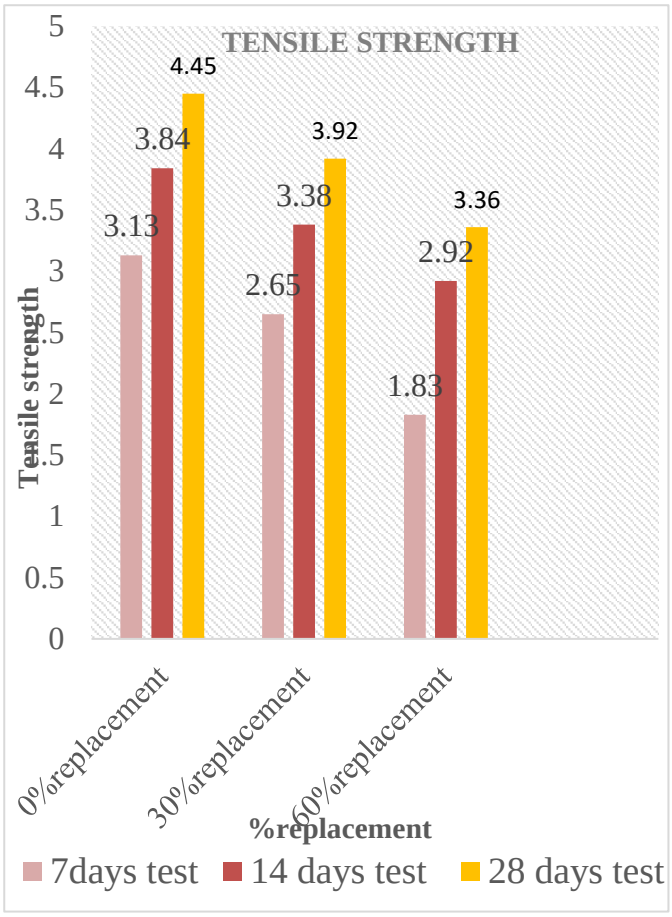
This graphical representation shows the compressive power of concrete relating to the substitution of RCA from 0 percent to 60 percent. From the above graphical representation of obtained findings that the compressive intensity decreases with increase percentage replacement of RCA. And it is significantly suggesting that 30 percent replacement of RCA shows very satisfactory result compare to 60 percent



Graph 1 of Compression strength in N/mm2

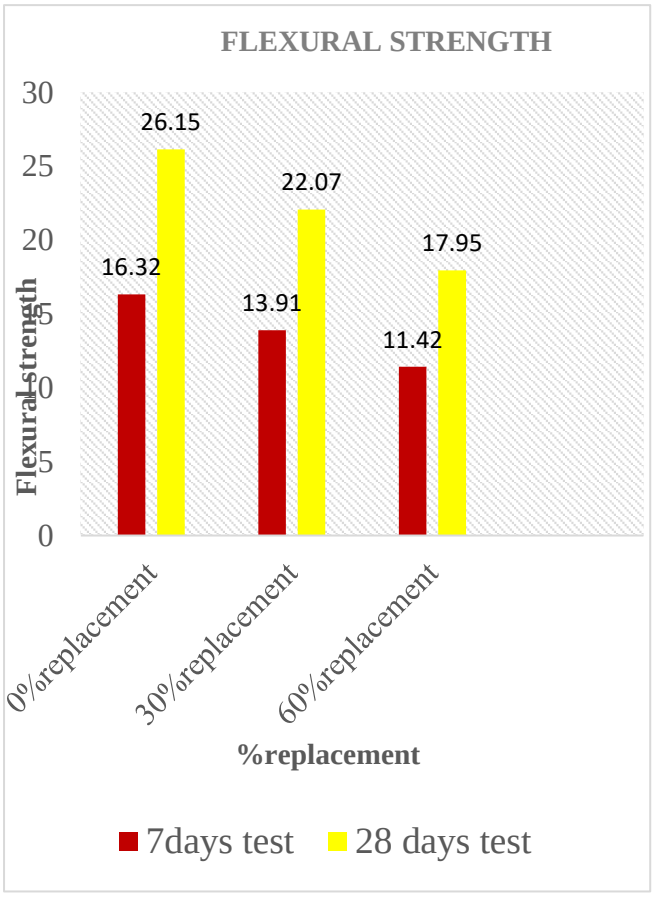
TENSILE STRENGTH (CYLINDERS):

The above figure displays the tensile strength of the concrete corresponding to the RCA substitution, from 0 to 60%. From the figure above, the findings obtained demonstrate that the tensile intensity declines with the percentage rise in RCA substitution. It also demonstrates substantially that 30% substitution for RCA is very satisfactory compared with 60%.



Graph 2 comparison of tensile strength in N/mm2

COMPARISON OF FLEXURAL STRENGTH OF BEAMS:This figure demonstrates the flexural power of the RCC beam referring to a substitute for RCA from 0% to 60%. From the above figure, the findings obtained decrease the flexural intensity with the increase of RCA. It also demonstrates substantially that 30% substitution for RCA is very satisfactory compared with 60%.



Graph 3 comparison of flexural strength of beams(MPa)

COST ANALYSIS AND COMPARISON:

From the above-mentioned cost study, we may infer that the project allocates the Natural Coarse Aggregate to the whole project has a chance to save the overall budget costs. And natural resources.

The study shown above is done for the own mixture configuration and for various beams dependent on percentage of the substitution of RCA with NCA as 0 percent, 30% and 60% replacement, two beams have been installed for each substitute percentage.

As a substitute for RCA with NCA, 60% replacement saves on the volume of each 0.1 cubic meter of cast beam, opposed to 30% substitution, and saves more.

Likewise, comparison studies are usually performed with the volume 1cubic meter beams to demonstrate the cost reductions of replacement by a broader magnitude. 60% substitution eliminates more expenses as compared to 30% substitution for NCA.

But it is not enough to assume that the strength parameter affects more, such that 60 percent substitution saves more resources, but 30 percent substitution is preferred with strength parameters.

"The rise in the replacement percentage often raises the cost benefit, with the increase in the replacement percentage reduces the strength".

0% of Replacement	0.1M3beamTotal cost	Total saving in Rs	1M3 beam Total cost	Total saving in Rs
0% replacement RCA	844	_	8440	_
30%replacement RCA	832	11	8320	110
60%replacement RCA	819	23	8190	230

Table 2 Cost Analysis and Comparison

30% substitute or less of 30% replacement is better in many ways compared with 60% substituting in RCA, as above review indicates that cost reductions are less yet appropriate for the amount of casting beams, allowing a difference even in major building ventures.

IV. CONCLUSION

- The strength characteristics of recycled Coarse aggregates (RCA) for application in structural concrete has been determined and compared with NCA test results.
- Mechanical properties of RCA like Water Absorption, Los Angeles Abrasion value, Aggregate Impact value, and Aggregate crushing

value etc.….of RCA is found to be greater than NCA.

- In this project work Natural Coarse Aggregate is partially replaced by RCA i.e. 0%, 30% and 60% in concrete mix to cast cubes, cylinders, prisms and RCC beam.
- The Compressive strength of concrete cubes, Tensile strength of Concrete cylinders and flexural capacity of prisms and RCC beam has been find out through various tests and compared the test results and conclude the viability of RCA usage.
- From the mix trials, in the strength aspect for different percentages of replacement, witnessed that 30% is the optimum % of replacement of RCA in Cubes, cylinders and Beam which gives comparatively safe result compared to 60% replacement.
- According to laboratory test results most importantly witnessed that the strength parameters of cubes, cylinders and beams decreases with increase in percentage of recycled aggregate.
- By partial Replacement of RCA we can reduce demand of NCA and reduce the duplicity of source and Cost of project, it is a good choice for economically and socially. .
- Know the importance of proper implantation of 3R's (reduce, recycle, reuse) concept in construction to save the Total Energy, that has to be implemented in all possible ways.
- The Cost Analysis shows that there is a cost saving in overall project when used the RCA under preferred replacement percentages
- From the above all parameters and results, the replacement of recycled coarse aggregate with NCA below 30% recommended since its strength parameters are nearest to ultimate strength obtained and it is a good choice in economic and social way.

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Effect of Sugar on Setting Time and Compressive Strength of Cement Mortar and Concrete

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ABSTRACT

In now a days the calamities changes it more effects on civil engineering work, almost construction works are site work based but due to this hot weather the concrete loses the strength further, rapid evaporation of water cause plastic shrinkage in concrete. The aim of the project is to focus on the maintain the standard condition, minimize early hydration of cement, admixtures are used. Retarder as admixtures extend the hydration induction period , thereby the setting time. Durability and other characteristics of concrete depends upon the properties of its ingredients, proportion of mix, placing, compaction and curing.

The natural easily available admixtures like sugar are used in the concrete which not only increase the workability of concrete and also increases the strength of concrete. Even at less dosage, it gives good results.

Absorption of the retarding compound on the surface of cement particles forms a protective skin, slows down the hydrolysis. Main purpose of this project is to suggest the locally available materials to improve the properties of concrete and to reduce the cost of construction.

Keywords : Admixture, Compressive Strength, Ordinary Portland Cement, Setting Time, Sugar

I. INTRODUCTION

Almost all civil engineering works are site work based but concreting in hot weather i.e. above 100 F accelerates the early hydration of cement and produce concrete having high strength at early ages, but the later strength is reduced considerably. Further, the rapid evaporation of water causes plastic shrinkage in concrete and subsequent cooling would cause tensile stress and cracking. Hence in order to maintain the standard condition, admixtures are used. Retarder is admixtures that extend the hydration induction period, thereby increasing the setting time. The strength, durability and other characteristics of concrete depends upon the properties of its ingredients, on the proportion of mix, placing, compaction and curing. Concrete blocks have its superior properties like binding, strength and durability, but it cannot be used in all places due to different weather conditions in different countries. Variation in weather condition and sessions causes changes in the initial setting time of concrete especially in winter sessions respectively. With the help of admixtures are used.

Concrete has a superior characteristic like strength and durability, but in certain situations it cannot be used in all the places because of low setting of concrete. Retarders are used in the concrete composition to improve the setting time and also to increase the temperature of the composition with different types of admixtures. Concrete made with admixtures like sugar can be utilized in particular situations. Usage of these admixtures will decrease the segregation and bleeding. Sugar is a carbohydrate, a substance composed of carbon, oxygen and hydrogen. So, it is useful to add as an admixture in the concrete composition. Cement industry consumes like raw materials rich in silica, alumina, iron and calcium. Sugar manufacturing is the major agro industry in India.

The natural easily available admixtures like sugar are used in the concrete which not only increase the workability of concrete and also increases the strength of concrete. Even at less dosage they give good results.

These admixture causes cement set retardation by the following mechanisms:

- Adsorption of the retarding compound on the surface of cement particles forms a protective skin, which slows down hydrolysis.
- Adsorption of the retarding compound onto nuclei of calcium hydroxide poisons their growth, which is essential for continued hydration of cement after the end of induction period.
- Formation of complexes with calcium ions in solution increases their solubility and discourages the formation of the nuclei of calcium hydroxide.
- Precipitation around cement particles of insoluble derivatives of the retarding compounds formed by reaction with the highly alkaline aqueous solution, forms a protective skin..

Retarding admixtures are mainly based on materials having lignosulfonic acids and their salts, hydroxyl-carboxylic acids and their salts, sugar and their derivatives & inorganic salts, such as borates; phosphates, zinc and lead salts.

II. LITERATURE SURVEY

Bazid khan (2004)[1] He added sugar as a admixture in cement paste into three different type of cements. The test result show that the effects of sugar on setting time of cement paste depends upon the dosages and different type of cements used. According to his investigation for one type of cement it accelerated the initial setting time and regarded the final setting time when dosages higher than 0.25% were used. **G. L. Oyekan** (2007[2] Successful worked on improving the compressive strength of concrete block by the addition of sugar. 0.1% sugar content (by weight of cement) increase the compressive strength of the blocks by nearly 17% at 28 days. At 0.2% sugar content (by weight of cement) the 28 – day strength of the blocks was increased by only 9% but the 14-day strengths of the blocks were increase by 56.6%. **Giridhar.V** (2013)[3] based on the test results, as percentage of admixture increases from 0 to 0.1% that compressive strength of concrete also increased. Maximums strength of concretes was related on workability of concrete and it can be achieved by high degrees of workability. The compressive strengths of concretes measured for both admixtures after 7 and 28 days. After 28 days, the percentages of variations between the ordinary concrete and concrete with 0.1% of sugar added as admixture was 12.0%. **B Bulent Baradan**[4]- According to their research they found that the setting of cement extended due to the incorporation of sugar by weight of cement up to certain extent of 0.15%, exceeding this limit of incorporation, it has acted as accelerator up to 0.3% and the optimum dosage of sugar added to concrete was 0.15%.

III. MATERIALS USED

A. CEMENT: -

Cement is a binding material which has been used in a concrete. Cement plays a very important role in concrete which binds the aggregates which helps to form concrete. Cements used in construction are usually inorganic and lime or calcium silicate-based cement is used. OPC 43 GRADE cement is used for the study.

B. FINE AGGREGATE: -

Fine aggregate is finer in size less than 4.75mm. its size ranges from 4.75mm to 150 microns. A fraction finer than 150 microns is considered as dust or silt. Due to development in construction and infrastructure, fine aggregates are available in various categories like manufactured sand - famously known as M-Sand, river or natural sand, Gujarat sand, etc. Fine aggregate requirement should be such that coarse and fine aggregates combined should produce minimum voids. This should necessitate minimum cement paste requirement. The properties of coarse and fine aggregates will vary from place to place depending upon particle size distribution of locally available materials. The efforts should be directed to arrive at the optimum ratio to coarse aggregate to arrive at the best particle packing of aggregates

C. COARSE AGGREGATE:-

Aggregates provide about 75% of the concrete volume making it a very important constituent. They should meet certain requirements with respect to grading, shape, size and strength. Though they are considered inert, they exhibit certain reactivity which is popularly known as alkali aggregate reaction. Since our geo-polymer concrete is highly alkaline due to sodium hydroxide hence alkali aggregate reaction marks significance importance.

Coarse aggregate is the predominant constituent of concrete. Hence, properties and characteristics of fresh and hardened concrete are significantly affected by the properties of coarse aggregate. Of course, characteristics of concrete are also affected by the properties of other constituent materials like cement, fine aggregates, chemical and mineral admixtures, SCM's etc. in addition to this, concrete performance is also affected by proportionating of constituent materials, method of mixing, transporting, placing, compaction and curing.

Table 1 : Physical properties of coarse aggregates

Sl. no	Physical characteristics	Coarse aggregates
1	Specific gravity	2.84
2	Water absorption	0 .5%
3	Aggregate Crushing value	28.65%
4	Aggregate Abrasion test	27.65%
5	Aggregate Impact test	26.22%

D. ADMIXTURE: -

Admixture like sugar used in the present study which is easily available from the market. Its easily soluble in cement and water. Sugar added in cement mix with different dosages as 0.025%, 0.05%, 0.075%, 0.1%, 0.5%, 1.0 % by the weight of cement.

IV. METHODOLOGY

Following techniques are received to complete the venture work:

- Study of writing and assortment of information for the equivalent
- Procurement of materials
- Visual examination of materials
- Laboratory test on materials
- Mix proportion

- Trial mixes
- Casting of cubes
- Testing of cubes to know the designing properties just as strength properties of concrete.
- Interpolating the outcomes to acquire the conclusive outcome of the task.

The cement mortar and concrete specimens were prepared with adding sugar percentage of (0.025%, 0.05%, 0.075%, 0.1%, 0.5%, 1.0 %). The cubes were casted in size of 150*150*150mm and, 70.6x70.6x70.6mm. After casting the specimens, the cubes were cured for 3days , 7days and 28 days. The specimens were tested for compressive strength. The test results were also compared with normal cement mortar /concrete specimens strength. Mix design adopted was M30.

V. RESULTS AND DISCUSSION

a) SETTING TIME OF SUGAR ADDED CEMENT

Table no - 2

S. N	Sugar content as % of weigh of cement	Initial setting time in min.	Final setting time in min.
1	0	65	390
2	0.025	80	420
3	0.05	115	450
4	0.075	127	495
5	0.1	135	375
6	0.25	50	230
7	0.5	25	76

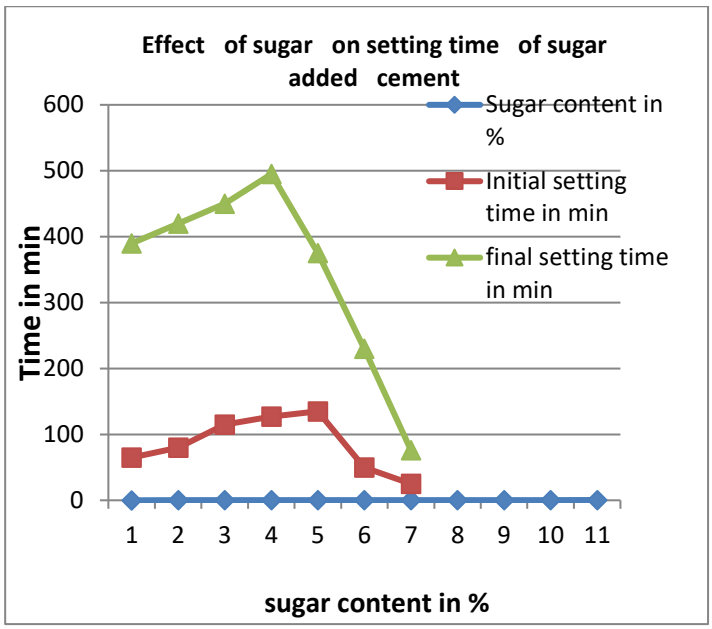

Fig 1: Setting time graph for various % of sugar content

b) COMPRESSIVE STRENGTH OF CEMENT MORTAR BY THE ADDITION OF VARIOUS PERCENTAGE OF SUGAR

The compression test was carried out on the test specimen 70.6x70.6x70.6mm and 150*150*150mm size cube specimen. The results of 3days and 7days and 28 days are considered. All the moulds were tested by using CTM of 2000 kN capacity which undergoes uniform rate of loading until failure occur and also the final loading in failure was taken for the calculation of compressive strength.

Table no -3

Sl.No	Sugar content as % of weight of cement	Average compressive strength(N/mm²)		
		3 days	7 days	28 days
1	0	26.03	32.27	45.17
2	0.05	34.20	45.25	55.58
3	0.1	39.07	46.68	59.68
4	0.25	31.89	38.56	47.12
5	0.5	27.79	31.28	37.25

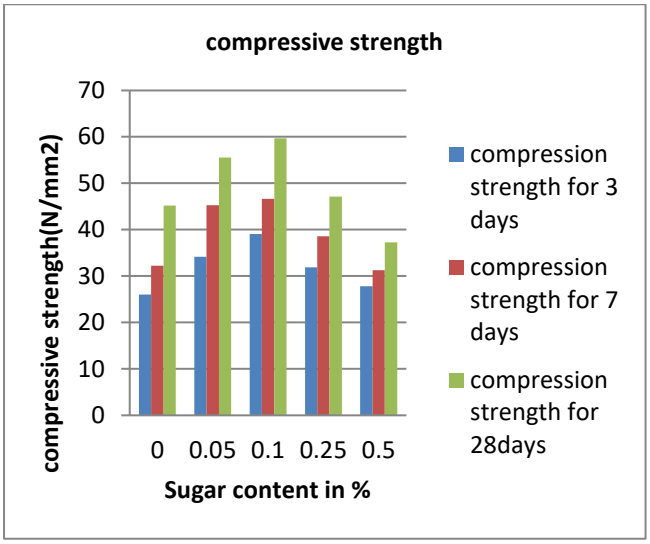

Fig 2 : COMPRESSIVE STRENGTH OF CEMENT MORTAR BY THE ADDITION OF VARIOUS PERCENTAGE OF SUGAR

c) COMPRESSIVE STRENGTH OF CEMENT CONCRETE FOR OPC 43 GRADE CEMENT

Table no - 4

Sl.No	Average compressive strength(N/mm²) OPC 43 grade cement		
	3 days	7 days	28 days
1	17	38	45
2	26	34	44
3	23	33	43

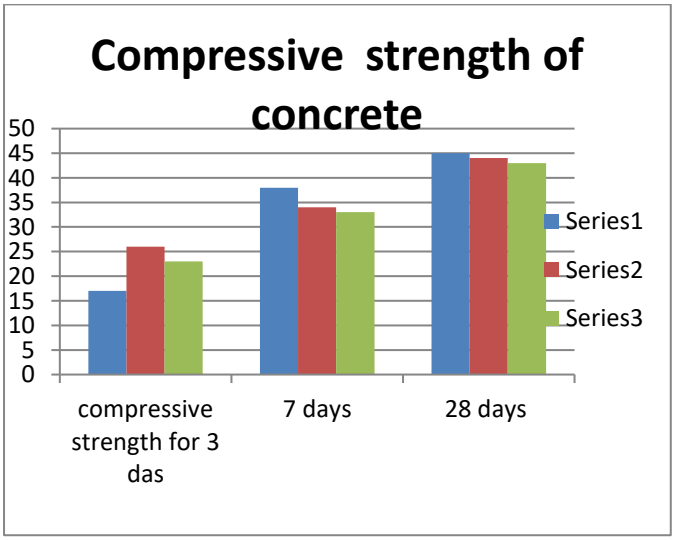

Fig 3 : COMPRESSIVE STRENGTH OF CEMENT CONCRETE FOR OPC 43 GRADE CEMENT

d) COMPRESSIVE STRENGTH OF CEMENT CONCRETE BY THE ADDITION OF VARIOUS PERCENTAGE OF SUGAR

Table no -5

Sr.No	Sugar content as % of weight of cement concrete	Average compressive strength(N/mm²)	
		7 days	28 days
1	0	25.20	36.9
2	0.05	33.25	45.2
3	0.1	34.68	48.68
4	0.25	28.56	33.12
5	0.5	20.28	28.25

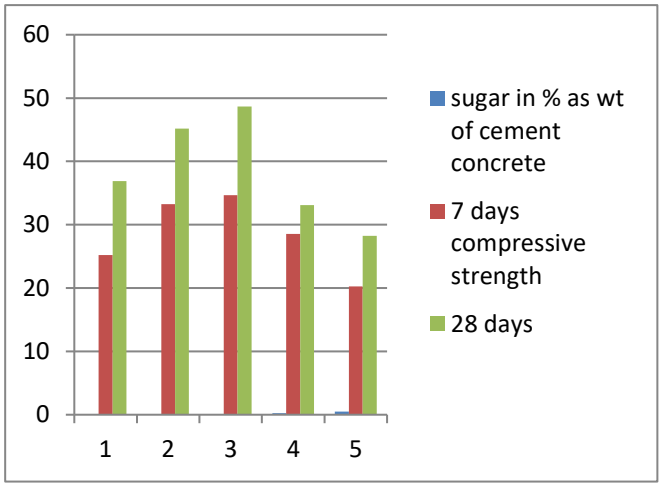

Fig 4: Compressive strength of cement concrete by the addition of various percentage of sugar

VI. CONCLUSION

- The results of effects of sugar on setting times and compressive strength of cement mortar are presented in above table.
- The increases in initial and final setting times are apparent up to sugar content of 0.075%. Reduction in setting times begins from 0.1% sugar

content. Sugar acts as retarder up to a suitable limits after that it acts as an accelerators.

- No adverse effect on cement and cement paste have been observed at this level of sugar concentration (0.075%). The delay in setting of cement at this level of sugar content (0.075%) could be useful in preventing cold joints and in reducing early setting of cement in hot weather concreting. Sugar above 0.075% by weight of cement accelerated the setting time with nominal gain in initial strength.
- Excessive volume expansion was noted in the sample as cracks were formed in the sample itself. So a careful use of sugar can be economical in comparison to commercially available set retarder.
- Compressive strength of cement with sugar as admixtures: Based on the test results , as percentage of admixture increases from 0 to 0.075% the compressive strength of cement also increased. Maximum strength of concrete is related on workability of cement and it can be achieved by high degree of workability.
- The compressive strength of cement measured for admixtures after 3,7 and 28 days. As the percentage of admixture increased, the compressive strength increased. The only reason for improvement of strength is bonding.
- Compressive strength of cement enhanced when dosage of admixture was increased. Cement with sugar as admixture, has given better strength values than only cement. Segregation and bleeding was very less due to the usage of these admixtures.
- Setting time of the concrete increased as the dosage of admixture was increased. Strength of the cement improved with little extra cost and utility in specified situations.
- By using admixtures like sugar the compressive strength of cement increased up to a 16 % compared to normal compressive strength.

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Comparative Study on Red Mud and GGBS In Concrete

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ABSTRACT

Faster development in industrialization leads to the maximum disposal of waste products which causes the environmental hazards. These wastes can be a substitute for conventional material, when can be utilized in the best way. Red Mud and GGBS is waste generated by the industry and its disposal is a major problem for these industries as this is highly caustic and causes ground water contamination, leading to health hazards. By taking cementatious behavior of the red mud into account, an experiment was carried out to partially replace the cement by red mud in concrete, also Ground Granulated Blast Furnace Slag (GGBS) for different percentages and also its effects on the strength and other properties of the concrete.

Keywords : Red Mud, Ground Granulated Blast Furnace Slag (GGBS) ,Compressive Strength, Tensile Strength, Slump, Industrial Waste

I. INTRODUCTION

Red mud is a solid- waste obtained from the Aluminum industry all over the world .In Western countries, about 35 million tons of red mud are produced every year. Because of the complex physico-chemical properties of red mud its challenging work for the engineers to find out the use and safe disposal of red mud. Disposal of this waste was the first major problem encountered by the alumina industry after the adoption of the Bayer process.

Ground-granulated blast-furnace slag is obtained by quenching molten iron slag from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder. GGBS used for this study is obtained from Nandi Cements, Bengaluru which is processed from slag obtained from JSW Steel plant, Bellary and SAIL, Bhadravathi. By Pycnometer investigation, the specific Gravity (G) is found to be 2.19.

Red mud or red sludge is a solid waste product of the Bayer process, the principal industrial means of refining bauxite. For the study, Red Mud is obtained from MALCO, near Mettur Dam in Salem, Tamil Nadu. The solid mass obtained is dried up in the sun light until it becomes moisture free.. Over the years, many attempts have been made to find a use for red mud, but none have proven to be economically satisfactory .In this paper the attempt is made to check the effectiveness of red mud and GGBS at 5%,10%,15%,20%,25% over Portland cement by partial replacement of cement in concrete.

II. OBJECTIVES OF THE STUDY

This paper deals with work carried out to overcome the problems due exhaustion and obsolescence of raw material required for manufacturing of conventional building material and also minimize the effect of thrust in Indusial waste on the environment by utilizing the same in the Construction Industry for the betterment.

- The use of industrial wastes in place of conventional raw materials help to decrease the effect of environmental pollution and also helps our natural resources.
- The innovation of alternate low-cost and suitable building materials from industrial wastes is an economic necessity.
- Identify industrial wastes suitable for utilization in cement manufacture industry.
- Check the constraints related with utilization of industrial waste.
- Present demand of cement is far in excess in production and is rapidly increasing day to day.

By keeping this in mind objectives are set for the present work is to check the suitability and use of neutralized red mud and GGBS as a partial replacement of Portland cement in concrete separately.

III. MATERIALS USED

3.1 Cement

The Ordinary Portland Cement (53 Grade) confirming to IS: 269-1976 was used throughout the investigation. Different tests were performed on the cement to ensure that it confirms to the requirements of the IS specifications. The physical properties of the cement were determined as per IS: 4031-1968 and are presented in Table:1

Table -1: Physical Properties of 53 Grade Cement

S.no	Characteristics	Values
1	Standard Consistency	53
2	Fineness of cement as retained on 90 micron sieve	3 %
3	Initial Setting Time	30 mints
4	Specific Gravity	3.15
5	7days compressive strength	37 Mpa

Table -2: Chemical Properties of Cement

S.no	Components	Weight
1	Lime(CaO)	63%
2	Silica(SiO_2)	22%
3	Alumina(Al_2O_3)	6%
4	Iron oxide(Fe_2O_3)	3%
5	Magnesium oxide(MgO)	2.5%
6	Sulphur trioxide & loss of ignition(SO_3)	1.5%
7	Alkalies	0.5%

3.2 Aggregates

The maximum size of coarse aggregate from investigation is 20 mm and specific gravity is 2.74. M-Sand used as fine aggregate,a nominal maximum size of 4.75 mm passing. The specific gravity of fine aggregate is 2.73.

3.3 Water

The Fresh and clean water is used for casting and curing of specimen. The water is relatively free from organic matters, silt, oil, sugar, chloride and acidic material as per requirements of IS. Combining water with a cementitious material forms a cement paste by the process of hydration. A cement paste glues the

aggregate together fills voids within it, and makes floor freely.

3.4 Red Mud

Red mud is composed of a mixture of solid and metallic oxide-bearing impurities,which solves one of the aluminium industry's most important disposal problems. The red colour is caused by the oxidized iron present, which can make up to 60% of the mass of the red mud. In addition to iron, the other dominant particles include silica, unleached residual aluminium, and titanium oxide. Red mud cannot be disposed of easily. As a waste product of the Bayer process the mud is highly basic with a Ph ranging from 10 to 13. The following is the composition of the Dry Red Mud of MALCO(Madras Aluminium Company Limited)

Table- 3: Composition of Red Mud

Components	Weight %
Al_2O_3	20-22
Fe_2O_3	40-45
SiO_2	12-15
TiO_2	1.8-2.0
CaO	1.0-2.0
Na_2O	4-5

Particle Size : less than 44 microns
Appearance & Odor : Red, Earthy odor, s light pungent

IV. CONCRETE MIX

The physical properties of blended cement (Portland cement replaced by 0%, 5%, 10%, 15%, 20% & 25%) With constant water ratio concrete design mix of grade M25 was prepared and design mix was studied for Compressive.

Table -4: Concrete Design Mix Proportions

Cement	Fine Aggregate	Coarse Aggregate	Water Content
1	1.59	2.72	0.45

Table -5: Composition of GGBS

Constituents	Weight %
SiO_2	34.4
Al_2O_3	21.5
Fe_2O_3	0.2
CaO	33.2
MgO	9.5
K_2O	0.39
Na_2O	0.34
SO_3	0.66

V. RESULTS AND DISCUSSION

The result of replacement of GGBS to the concrete is shown in Table – 6.

Block Nos	**Conventional**			**GGBS 10%**		
Day of testing	7	14	28	7	14	28
Maximum load (KN)	414	505	605	502	647	713
Compressive Strength (N/mm^2)	18.4	22.4	26.88	22.31	28.78	31.63

Block Nos	**GGBS 15%**			**GGBS 20%**		
Day of testing	7	14	28	7	**14**	**28**
Maximum load (KN)	437	599	725	**440**	**676**	**806**
Compressive Strength (N/mm^2)	19.45	26.61	32.35	**19.58**	**30.04**	**35.83**

Block Nos	GGBS 25%		
Day of testing	7	14	28
Maximum load (KN)	602	731	781
Compressive Strength (N/mm^2)	27.78	32.51	34.73

Experimental procedure carried out: The cement mix proportion of partially replacing is done as per the IS codal provision 10262:2009. For the optimal mix GGBS in concrete mix is considered, (from 5% to 25%) are prepared and compared with PCC with mix proportion of 1:1.504:2.669 are prepared as per the IS codal provision. The replacement of OPC with GGBS is done based on optimum mix. The w/c ratio is taken 0.45% for all the mixes as per the Indian codal provision. The result of replacement of GGBS to the concrete is shown in Table -6.

The cement proportion mix is done as per IS codal provision 10262:2009.

In this investigation 90 cubes specimen were tested. The mould size 150 x 150 x 150 mm is considered and is prepared different mixes to compare with compressive

strength of concrete at the age of 7 days, 14days, and 28 days strength. then tested in CTM.

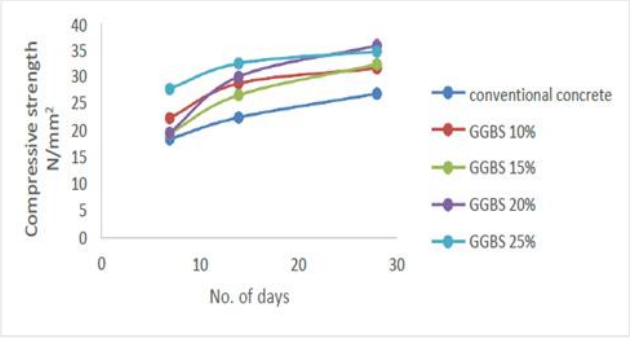
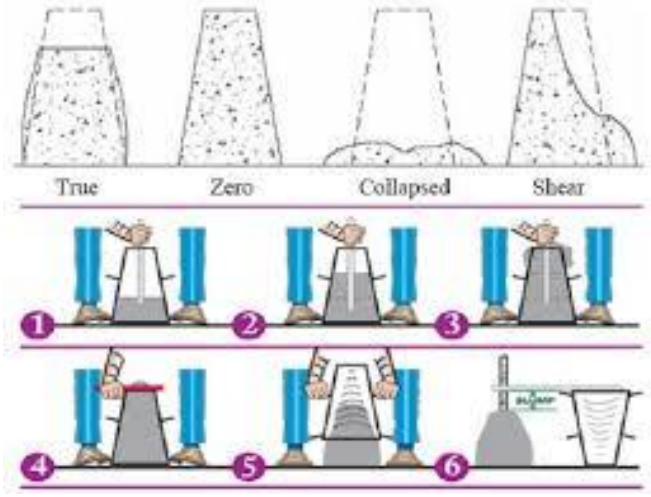


Figure 1 -BEHAVIOUR OF GGBS ON DIFFERENT PROPORTIONS

4.1 Slump Cone Test

A slump test is a method used to determine the consistency of concrete. The consistency, or stiffness, indicates how much water has been used in the mix. The stiffness of the concrete mix should be matched to the requirements for the finished product.

Graph shows the slump test results for replacement percentage which falls in the slump range.



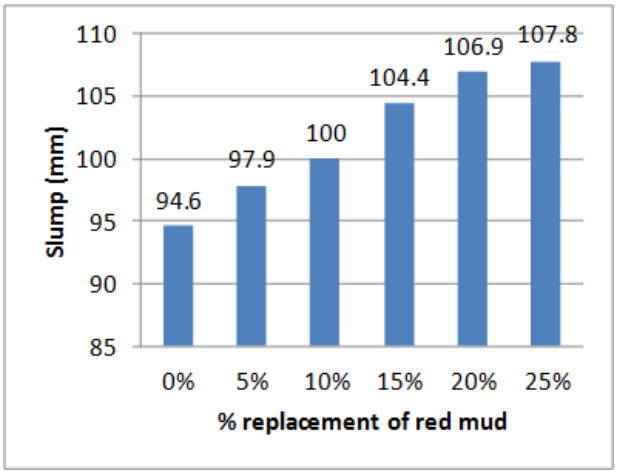


Chart -1: Slump

The workability of the concrete seems to be increasing as the percentage of red mud increasing in the mix.

Fig 1: Slump Test

4.2 Compressive Strength Test

Mechanical test measuring the maximum amount of compressive load a material can bear before fracturing. The test piece, usually in the form of a cube, prism, or cylinder, is compressed between the platens of a compression-testing machine by a gradually applied load. Brittle materials such as rock, brick, cast iron, and concrete may exhibit great compressive strengths; but ultimately they fracture. The crushing strength of concrete determined by breaking cubes and cylinders.

Fig 2: compressive strength test

Graph shows the 28 days compressive strength of red mud concrete cubes & cylinders

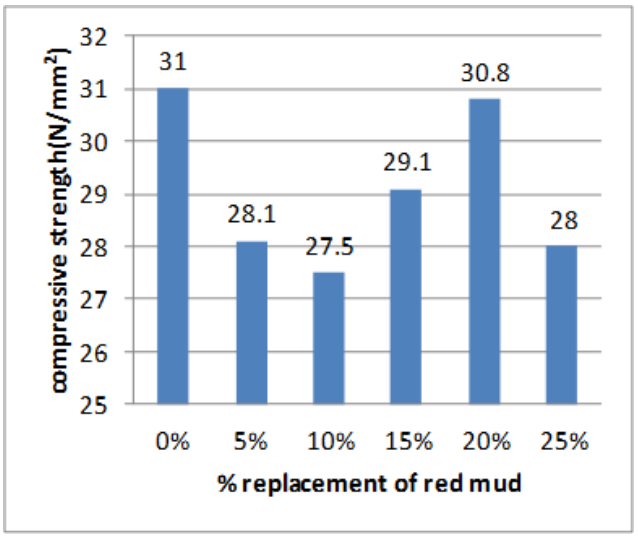


Chart -2: Compressive strength

4.3 Splitting Tensile Strength

The tensile strength is one of the basic and important properties of the concrete. The concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. However, the determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack. The cracking is a form of tension failure. This test method covers the determination of the splitting tensile strength of cylindrical concrete specimens.

Graph shows the 28 days split tensile strength of red mud concrete cylinders.

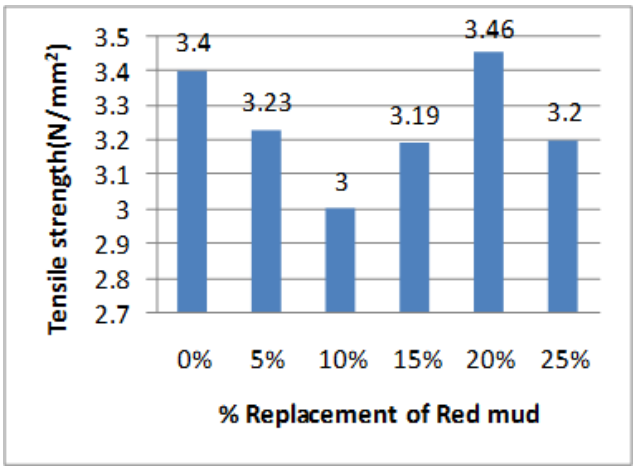


Chart -3: Splitting tensile strength

VI. CONCLUSION

From this experimental study following are concluded:

- Each percentage replacement upto 20%, the compressive strength values of the red mud concrete coincides with that of conventional concrete. But beyond 20% small reduction in strength of conventional concrete is found.
- The optimum use of slag(GGBS) in the concrete is observed to be 20% of cement & it shows higher compressive strength than OPC for 28 days strength
- From the experimental work it was found that increase in red mud content(greater than 20%) decreases the compressive strength as well as tensile strength of concrete.
- Optimum percentage of the replacement of cement by weight is found to be 20%. By this replacement results got are nearly equal to the results of conventional concrete.
- We use mixture of red mud and cement for non-structural work purpose.
- Partial replacement of cement by using red mud is suitable in ornamental works and gives aesthetically pleasant appearance.

The above results show that the optimum utilization of Red mud in concrete is 20% and GGBS is also 20% as a partial replacement of cement. This study concludes that Red mud and GGBS can be innovative supplementary cementitious materials

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Installation of Elastomeric Bearings in Gradient (Sloped) Type Bridge Constructions

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ABSTRACT

Bearings are provided in the bridge construction to transfer the load safely from superstructures to substructures. Different type of bearings is being used in different scenario. For economical consideration, Elastomeric Type Bearings are commonly used in bridge constructions. Elastomeric Bearings are to be placed in true horizontal plane below the super structures. Formation of true horizontal plane below the structures is not difficult in case of bridges constructed at " 0 "gradient, whereas special care has to be taken to create horizontal plane in case of bridges constructed in gradient.

In most of the cases, bridges constructed across the sea, creak, river, road/railway crossings are with " 0 "gradient i.e., in level condition (true horizontal plane), but in case of flyovers and metro viaducts, it is required to keep bridge structure in gradient, depends upon on topography and existing structures in the city area.

In order to create true horizontal plane at the bearing location, a separate structure called down stand/ up stand is to be formed in the girder itself.

Keywords : Elastomeric Bearing, Down Stand/Up Stand, Segmental Construction, Micro Concrete

I. INTRODUCTION

Metro Rail network in India is rapidly expanding in major Indian cities having papulation more than 30 lakhs. Around 15 cities have already been covered in metro network. Metro rail system is the only mode for mass rapid public transport in big and medium cities and lead to making growing cities more liveable and sustainable.

Metro alignments generally run through one end of the city to other end and along the outer/peripheral ring roads. Majority of the metro alignment will be elevated structure (Viaduct) and only in central business, area will be underground Tunnel.

Elevated structure (Viaduct) constructed with segmental type of pre cast, post stressed box girder and most of places bearing used in viaduct are Elastomeric Bearings, only in sharper curves and span more than 31 m, a pot PTFE type bearing are used.

Elastomeric bearings are to be placed in true horizontal plane to avoid tangential forces. The horizontal plane at bearing location can be formed by constructing the down stand/ up stand with pre-designed gradient in the girder itself.

Horizontal plane created in the pre cast pier segment changes due to various reasons., viz 1) gradient of down stand and alignment are not matching, 2) twist (small magnitude) in the segments will happen during stressing. Therefore, the plan of the soffit of the precast down stand will not be in true horizontal plane and unequal distribution of loads over the elastomeric bearing.

In order to avoid this practical difficulty, in staid off pre cast down stand, a cast in situ down stand can be formed by this innovative method.

II. EXISTING METHODS AND FLAWS

Different metro organizations have adopted different construction methodologies for installation of elastomeric bearings for pre cast post tension segmental box girder construction. However, method of forming the down stand is same in all metro constructions, but filling the gap so formed is different.

A. Placing the grout below the bearing (Fig.1)

1. Top level of bearing pedestals over pier cap/Portal Beam were casting by keeping 25 to 30 mm lower than the required level to make the room for filling the cementitious grout.
2. After matching all segments in the span and stressing operations were completed. Stressed girder placed on temporary bearing and continuing the same procedure for next span.
3. At the time of aligning and placing the girder in the final location, girder moved with the help of jacks to bring final line and level (at this operation, it will difficult to bring the pre cast down stand/up stand to exact true horizontal plane).
4. Elastomeric bearing pads were placed attaching to the down stand/up stand provided at the soffit of the pier segment, irrespective of its plane (horizontal or inclined) resulting variable gap between elastomeric bearing and top of bearing pedestal constructed on top of pier cap.
5. In order to rest the elastomeric bearing, sim plates were placed in the gap formed between elastomeric bearing pad and concrete pedestal.
6. The gap between elastomeric bearing pad and pier pedestal grout is filled with free flow from top of viaduct.
7. Proper shattering arrangement was mode to hold the grout by steel angles.
8. Finally, thickness of grout varied from 25 to 110mm in depth and grout stick to the elastomeric bearing pad.

Fig. 1 -Placing the grout above the bearing (Fig.2)

1. Pedestals are casting to the required line and level and placing the elastomeric bearing pad on the top of pedestals

2. A grout is filled through pipe (vertical duct) provided in the pre cast pier segment directly over the bearing with suitable shuttering arrangements.

Fig. 2 –Space created to pour the micro concrete

Fig. 3 –Grout placed above the bearing

B. By Fixing steel plate 16 to 25mm thick over 3 to 10 mm thick epoxy grout (Fig-3).

Fig. 4 – Steel Plate below bearing

C. Grinding the surface of the concrete at top and bottom of elastomeric bearing and filling grout if required

Fig. 5 – Grinding the surface and thin layer of grout below bearing

The above construction methods are not in accordance with the standard code of practice.

The installation procedure explained in the IRICEN Publication book at para 9.3, bearings must be placed between true horizontal surfaces (Maximum tolerance 0.2 per cent perpendicular to load) and at true plan position of their control lines marked on receiving surfaces (Maximum tolerance +/- 3mm). Concrete surface shall be free from local irregularities (Maximum tolerance +/- 1mm in depth). As par 9.7 of IRICEN publication book (Ref-2), for precast concrete or steel super structure elements, fixing of bearing to them may be done by application of epoxy resin adhesive to interface, after specified surface preparation.

Elastomeric bearings are supposed to be kept in true horizontal plane on bearing pedestal, without any foreign material. As such methodology adopted in construction of pre cast post tensioned segmental box girder is not in accordance with the procedure explained in IS code /IRICEN publications.

Some Photographs showing the failures (Fig.6 to 8)

Fig. 6 – Bearing placed with top cementitious grout without proper bonding

Fig. 7 – Bearing placed with bottom cementitious grout which reduces the effective thickness.

Fig. 8 – Grout so placed on pedestal it is coming out due to bond failure and train movement.

III. MODIFIED APPROACH

In view of the above deficiency in construction, it is proposed to construct the cast in-situ down stand in staid off pre cast down stand in the pier segment itself, so that Elastomeric bearing can be placed in true horizontal plane. This cast in-situ high strength cementitious grout (Micro concrete) shall be placed

in the recess provided in the precast segment along with shear reinforcements.

The following methodology explains the procedure of construction of cast in-situ down stand.

1. A recess shall be formed at the location of bearing in the pier segment.
2. While casting of pier segment, dowels are to be kept in order to take care of shear force, if any & hold steel mesh.
3. A duct is to be created by placing the PVC pipe in pier segment itself. This will facilitate for pouring of non-shrink concrete from top exactly over top of bearing.
4. After placing and stressing the segments and aligning the stressed segments (girder) brought to the required line and level.
5. After checking line, level and plane of bearing, a non-shrink grout is to be poured from top of the viaduct over the bearing.
6. Shuttering arrangements are to be removed after attaining the required grout strength.

With this methodology both (Top & Bottom) surface of the bearing will be in true horizontal plane and rest of the procedure will be as per IS code/ IRCEEN Publication book.

TABLE I

Comparison of existing and proposed system

Item Description	**Pre-Cast Down Stand**	**Cast in situ down stand**	**Remarks**
Concrete used to form down stand	M-50 grade	M-60 grade and above	Minimum strength of concrete is M-60 in case of cast in situ.
Plane of down stand sitting	Not in perfect horizontal plane	Perfect horizontal plane formed	Due to pre-determined plane in case of pre cast, it is very difficult to bringing to true horizontal plane
Load distribution	Not uniform due inclined plane	Uniform due true horizontal plane	Bearing failures are noticed in pre cast
Cost of construction	Less	Little More	
Life of Bearing	Failed before the manufactured warranty	Will be as per manufacturer warranty	
Maintenance	Regular maintenance required during service life	No maintenance required during service life	

IV. CONCLUSION

Additional component (down stand/ up stand) provided in the pier segment to form true horizontal plane for segmental type super structures (girders) construction shall be done with cast in-situ concrete instead of pre cast down stand/ up stand to form true horizontal plane and proper seating on bearing, so as to avoid un equal load distribution and failures in elastomeric bearings.

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Experimental Investigation of M-Sand in Concrete

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ABSTRACT

The natural river sand was the cheapest resource of sand. However the excessive mining of river bed to meet the increasing demand for sand in construction industry has led to the ecological imbalance in the country. Now the sand available in the river bed is very coarse and contains very high percentage of silt and clay. The silt and clay present in the sand reduce the strength of the concrete and holds dampness. A few alternatives have come up for the industry to bank on of which manufactured sand or M-sand (manufactured sand), as it is called, is found to be the most suitable one to replace river sand. M-sand has caught the attention of the construction industry and environmentalists alike for its quality and the minimum damages it causes to nature. Usage of M-Sand can drastically reduce the cost since like river sand, it does not contain impurities and wastages is nil since it is made with modern technology and machinery. Once them-sand becomes more popular in the construction industry, the demand for river sand and illegal sand-mining would come down. M-sand that is available is graded, sieved and washed. The particles are more rounded and granular and do not have sharp edges. Usage of M-Sand can overcome the defects occurring in concrete such as segregation, voids, capillary, etc. The main purpose of this investigation is to replace sand in concrete with M-Sand for both M-30 and M-40 grades. The test results were compared to that of conventional concrete for 7 days and 28 days. Thus from result it is concluded that m-sand can be effectively used instead of river sand in concrete.

Keywords : M-Sand, Compressive strength, Split tensile strength and Flexural Strength

I. INTRODUCTION

Concrete is a building material used in building construction, consisting of a hard and chemically inert substance known as aggregate usually made from different type of sand and gravel that is bonded together by element and water. The wide spread use of concrete in many Roman structures has ensured that aggregates cement and water.

The aggregate is generally a coarse gravel or crushed rock such as limestone or granite along with fine aggregate. Now days due to over exploitation of river sand, which results in shortage of river sand so M-sand helps by substituting the river sand. M-Sand is a substitute of river sand for concrete construction. Manufactured sand is produced from hard granite stone by crushing. The crushed sand is of cubical shape with grounded edges, washed and graded to as a construction material. The size of manufactured sand (M-Sand) is less than 4.75 mm. Usage of manufactured sand prevents dredging of river beds to get river sand which may lead to environmental disaster like ground water depletion, water scarcity, threat to the safety of bridges, dams etc. to make M-Sands more eco-friendly than river sand.

II. LITERATURE REVIEW

Numerous studies have been reported in the literature in respect of M-sand concrete. Some of the significant contributions are briefly mentioned in the literature.

Yajurved Reddy M et al.[1] describes the feasibility study on concrete made with manufacture sand as fine aggregate. They evaluated the workability characteristics in terms of slump, compaction factor and vee-bee time with addition of manufactured sand as replacement to natural sand ranging from 0-100%. To evaluate the percentage of admixture that should be added to get the required slump of 40mm-80mm. Finally the mechanical properties of concrete were tested for 3, 7 and 28 days by replacing natural sand in proportions of 0%, 20%, 40%, 60% and 100%.

Sachin kumar et al.[2] their study intended to identify the potential of using M-Sand as fine aggregates in concrete manufacturing . For the investigation M-20 grade concrete was considered. MS was replaced by the river sand with different fractions in concrete. Detail experimental investigation was undertaken to examine the physical properties of MS and strength properties of CMS. Outcomes of the results showed promising applications of MS in grade 20 concrete elements.

M.Adams Joe et al. [3] they experimentally investigate the effect of M-Sand in structural concrete by replacing river sand and develop a high performance concrete. It is proposed to determine and compare the differences in properties of concrete containing river sand and M-sand. It is also proposed to use steel fibres and chemical admixtures to increase the strength and workability of concrete respectively. The investigations are to be carried out using several test which include workability test, compressive test, tensile test, and flexural test.

Mani Kandhan. K.U et al.[4] their investigation mainly focused on the m-sand properties and the strength obtained from the both the river sand and m-sand. In order to solve the problem of the granite powder disposal from the industries and also to solve the raw material storage problem for concrete, studies are being made to utilize the m- sand in the manufacture of the varieties of building and ceramic products, this investigation also based on the comparison of compressive strength, split tensile strength, achieved by the cubes and cylinders in normal sand and m-sand

III. MATERIALS

The following materials have been used in the experimental study

a) Ordinary Portland Cement (43 grade) confirming toIS:8112-1989 [5] having specific gravity 3.10
b) Fine aggregate: M-sand confirming to zone-II of IS:383-1970[6] having specific gravity 2.56and fineness modulus of 3.05 the view of sample is given in Fig.1.
c) Coarse Aggregate: crushed granite metal confirm to IS:383-1970[6]having specific gravity 2.75 and fineness modulus of 6.15.
d) Water: clean potable water for mixing.

Fig.1 M-sand

Tests were conducted on specimen of stand a size as Per IS:516-1959 [7] Details of tests conducted and specimens used are given in Table.1

Table 1 Tests carried out as per Indian Standards

Type of tests Conducted	Size of specimen(mm)	No of specimen
Compressive strength (cube)	150x150x150	3
Split tensile Strength (cylinder)	100x200	3
Flexural strength (Beam)	100x100x500	3

IV. MIX DESIGN

The process of selecting suitable ingredients of concrete and determining their relative proportion with the object of producing a concrete of required strength, work ability as economical as possible is termed as mix design. In the present investigation M-30 and M-40 grades are taken for study. and design is done according to IS:10262-2009 [8]. The details of mix proportions are given in Table 2.

Table 2 Mix design details

Grade of concrete	water	Cement (kg/m^3)	F.A (kg/m^3) (M-Sand)	C.A (kg/ m^3)	W-C
M-30	161.41	420	600.1	1231.2	0.38
M-40	197.47	430	707.8	1053	0.36

V. RESULTS AND DISCUSSION

A. Workability

The tests on fresh concrete was done using slump cone. From Fig. 2 it is clear that flow of concrete with river sand is more as compared to M-sand. The slump values are average in case of M-sand so it is good for strength of concrete.

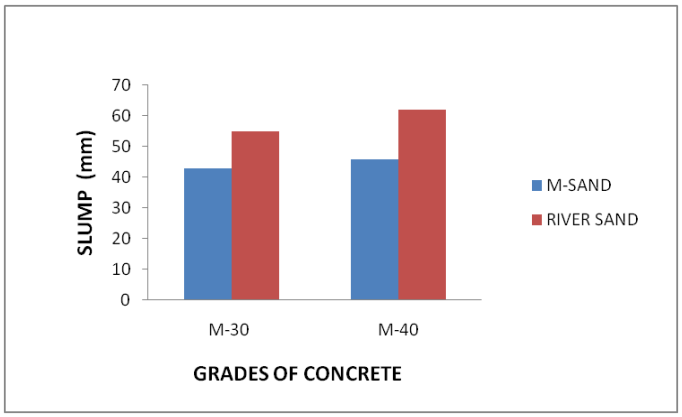

Fig. 2 Slump v/s Grades of concrete

B. Compressive strength

The compressive strength is one of the most note worthy properties of hardened concrete and is considered as the characteristic material value for the classification of concrete. Here the comparison of compressive strength of river with M-sand is done for both 7 days and 28 days curing as given in Fig.3 and Fig.4 respectively. By observing the Fig's we can say that for both 7 days and 28 days the compressive strength is higher in m-sand concrete, which is good for us. so that it will easily replace the river sand and helps in reducing dependency on river sand.

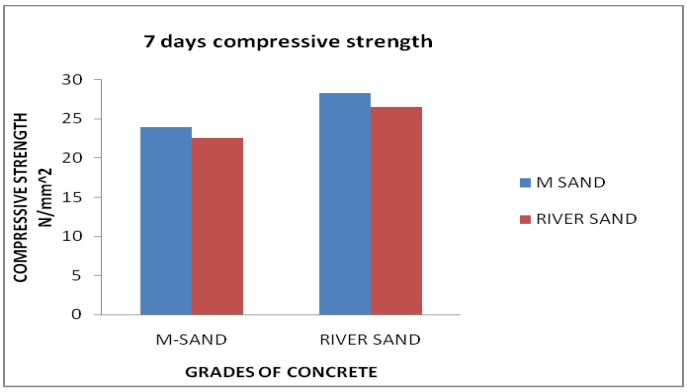

Fig. 3 Comp. strength Vs Grades of concrete (M-30)

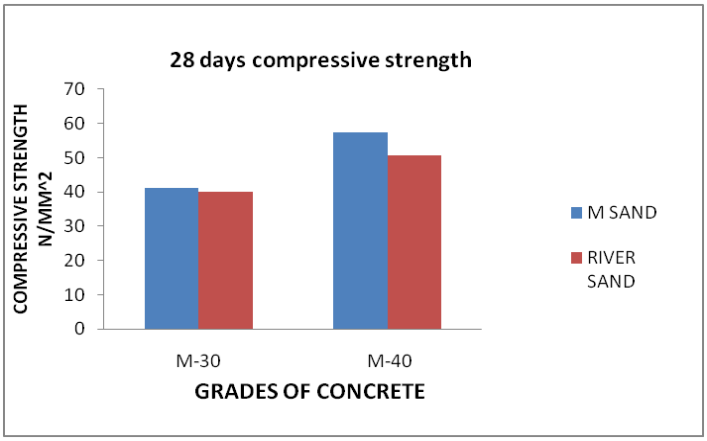

Fig. 4 Comp. strength Vs Grades of concrete (M-40)

C. Split tensile strength

Here the comparison of split tensile strength of river v/s m-sand is done for both 7 days and 28 days curing as given in Fig.5 and Fig.6 respectively. By observing the Fig's we can say that for both 7 days and 28 days the split tensile strength is higher in m-sand concrete, which is good for us. so that it will easily replace the river sand and helps in reducing dependency on river sand.

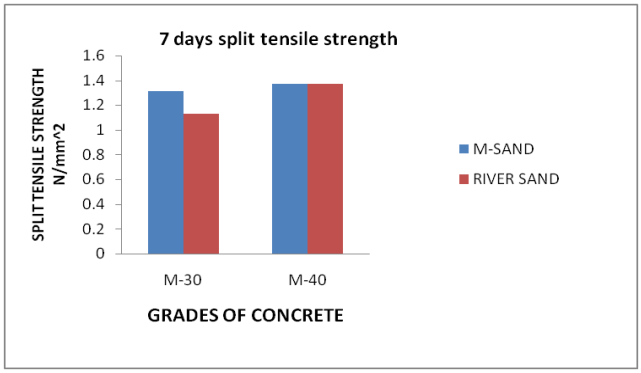

Fig. 5. Split tensile strength Vs Grades of concrete (M-30)

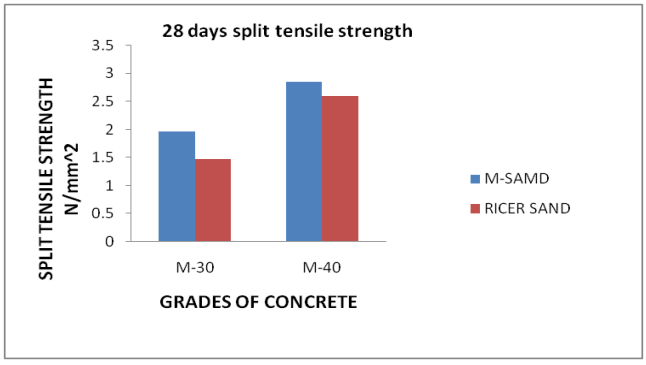

Fig. 6. Split tensile strength Vs Grades of concrete (M-40)

D. Flexural strength

The IS:456-2000[12] represents the relationship between the concrete flexural tensile strength (ft) and the compressive strength (fck) by $f_t = 0.7(fck)^{0.5}$ Here the comparison of flexural strength of river v/s m-sand is done for both 7 days and 28 days curing as given in Fig.7 and Fig.8 respectively. By observing the Fig's we can say that for both 7 days and 28 days the flexural strength is higher in m-sand concrete, which is good for us. so that it will easily replace the river sand and helps in reducing dependency on river sand.

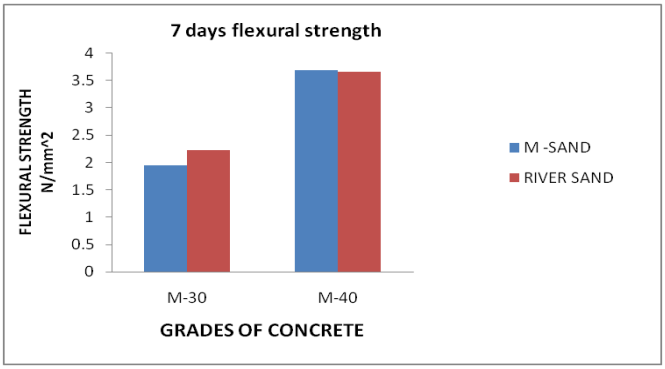

Fig. 7 Flexural strength Vs Grades of concrete (M-30)

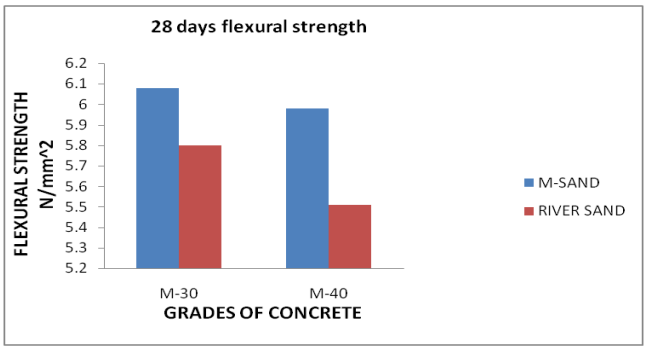

Fig. 8 Flexural strength Vs Grades of concrete (M-40)

VI. CONCLUSION

Based on the experimental investigations carried out, it can be concluded that replacing river sand with that of M-sand provides most effective result in reduction of dependency on river sand.

The workability of M-sand concrete was low compared with river sand, apart from that when we looked at the mechanical properties these concretes gave higher strength in compression, tension and flexural also. Hence in today's construction, it can be stated that M-sand can be effectively used.

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Analysis of Reinforced Embankment using Plaxis Software

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ABSTRACT

An Embankment is constructed to meet the gradient of roadway, railway, canal by keeping land flat or straight and uninterrupted. An embankment may be constructed with variable slopes and foundation strata along with different filler materials. The safety of embankment is analyzed by various methods by analytical methods or by using software which are based on FEM theories with different analysis techniques. A numerical study was carried out on an embankment having a geometrics of height 5m, with top width of 30 m and a slope of 1H:2V is considered with a phreatic level of 2 m from the bottom of the embankment. The foundation bed of Clay over Sand is considered along with Gravel as a fill material. Geosynthetics having different tensile strengths both Uni axial and Bi axial are used in the present analysis at different layers of reinforcement. PLAXIS 2D software is used for the analysis of parameters like Factor of Safety(FOS), Effective stress, Effective total stress and excess pore water pressure. The effect of reinforcement by varying tensile strength from 28.50 kN/m to 300 kN/m are analyzed. Based on the analysis Geogrid uni-axial (TGU 8-300 kN/m) proves to be more effective reinforcement for the present condition.

Keywords : Plaxis, Geosynthetics, Tensile Strength, Effective stress, Factor of Safety.

I. INTRODUCTION

An Embankment can be defined as a volume of earthen material that is placed and compacted for the purpose of raising the grade of roadway or railway above the level of the existing ground surface to meet the required gradient. The embankments may be classified as low or high embankment depending on their height and also depending on the filler materials as earth or rock filled embankment. The factor of safety plays an vital role in the embankment stability as concern. The same can be analyzed either by graphical method ,FEM or LEM methods. The software analysis involves the FEM or LEM as a base incorporating the different methods of analysis like Bishop method , Janbu's method, Fellinius method, Margesteran–price method are commonly adopted by considering the pore water pressure.

Plaxis software model was created for the geometrics and he material property , the analysis was carried out with and without reinforcement heights. The analysis was carried out to know the effective stress , displacement , effect of pore water pressure and the effect of reinforcement with its varied tensile strengths. The effect of reinforcement on stability was analyzed by using Plaxis , by decreasing the slope of the embankment and with increase in the stiffness of reinforcement the deformation is getting reduced(Payam et.al and Javed Safadoust). Based on the use of Geogrid over a weaker sub grade increases the sheaf strength of the soil (Salahudan et.al) similar study was carried out on lateritic soil and

improvement is found by analyzing the embankment by Plaxis(Anilkumar et.al and also Pavitra SW et.al). The effect of Geo textile study was carried out by Sivoshnia et.al concludes that effective place for inserting the reinforcement is in between bed and embankment. The Factor of safety can be increased by introducing the Geogrid over fly ash(Sabahat Khan et.al). Stability analysis along with the effect of the ground water table was carried out by Chih Wei if there is an incremental increase in the ground water the factor of safety decreases.

II. METHODOLOGY

For the analysis purpose a 5m height embankment having a side slope of 1V:2H and top width of 30m is considered. A clayey soil foundation over sandy soil is considered, similarly for embankment fill a well graded gravel is considered for the analysis. The pore water head is considered at 2m distance from the bottom of the embankment.

Table 1 – Properties of material used in FE Plaxis Software

Subsoil Properties	**Unit**	**Clay**	**Well graded Sand**	**Gravel**
Type of behaviour	-	Undrained	Drained	Drained
Unsaturated unit weight (γ_{Unsat})	KN/m^3	15	17	16
Saturated unit weight (γ_{sat})	KN/m^3	18	20	20
Permiebility in Horizantal (K_X)	m/day	1E-4	0.5	1
Permeability in Vertical (K_Y)	m/day	1E-4	0.5	1
Reference Young's Modulus (E_{ref})	KN/m^2	1000	30000	3000
Poisson's Ratio (v)	-	0.33	0.3	0.3
Cohesion (C)	KN/m^2	2	1	1
Friction angle (Φ)	Degree	24	34	30
Dilatancy angle(Ψ)	Degree	0	4	0
Material Model	-	Mohr-coulomb(MCM)	Mohr-coulomb(MCM)	Mohr-coulomb(MCM)

The Woven Multifilament Geotextile of 57kN/m ,45kN/m and 28.50kN/m tensile strength were considered. Geogrids having the tensile strength of 30,40 and 60 kN/m are considered. Geo composite having tensile strength of 50,100kN/m are considered.

The models are created in Plaxis for the considered geometric and assigned all the material properties as tabulated in Table1.

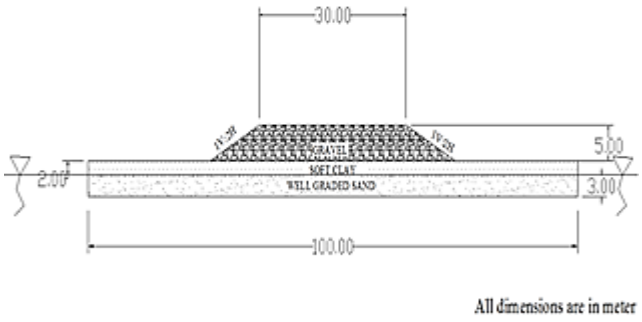

Fig 1. Dimension and the materials used in the analysis.

After generating the geometric and assigning the initial conditions of the boundary material characteristics the analysis was carried out for the Factor Safety , Effective stresses and total stresses.

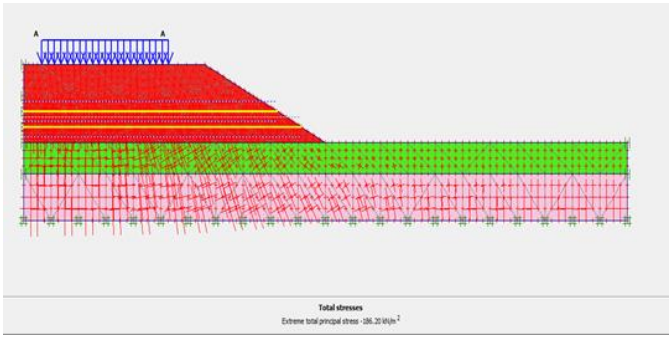

Figure 2 : Total stresses (Geotextile-57 kN /m2 -2nd layer of reinforcement)

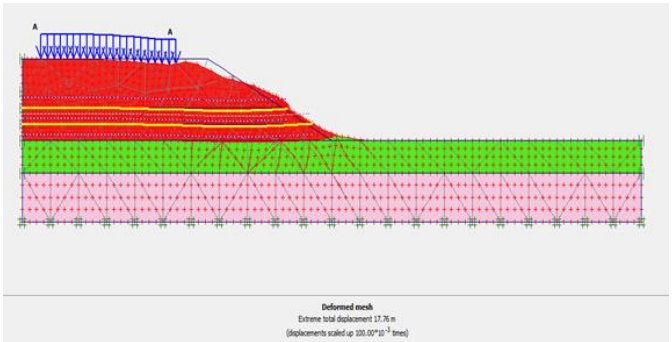

Figure 3 : Deformed mesh (Geotextile-57 kN/m2 -2nd layer of reinforcement)

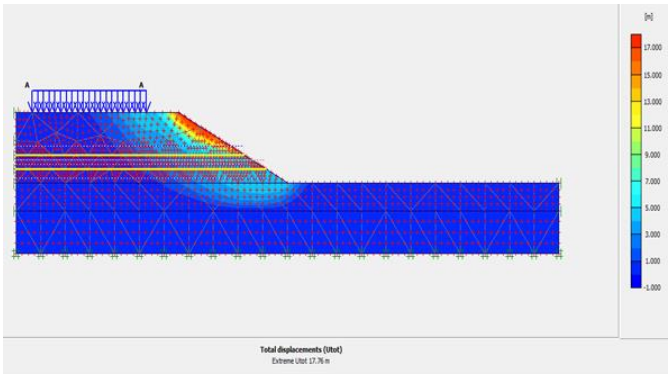

Figure 4 : Total displacement (Geotextile-57 kN/m2 - 2nd layer of reinforcement)

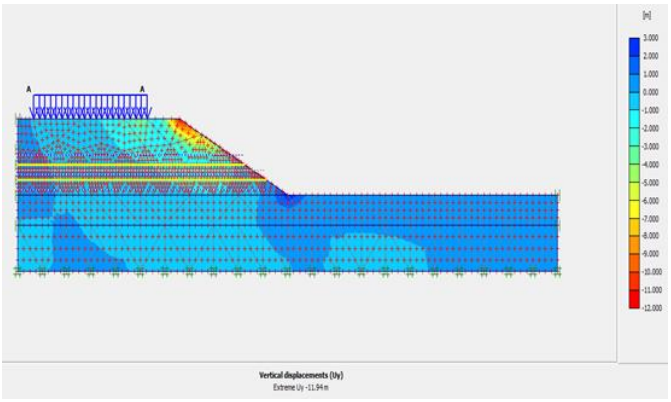

Figure 5 : Vertical displacement (Geotextile-57 kN/m2 -2nd layer of reinforcement)

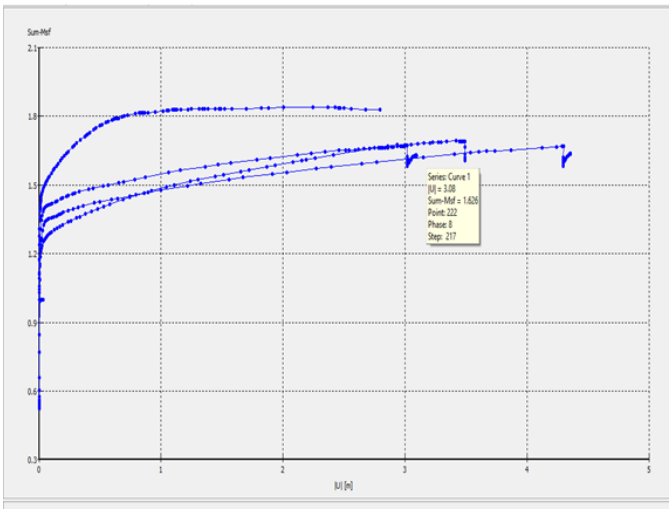

Figure 6 : Factor of safety curve (Geotextile-57 kN/m -2nd layer of reinforcement)

The output parameters obtained after analysis for the parameter FOS, Effective stresses, total displacement are tabulated in the respective tables.

Table 2. Summary result for Base model (without reinforcement)

Base model													
Foundation soil: Clay and Wellgraded sand Fill material : Gravel													
Model type	Safety factor (FOS)	Principal Effective stress,kN/m²	Principal Total stress,kN/m²	Total displacement,m			Incremental displacement,m			Total Strain (%)	Incremental strain(%)	Active pore pressure,kN/m²	Excess pore pressure,kN/m²
				Horizonatl	Vertical	Total	Horizonatl	Vertical	Total				
Base model	1.371	-157.38	-185.78	2.495	1.922	2.831	0.1432	0.11	0.1625	-51350000	-2950000	-73.98	-73.98

Table 3. Summary of results for all type of reinforcement at Interface

At Interface layer of reinforcement													
Foundation soil: Clay and Wellgraded sand Fill material : Gravel													
Type of reinforcement (kN/m)	Safety factor (FOS)	Principal Effective stress,kN /m²	Principal Total stress,kN/m²	Total displacement,m			Incremental displacement,m			Total Strain (%)	Incremental strain (%)	Active pore pressure,kN/m²	Excess pore pressure,kN/m²
				Horizonatl	Vertical	Total	Horizonatl	Vertical	Total				

Geotextile (Woven)	TFI1 (57)	1.323	-156.19	-184.8	1.715	1.085	2	0.0763	0.0537	0.0931	395.28	12.24	-66.26	-66.26
	TFI2 (45)	1.449	-158.77	-186.51	2.321	2.521	3.35	0.104	0.116	0.154	$10.22*10^3$	-492.5	-33.76	-33.76
	TFI3 (28.5)	1.861	-153.44	-181.84	1.73	1.032	1.836	0.0137	0.0081	0.0144	-760.64	7.32	-35.8	-35.8
Geogrid (Biaxial)	TGB1 (30)	1.378	-157.99	-186.4	1.937	1.517	2.044	0.199	0.214	0.285	$5.99*10^3$	915.41	-64.44	-64.44
	TGB2 (40)	1.392	-158.01	-186.42	1.241	1.358	1.816	0.076	0.085	0.113	$11.20*10^3$	-721.33	-74.59	-74.59
	TGB3 (60)	1.455	-157.95	-186.38	1.732	1.874	2.498	0.192	0.211	0.28	$15.57*10^3$	-1780	-34.18	-34.18
Geogrid (uniaxial)	TGU1 (60)	1.455	-157.95	-186.38	1.732	1.874	2.498	0.192	0.211	0.28	$15.57*10^3$	-1780	-34.18	-34.18
	TGU2 (80)	1.27	-156.31	-184.92	2.94	1.722	3.2	0.107	0.074	0.13	-164.1	-5.85	-64.87	-64.87
	TGU3(100)	1.446	-215.71	-216.45	1.262	1.374	1.83	0.15	0.164	0.218	$57.96*10^3$	$6.94*10^3$	-150.05	-150.05
	TGU4(120)	1.451	-214.58	-221.87	1.243	1.374	1.826	0.131	0.145	0.193	$57.80*10^3$	$6.12*10^3$	-149.77	-149.77
	TGU5(150)	1.454	-223.99	-342.27	1.31	1.47	1.94	0.116	0.131	0.173	$126.32*10^3$	-11290	-266.57	-266.57
	TGU6(200)	1.446	-223.86	-406.9	2.03	2.37	3.06	0.098	0.114	0.148	$207.55*10^3$	$10.03*10^3$	-329.15	-329.15
	TGU7(250)	1.456	-218.74	-439.81	2.24	2.59	3.37	0.123	0.142	0.185	$223.04*10^3$	$12.24*10^3$	-360.86	-360.86
	TGU8(300)	1.455	-212.1	-476.59	1.38	1.585	2.065	0.131	0.15	0.196	$270.97*10^3$	$25.72*10^3$	-396.36	-396.36
Geo-composite	TGC1 (50)	1.25	-156.6	-185.21	0.225	2.039	2.055	0.0077	0.0747	0.074	$4.08*10^3$	82.9	-65.15	-65.15
	TGC2(100)	1.446	-215.71	-216.45	1.262	1.374	1.83	0.15	0.164	0.218	$57.96*10^3$	$6.94*10^3$	-150.05	-150.05

Table 4. Summary of results for all type of reinforcement at 1st layer.

1st layer of reinforcement														
Foundation soil: Clay and Wellgraded sand Fill material : Gravel														
Type of reinforcement (kN/m)		Safety factor (FOS)	Principal Effective stress,kN/m²	Principal Total stress,kN/m²	Total displacement,m			Incremental displacement,m			Total Strain (%)	Incremental strain (%)	Active pore pressure,kN/m²	Excess pore pressure,kN/m²
					Horizonatl	Vertical	Total	Horizonatl	Vertical	Total				
Geotextile (Woven)	TFI1 (57)	1.481	-158.73	-187.14	1.213	1.24	1.686	0.15	0.16	0.213	$5.43*10^3$	737.62	-28.41	-20.97
	TFI2 (45)	1.48	-158.58	-186.99	1.519	1.46	2.036	0.107	0.115	0.153	$2.32*10^3$	212.07	-28.4	-22.

													1	99
	TFI3 (28.5)	1.475	-158.36	-186.77	2.308	1.994	2.926	0.109	0.116	0.155	1.31*10^3	106.77	-28.41	-24.73
Geogrid (Biaxial)	TGB1 (30)	1.491	-158.43	-186.84	1.342	1.209	1.74	0.118	0.126	0.169	1.73*10^3	232.48	-28.41	-24.04
	TGB2 (40)	1.492	-158.41	-186.82	1.621	1.557	2.176	0.113	0.121	0.162	2.48*10^3	-222.67	-28.41	-22.2
	TGB3 (60)	1.49	-158.7	-187.11	1.598	1.657	2.24	0.164	0.175	0.234	7.36*10^3	807.19	-28.41	-20.92
Geogrid (Uniaxial)	TGU1 (60)	1.49	-158.7	-187.11	1.598	1.657	2.24	0.164	0.175	0.234	7.36*10^3	807.19	-28.41	-20.92
	TGU2 (80)	1.491	-158.63	-187.04	1.607	1.705	2.284	0.349	0.372	0.498	31.22*10^3	6.87*10^3	-28.41	-21.63
	TGU3(100)	1.495	-158.57	-186.98	1.745	1.859	2.484	0.16	0.171	0.228	34.09*10^3	3.17*10^3	-28.41	-21.91
	TGU4(120)	1.496	-158.69	-187.1	1.05	1.119	1.568	0.12	0.128	0.172	51.37*10^3	5.93*10^3	-28.41	-21.88
	TGU5(150)	1.497	-158.63	-187.04	2.32	2.48	3.3	0.276	0.296	0.395	114.01*10^3	13.67*10^3	-28.41	-22.46
	TGU6(200)	1.506	-158.23	-186.64	1.41	1.5	2	0.138	0.147	0.197	138.13*10^3	13630	-28.41	-21.98
	TGU7(250)	1.504	-181.43	-186.76	1.713	1.828	2.442	0.183	0.195	0.26	8.44*10^6	901.72*10^3	-28.53	-28.53
	TGU8(300)	1.51	-157.94	-186.35	1.51	1.61	2.16	0.083	0.0887	0.11884	148.90*10^3	-8180	-28.41	-21.07
Geo-composite	TGC1 (50)	1.492	-158.72	-187.13	1.616	1.574	2.186	0.05505	0.054	0.07225	2.57*10^3	-99.9	-28.41	-22.53
	TGC2(100)	1.49	-158.57	-186.98	1.745	1.859	2.484	0.16	0.171	0.228	34.09*10^3	3.17*10^3	-28.41	-21.91

Table 5. Summary of results for all type of reinforcement at 2nd layer.

2nd layer of reinforcement														
Foundation soil: Clay and Wellgraded sand Fill material : Gravel														
Type of reinforcement (kN/m)		Safety factor (FOS)	Principal Effective stress,kN/m²	Principal Total stress,kN/m²	Total displacement,m			Incremental displacement,m			Total Strain (%)	Incremental strain (%)	Active pore pressure, kN/m²	Excess pore pressure ,kN/m²
					Horizontal	Vertical	Total	Horizontal	Vertical	Total				
Geotextile (Woven)	TFI1 (57)	1.62	-157.8	-186.2	1.637	1.194	1.776	0.0075	0.0055	0.0079	1.27*10^3	-9.04	-28.41	-27.1
	TFI2 (45)	1.606	-157.77	-186.17	1.725	1.236	1.874	0.0101	0.00752	0.0106	1.21*10^3	-12.28	-28.41	-27.09
	TFI3 (28.5)	1.608	-153.16	-181.56	2.131	1.231	2.305	0.0025	0.0019	0.0026	-1380	2.65	-34.72	-34.72
Geogrid (Biaxial)	TGB1 (30)	1.607	-152.29	-180.67	2.424	1.43	2.613	0.00154	0.00115	0.00161	-1470	-1.6	-35.42	-35.42
	TGB2 (40)	1.607	-152.29	-180.67	2.424	1.43	2.613	0.00154	0.00115	0.00161	-1470	-1.6	-35.42	-35.42

	TGB3 (60)	1.625	-152.71	-181.32	2.564	1.452	2.736	0.00949	0.00718	0.00996	-922.27	-4.96	-52.13	-52.13
Geogrid (uniaxial)	**TGU1 (60)**	1.625	-152.71	-181.32	2.564	1.452	2.736	0.00949	0.00718	0.00996	-922.27	-4.96	-52.13	-52.13
	TGU2 (80)	1.635	-153.34	-181.75	2.928	1.943	3.13	0.0756	0.0561	0.0793	-990.17	-39.83	-33.19	-33.19
	TGU3(100)	1.635	-152.64	-181.06	1.906	1.316	2.025	0.156	0.114	0.163	-1530	-166.16	-33.17	-33.17
	TGU4(120)	1.64	-152.99	-181.4	2.02	1.419	2.141	0.0348	0.0253	0.0336	-1710	-35.96	-32.87	-32.87
	TGU5(150)	1.637	-155.55	-182.13	2.013	1.432	2.126	0.0549	0.0399	0.0577	-1800	-57.12	-31.76	-31.76
	TGU6(200)	1.62	-157.23	-185.64	2.134	1.599	2.244	0.104	0.0775	0.109	$4.75*10^3$	238.43	-28.41	-21.74
	TGU7(250)	1.626	-157.34	-185.75	2.825	2.111	2.971	0.198	0.148	0.208	$6.42*10^3$	458.12	-28.41	-21.44
	TGU8(300)	1.628	-157.37	-185.78	2.295	1.718	2.41	0.13	0.097	0.137	$12.30*10^3$	-708.31	-28.41	-21.05
Geo-composite	**TGC1 (50)**	1.62	-152.82	-181.22	1.909	1.224	2.057	0.042	0.0314	0.044	-1090	-44.01	-32.95	-32.95
	TGC2(100)	1.622	-152.64	-181.06	1.906	1.316	2.025	0.156	0.114	0.163	-1530	-166.16	-33.17	-33.17

Table 6. Summary of results for all type of reinforcement at 3rd layer.

3rd layer of reinforcement														
Foundation soil: Clay and Wellgraded sand Fill material : Gravel														
Type of reinforcement (kN/m)		**Safety factor (FOS)**	**Principal Effective stress,kN/m²**	**Principal Total stress,kN/m²**	**Total displacement,m**			**Incremental displacement,m**			**Total Strain (%)**	**Incremental strain (%)**	**Active pore pressure,kN/m²**	**Excess pore pressure,kN/m²**
					Horizontl	**Vertical**	**Total**	**Horizonatl**	**Vertical**	**Total**				
Geotextile (Woven)	**TFI1 (57)**	**1.74**	-152.55	**-180.95**	1.495	0.908	1.684	0.0076	0.0073	0.0096	-633.07	7.63	-34.12	-34.12
	TFI2 (45)	**1.74**	-152.72	-181.12	1.83	1.102	1.966	0.0126	0.012	0.0158	-764.03	12.55	-36.78	-36.78
	TFI3 (28.5)	1.876	-152.54	-180.95	3.15	1.89	3.35	0.0304	0.0201	0.0334	-1370	-12.02	-42.6	-42.6
Geogrid (Biaxial)	**TGB1 (30)**	1.896	-154.78	-183.18	2.231	1.312	2.359	0.0328	0.0215	0.0356	-2130	30.11	-45.14	-45.14
	TGB2 (40)	1.889	-154.77	-183.17	1.67	0.985	1.767	0.00269	0.00236	0.00316	-1590	3.86	-44.46	-44.46
	TGB3 (60)	1.882	-154.69	-183.1	2.236	1.34	2.388	0.00152	0.0015	0.00196	-1060	1.37	-42.1	-42.1

													4	4
Geogrid (uniaxial)	TGU1 (60)	1.882	-154.69	-183.1	2.236	1.34	2.388	0.00152	0.0015	0.00196	-1060	1.37	-42.14	-42.14
	TGU2 (80)	1.747	-154.7	-183.11	1.668	0.98	1.824	0.00597	0.00578	0.00759	-791.85	5.74	-39.98	-39.98
	TGU3 (100)	1.75	-154.49	-182.9	1.416	0.858	1.58	0.0224	0.0219	0.0288	-623.46	-22.13	-38	-38
	TGU4 (120)	1.751	-155.07	-183.47	1.526	1.006	1.728	0.0312	0.0301	0.0398	-578.3	32.02	-39.43	-39.43
	TGU5 (150)	1.754	-154.09	-182.5	1.408	1.032	1.636	0.0662	0.0632	0.0838	703.76	67.24	-35.56	-35.56
	TGU6 (200)	1.752	-153.81	-182.21	2.124	1.971	2.635	0.101	0.099	0.131	$3.98*10^3$	-208.26	-28.41	-27.14
	TGU7 (250)	1.729	-154.3	-182.71	2.243	2.138	2.83	0.137	0.134	0.1765	$8.75*10^3$	-556.96	-28.41	-26.71
	TGU8 (300)	1.742	-154.15	-182.56	2.682	2.532	3.36	0.0929	0.0912	0.12	$5.22*10^3$	-192.39	-28.41	-26.69
Geo-composite	TGC1 (50)	1.742	-154.58	-182.99	2.644	1.552	2.8	0.00139	0.00135	0.00796	-1250	-1.25	-43.25	-43.25
	TGC2 (100)	1.75	-154.49	-182.9	1.416	0.858	1.58	0.0224	0.0219	0.0288	-623.46	-22.13	-38	-38

Table 7. Summary of results for all type of reinforcement at 4th layer.

4th layer of reinforcement														
Foundation soil: Clay and Wellgraded sand Fill material : Gravel														
Type of reinforcement (kN/m)		Safety factor (FOS)	Principal Effective stress,kN/m²	Principal Total stress,kN/m²	Total displacement,m			Incremental displacement,m			Total Strain (%)	Incremental strain (%)	Active pore pressure, kN/m²	Excess pore pressure,kN/m²
					Horizontal	Vertical	Total	Horizontal	Vertical	Total				
Geotextile (Woven)	TFI1 (57)	2	-153.6	-182.01	1.41	0.848	1.496	0.00122	0.00066	0.00127	-623.73	$590.9*10^{-3}$	-35.19	-35.19
	TFI2 (45)	1.861	-153.44	-181.84	1.73	1.032	1.836	0.0137	0.0081	0.0144	-760.64	7.32	-35.8	-35.8
	TFI3 (28.5)	1.849	-152.81	-181.22	2.048	1.238	2.166	0.0258	0.016	0.0272	-842.61	14.49	-33.37	-33.37
Geogrid (Biaxial)	TGB1 (30)	1.945	-156.52	-184.93	1.934	1.158	2.036	0.0428	0.0275	0.0446	-1870	48.38	-45.14	-45.14
	TGB2 (40)	2.03	-157.3	-185.71	1.694	1.012	1.786	0.027	0.0169	0.0281	-1670	-29.51	-45.91	-45.91
	TGB3 (60)	2.148	-156.99	-185.39	2.3	1.33	2.422	0.026	0.0138	0.026	-1090	-15.64	-43.53	-43.53
Geogrid (uniaxial)	TGU1 (60)	2.148	-156.99	-185.39	2.3	1.33	2.422	0.026	0.0138	0.026	-1090	-15.64	-43.53	-43.53
	TGU2 (80)	1.819	-158	-186.41	2.244	1.342	2.354	0.027	0.0134	0.0301	-1080	-24	-45.01	-45.01
	TGU3 (100)	2.055	-158.09	-186.49	1.836	1.084	1.924	0.00026	0.0002	0.00028	-871.89	0.00598	-44.21	-44.21

	TGU4 (120)	2.065	-158.12	-186.52	1.548	0.912	1.62	0.00052	0.00039	0.00056	-729.65	-1.2	-43.11	-43.11
	TGU5 (150)	2.073	-158.11	-186.52	3.135	1.84	3.28	0.00464	0.00324	0.00487	-586.58	4.25	-41.81	-41.81
	TGU6 (200)	2.009	-152.63	-181.04	2.2	1.422	2.248	0.366	0.274	0.38	$3.50*10^3$	-695.75	-31.95	-31.95
	TGU7 (250)	2.01	-152.72	-181.13	2.872	1.958	2.944	0.216	0.161	0.224	$4.90*10^3$	411.05	-31.65	-31.65
	TGU8 (300)	2.009	-152.8	-181.21	2.02	1.429	2.08	0.164	0.122	0.17	$7.22*10^3$	623.95	-31.18	-31.18
Geo-composite	TGC1 (50)	2.267	-157.77	-186.17	3.14	1.898	3.26	0.026	0.0154	0.0268	-1560	12.74	-46.56	-46.56
	TGC2 (100)	2.049	-158.09	-186.49	1.836	1.084	1.924	0.00026	0.0002	0.00028	-871.89	0.00598	-44.21	-44.21

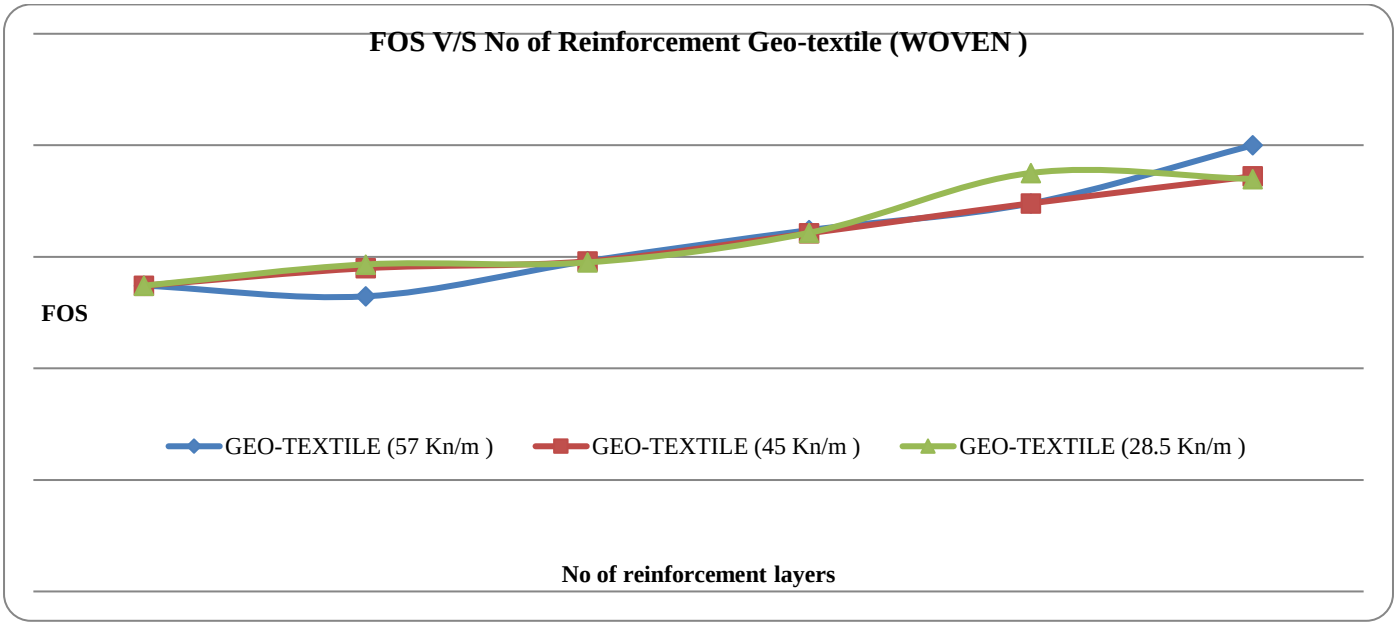

Figure 7. Variation of Tensile strength of Reinforcement(Geotextile) v/s Factor of safety

Similarly the analysis was carried out for different types of the reinforcement.

III. CONCLUSION

a) For stability point of view all the reinforcement are having FOS > 1.5 equal to 1.5 at two layers of reinforcement.

b) The effective stress are considerable reduced by using Geogrid Uniaxial having tensile strength of 300 kN/m2.

c) Minimum of two layer of reinforcement is essential as per the data assumed irrespective of tensile strength of the reinforcement.

d) Over all Geogrid Biaxial proven to be more effective reinforcement for the embankment.

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Flexural Strength of Geopolymer Concrete Beam Using GGBS

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ABSTRACT

Cement is the most consumed product in the world, contributes nearly 7%of the global carbon dioxide emission. In order to reduce the use of portland cement in concrete address the warming issues. Geopolymer concrete is a cementless concrete. The geopolymer concrete was prepared with GGBS as the primary binder instead of cement. The Flexural strength test on concrete was made. This study compares the flexural strength of geopolymer concrete based on GGBS. Geopolymer concrete is made by mixing GGBS, fine aggregate, coarse aggregate and alkaline activator solution. GGBS is a by-product of the iron industry. This paper shows the results on experimental investigation done on reinforced geopolymer concrete beams to know the flexural behaviour. The alkaline activator solution is prepared by sodium hydroxide NaOH and sodium silicate Na2SiO3 in 1:2.5 ratio. The flexural behaviour of the beams is examined with different molars of NaOH solution. The GPC beams are compared with conventional reinforced concrete beam of M40 grade concrete. The type of curing adopted in the experimental study is ambient. The size of beam is 1200 mm × 150 mm × 150 mm. The flexural test is done on the loading frame of capacity 200 tons. The ultimate load, cracking load and the maximum deflection and the crack pattern is determined and the load Vs deflection graphs are plotted. This experimental study gives a clear conclusion on the flexural behaviour of conventional reinforced concrete beam and reinforced geopolymer concrete beam made with GGBS.

Keywords : GGBS, Geopolymer, Ordinary Portland Cement

I. INTRODUCTION

The development on the planet is in a fast way and enterprises are likewise expanding because of this the garbage removal was in a huge scope. Legitimate usage of modern waste in the development field turns into a significant job. What's more, on the opposite side the an Earth-wide temperature boost is a tremendous issue, the reason for an unnatural weather change is for the most part by discharge of greenhouse gases from enterprises into the environment. Carbon dioxide is one of the significant greenhouse gases, and the concrete assembling ventures additionally transmits CO2. In this angle, geopolymer innovation can be utilized in the solid as the option of OPC. A soluble activator is needed to respond with the silica and aluminum in the source material in light of this a synthetic response happens which is called as polymerization measure and "geopolymer" is named for this sort of fasteners. These geopolymer cements are required where natural conditions are not appropriate for OPC concrete.

The total populace is expanding quickly and the developments are likewise expanding as indicated by the populace for different requirements, because of this need of concrete is more as we as a whole know while concrete is fabricating parcel of contamination discharges into the climate. In the construction of structures need of steel is main so that the production of steel is also more, while iron in manufacturing ground granulated blast furnace slag(GGBS) is produced which is a by-product. Increasing in quantity of GGBS disposal will cause environmental problems. As the pace of construction increases the use of ordinary portland cement (OPC) increases. As a civil engineer we know the problems that are related to environmental issues while cement is manufactured. Huge amount of fossil fuels are consumed for the production of cement and also CO2 is emitted in to the upper air which is almost equal to the quantity of cement produced. Lot of research works have been carried out for several years to conform geopolymer concrete as best construction material. There is a need of alternative concrete like geopolymer concrete, where large scale of wastes were disposed from the industries. These geopolymer concretes were used where the environmental conditions are not supporting the OPC concrete structures such as chemical resistant structures geopolymer concrete is used. In India like country the use of geopolymer concrete was increasing in various applications. Geopolymer concrete is durable, because of silica and alumina were present. As conventional concrete is reinforced the concrete made of geopolymer should also reinforced for its structural applications. By this study the flexural behaviour of the geopolymer concrete beams were studied. This paper deals with reinforced geopolymer concrete beams made with 100% of GGBS under ambient curing. The reinforced geopolymer concrete beams were compared with reinforced beams made with OPC. A total of 7 beams were cast, in that 6 geopolymer concrete mixes and the remaining 1 is of ordinary Portland cement mix made of M40 grade. Behaviour aspects like load carrying capacity and deflection were studied. This paper analyse the flexural strength behaviour of reinforced geopolymer concrete beams (RGPC) with beams made of reinforced ordinary Portland cement concrete.

II. MATERIALS AND METHODOLOGY

GGBS is the result of the impact heater and which has been utilized for iron assembling, around 1500 degrees centigrade coke, iron metal and limestone are taken care of into the heater. Where the iron metal becomes iron and the leftover materials structures like liquid slag and that glides on top surface with the iron in the heater and this slag is taken out from the heater and fast extinguishing with water after that it structures like granulated slag and this slag is pounded after this cycle GGBS is framed.Ground-granulated slag is synthesized through process of quenching. It is amorphous in nature and formed a result of slag quenching from blast furnace. It can also be seen as auxillary product during production of steel which can aid in concrete technology.

Table 1: Chemical Composition of GGBS

Sl no	Characteristics	GGBS (%Wt)
1	Al2O3	7-12
2	CaO	34-43
3	S	1.0-1.9
4	MgO	0.15-0.76
5	SiO2	27-38
6	MnO2	7-15
7	Fe2O3	0.2-1.6

Alkali solution Soluble arrangement is the blend of the sodium silicate and sodium hydroxide with the water which shapes the antacid arrangement. These arrangement was needed to be readied 24 hr before the projecting. The distinctive convergence of NaOH arrangement were set up in the lab the NaOH arrangements are set up by computing the amount NaOH arrangement is being needed according to plan

and for that the amount NaOH pellets are needed by doing molarity estimations. Sodium silicate of 40% fixation and required evaluation was added to sodium hydroxide arrangement and the antacid arrangement will be readied. A compound sodium metasilicate will be the regular name for sodium silicate (Na2SiO3). It was helpful as fluid and strong. Sodium silicate arrangement is utilized in assembling of concrete and car. Silicon dioxide and sodium carbonate which responds in liquid state to shape sodium silicate and the carbon dioxide.

Figure 1: NaOH Flakes & NaOH solution

Fine aggregates size should be less than 4.75mm its size ranges from 4.75mm to 150 micron. The fraction of finer than 150 microns is considered as dust or it may be silt. Due to this development in construction and infrastructure, fine aggregates are available in various categories like manufactured sand similarly known as M-sand, natural or river sand etc. The fine aggregates are the particles which passes through 9.5mm sieve, almost entirely passing the 4.75mm sieve and predominantely retained on a 75micron sieve are called fine aggregates. Sieve analysis is done for determining the finess of sand, it should be good graded and less silt content.

Coarse aggregate is the main constituent of concrete. Hence, properties and characteristics of fresh and hardened concrete are siginificantly affected by the properties coarse aggregate. Coarse aggregate provides the interlocking between them and thats help to increase the strength. Aggregates provide about 75% of the concrete volume making it a very important constituent. They should meet certain requirements with respect to grading, size, shape and strength. Of course, the characteristics of concrete are also affected by the properties of other constituent materials like cement, fine aggregate, chemical and mineral admixtures, SCM's etc. by viewing all these, concrete performance will also affected by the proportionating of constituent materials, method of mixing, transporting, placing, compaction and curing

Cement concrete is a latch, a material used for development advancement that sets, cements and holds quick to various issues to tie together. Concrete was blended in with fine absolute produces mortar for block work, or with sand and creates concrete. Concrete is the most by and large used material in present.

III. EXPERIMENTAL PROGRAMME

Initial trial mixes are made to achieve a proper mix for geopolymer concrete with proper workability to caste geopolymer concrete specimens. For trailing purpose we have casted a specimens of 70*70*70mm size were casted for which alkaline fluid to which binder ratio will be taken as 0.3 and for nominal mix concrete M40 grade of concrete as been taken accordingly from the references. The alkaline solution ratio will varies from 0.5 to 2.5 in the intervals of 0.5 and the cubes will be casted and oven dried for 3days. Later those cubes will be tested for compression strength in compression testing machine to decide the value of Na2SiO3 and NaOH ratio. After that the cubes will be casted in the size of 150*150*150mm in different molarities like 8M, 10M, 12M, 14M and those cubes will be cured for 7days and 28days and the cubes will be tested in compression testing machine for 7days strength and 28days strength. For testing reason a stacking outline was utilized and all the course of action was made to test the beam. Jack and metal plates were submitted on the shaft in request to give burden to the beam .In this trial study glass strands and epoxy were utilized .For this proposed work four genuine light emission 1200*150*150mm were casted. Seven beam was casted with reinforcements M40, 8M to 16M. For calculating the cracking and ultimate load.

Table 2: Mix proportions

Design parameters	Value	Unit	Experimental work
Wet density of GPC	2400	Kg/m3	Constant
Ratio of alkaline solution	2.5	Constant	Constant
Alkaline to GPC binder	0.3	Constant	Constant
Molarity Solution	8M-16M	Molarity	Variable
GGBS	40%-60%	Percentage	Variable
FA	35%	Percentage	Constant
CA	65%	Percentage	Constant

The flexural quality of strengthened bar made with GPC .The beam is made with 4-12mm diameter bars and stirrups are given at 150mm c/c of 8mm diameter. The test is taken in thought for three point stacking and test was accomplished for 7days and 28 days quality for M40, 8M, 10M, 12M, 14M, 16M. The outcomes are taken for the conclusion and conversation

IV. RESULTS AND DISCUSSIONS

The reinforced GPC beam is casted of size 1200x150x150 mm. The main objective of this test was to analyse how GPC going to react when slenderness ratio is increased by increasing its length and it is going to react to the reinforcement. The major problem in the concrete we see that how it is binding with the reinforcement.

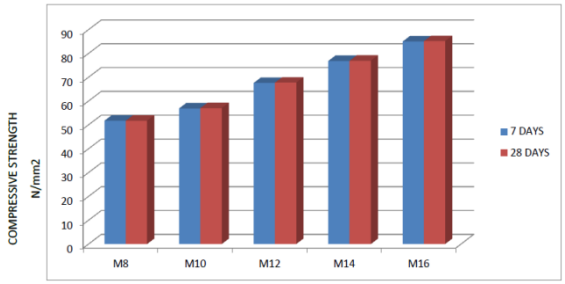

Figure 2: Graph of 7days and 28days of Compressive Strength

Table 3: Flexural strength of concrete

Grade& Molarity of Concrete	Flexural strength in N/mm2
M40	37.68
8M	37.86
10M	39.49
12M	46.18
14M	50.78
16M	52.43

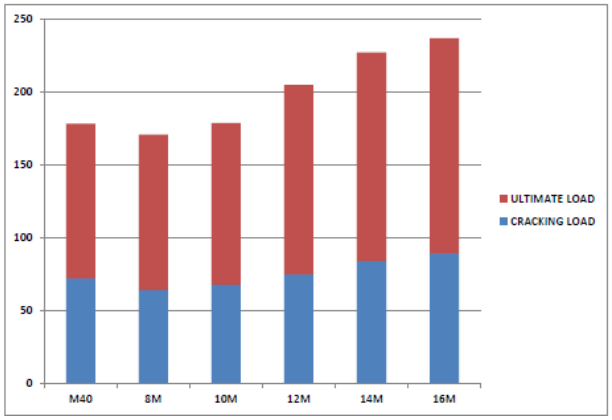

Figure 3: Cracking load and ultimate load

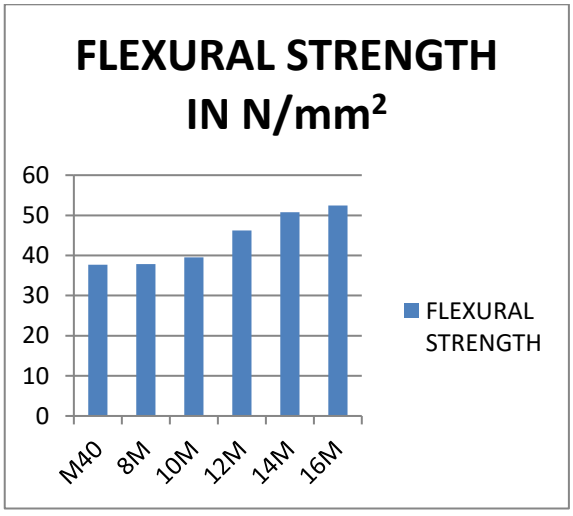

Figure 4: flexural strength of concrete

From the flexural strength test of reinforced geopolymer concrete beam we can get the load and deflection graph and watch the cracking at the specific load it is called as cracking load.

From the load deflection graph the cracking and ultimate load can be seen and the pattern of cracking can be analysed. Cracking occurred faster in OPC beam than GPC beam and after cracking reaching to the ultimate load takes some time this was more in GPC beam as compared to the OPC beam so it gives more time to the observer and for taking the preventive measure

V. CONCLUSION

Based on experimental studies that were carried out on conventional concrete beam and GPC beams it can be concluded that:

a. The compressive strength of the GPC are higher than the OPC.
b. The GPC beams can sustain higher loads even after combining with reinforcements.
c. The failure occurred in the beams were in flexural mode. The cracks propagated from the tension zone to the compression zone.
d. The load carrying capacity of the GPC beams increases as the sodium hydroxide concentration increase in terms of molarity.
e. The load deflection graph shows that crack comes in OPC is faster than GPC and its propagation is also faster.
f. From all these studies it can be concluded that GPC possess higher strength than OPC in all type of tests.
g. GPC has various advantages and this test it can be concluded that it is safe for construction and it full fills our needs as construction engineer.
h. Geo polymer concrete can be recommended as an innovative construction material for the use of construction.
i. Apart from less energy intensiveness, the GPCs utilize the industrial wastes for producing the binding system in concrete. There are both environmental and economical benefits of using GGBS.

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A Comparative Study of SCC with and without Fibre

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ABSTRACT

A self-compacting concrete (SCC) is the one that can be placed in the formwork and can go through obstructions by its own weight and without the need of vibration. The primary aim of this study is to increase the strength properties of SCC with the addition of PP fibers and also compare the strength of concrete obtained with and without the use of PP fibers. This experimental study is aimed at producing SCC mix by using the Okumura Method, incorporating Master Glenium sky 8630 as chemical admixture and GGBS and Fly Ash powder as mineral admixtures which are supplementary cementing material. Replacement of mineral admixture by weight of cement was done in percentages, namely 100% cement, 70%cement + 30%GGBS. The test specimens were casted and cured well for 7 and 28 days and the compressive strength, flexural strength and split tensile strengths were investigated.

Keywords :- Self compacting concrete, Mix design, Modified nan su method,GGBS, Micro cement, Flow tests, Compressive strength, Flexural strength, Split tensile strength

I. INTRODUCTION

Modern, present-day Self-Compacting Concrete (SCC) can be classified as an advanced construction material. The SCC, as the name suggests, does not require to be vibrated to achieve full compaction. This offers many benefits and advantages over conventional concrete. These include an improved quality of concrete and reduction of on-site repairs, faster construction times, lower overall costs, facilitation of introduction of automation into concrete construction. An important improvement of health and safety is also achieved through elimination of handling of vibrators and a substantial reduction of environmental noise loading on and around a site. The composition of SCC mixes includes substantial proportions of fine-grained inorganic materials; this offers possibilities for utilization of dusts, which are currently waste products demanding with no practical applications and which are costly to dispose of. So far a mix design procedure to fix the ratio of all the ingredients in SCC is not standardized.

II. POTENTIAL BENEFITS OF SCC

- **Use of complex designs and heavy reinforcement:**
  Because SC flows so readily into thin sections & details; it opens the potential for using complex shapes and intricate surfaces. It also ensures no patching of holes after casting or potential damage to pieces during vibration.

- **Construction times:**
  Because SCC flows smoothly; it can be poured quickly & eliminates the need to vibrate the concrete into the tight spaces & around densely packed reinforcement. That speeds the entire production process.
- **Improved aesthetics and durability:**
  The SCC's ability to remain stable during and after placement maximizes the structural integrity & durability of the concrete. It offers less permeability due to the high consolidation of material, allowing it to resist chemical attack & improve the components durability. Flow ability with higher powder content makes the surface finish look superior and attractive.

III. APPLICATION OF SCC

After an extremely successful initial application in actual structures in Japan, the application of self-compacting concrete began in the entire world. Presently it is a very eagerly used material both in construction sites and in production of precast members. Extensive testing of physical and mechanical properties of SCC was carried out during the past decade. This was followed by economic analysis which confirmed the rationality of SCC application. Practical application was extended from large infrastructure buildings (bridges, tanks, retaining walls, tunnels, etc.) Onto architectural buildings. SCC appears here as a structural material in load-bearing members but at the same time, it also appears frequently as architectural concrete. Architectural concrete was defined by the American Concrete Institute as "concrete which will be permanently exposed to view and which therefore requires special care in selection of the concrete materials, forming, placing and finishing obtaining the desired architectural appearance".

IV. CONSTITUENT MATERIALS OF SCC:

A. Cement

Cement used for SCC should not contain C_3A content higher than 10% to avoid the problems of poor workability retention (EFNARC, 2002). Selection of the type of cement depends on the overall requirements for concrete, such as strength and durability. The typical content of cement is 350-450 Kg/m^3. More than 500 Kg/m^3 cement can be dangerous and increase the shrinkage. Less than 350 Kg/m^3 may only be suitable with the inclusion of other fine filler, such as fly ash, pozzolana etc. Ordinary Portland cement 43 Grade (Brand name: RAMCO (43 GRADE)) confirming to the requirements of Grade IS 8112: 2013 was used in this experimental work. The quantity of cement required for the experiments was collected from single source and stored in a nearly airtight container. The tests were conducted on cement to obtain specific gravity, normal consistency, initial setting time and compressive strength.

B. Coarse Aggregates:

The maximum size and grading of the aggregates depends on the particular application. Maximum size of aggregate is usually limited to 20 mm. The coarse aggregate content in SCC is kept either equal to or less than that of the fine aggregate content. Better results were also obtained with smaller aggregate diameter.

According to Okamura (1977), if the coarse aggregate content in a SCC mixture exceeds a certain limit, blockage would occur independently of the viscosity of the mortar. Super plasticizer and water content are then determined to ensure desired self compacting characteristics. The aggregate packing factor determines the aggregate content, and influences the strength, flow ability and self- compacting ability (Su et al., 2001).The moisture content of aggregates should be closely monitored and must be taken into account in order to produce SCC of constant quality (EFNARC, 2005).The granite jelly of 12.5mm passing

is used. The sieve analysis of coarse aggregates conforms to the specifications of IS 383: 1970 for graded aggregates and specific gravity.

C. Fine Aggregates :

Locally obtained natural river sand is used as the fine aggregate in the concrete mixes. The physical characteristics and sieve analysis results are presented in tables below. The sieve analysis result indicates that the sand confirms to zone-II as per IS: 383-1970 Fineness modulus (FM = Sum of cumulative % of wt. retained / 100) FM = 294/100 = 2.94.

D. Masterglenium Sky 8630:

MasterGlenium SKY 8630 is an admixture of a new generation based on modified polycarboxylic ether. The product has been primarily developed for applications in high performance concrete where the highest durability and performance is required. MasterGlenium SKY 8630 is free of chloride &low alkali. It is compatible with all types of cements.

GGBS: Slag is a by-product of the iron industry, generally used to replace Portland cement in the range of 15% to 30% of the total cementitious conventional concrete mixtures. Ground granulated blast furnace slag from JSW, used as cement replacement material.

V. WORK PLAN

The research work has been conducted in the following phases.

- The first phase included a comprehensive literature survey and data collection in the following areas:
    1. Basic requirements of SCC
    2. Properties of fresh SCC
    3. Test procedures of SCC
    4. Mix design procedure for SCC
- The second phase involves the quantity calculation of required materials and procurement of the same.
- In the third phase, the mix design of a suitable SCC has been carried out in an exploratory manner. A series of trials has been conducted to develop a suitable mix design using local aggregates. Number of trial mixes prepared using w/p ratio and FA/CA ratio keeping constant and varying super plasticizer dosages.
- In the fourth phase, specimens were casted and cured for 7 & 28 days
- The fifth phase, involved the analysis of experimental data.

VI. TESTS ON MATERIALS:

Table 1: Cement

Sl. No	Properties	Test Results
1	Normal Consistency (in %)	32
2	Specific Gravity	3.14

Table 2: Coarse Aggregate & Fine Aggregate

Sl N	Physical properties	Fine aggregate	Coarse aggregate
1	Size	4.75mm	12.5mm
1	Specific gravity	2.62	2.60
2	Fineness modulus	2.69	6.6
3	Loose Bulk density(kg/m^3)	1456.78	1346.60
4	Rodded Bulk density(kg/m^3)	1642.89	1498.2

VII. TESTS ON CONCRETE:

Properties of concrete:

The properties of concrete is two types, they are fresh and hardened concrete properties. The performance of concrete properties are mainly depends upon the mix design, shape and strength of aggregates. Water-cement ratio is a main factor of fresh concrete property. It also affects the durability of concrete. The strength and life time of the structure is mainly depending on properties of concrete only.

Fresh Properties Of Concrete:

A. Slump test :

The slump flow is used to assess the horizontal free flow of SCC in the absence of obstructions. It was first developed in Japan for use in assessment of underwater concrete. The test method is based on the test method for determining the slump. The diameter of the concrete circle is a measure for the filling ability of the concrete.

B. V-Funnel Test And V-Funnel At T_5 Minutes:

The test was developed in Japan and used by Ozawa Et Al . The equipment consists of a V-shaped funnel, shown in figure 3.4 An alternative type of V-funnel, the O funnel, with a circular section is also used in Japan. The described V-funnel test is used to determine the filling ability (flow ability of the concrete with a maximum aggregate size of 20mm. The funnel is filled with about 12 liters of concrete and the time taken for it to flow through the apparatus measured. After this the funnel can be refilled with concrete and left for 5 minutes to settle. If the concrete shows segregation then the flow time will increase significantly.

C. L- Box Test:

This test, based on a Japanese design for underwater concrete, has been described by Peterson . The test assesses the flow of concrete, and also the extent to which it is subjected to blocking by reinforcements. The apparatus is as shown in figure. The apparatus consists of a rectangular section box in the shape of an "L", with a vertical and horizontal section, separated by a movable gate, in front of which vertical lengths of reinforcement bars are fitted. The vertical section is filled with concrete, and then the gate is lifted to let the concrete flow into the horizontal section. When the flow has stopped, the height of the concrete at the end of the horizontal section is expressed as a proportion of that remaining in the vertical section. It indicates the slope of the concrete when at rest. This is an indication of the passing ability, or the degree to which the passage of concrete through the bars is restricted.

D. U-Box Test:

The test is used to measure the filling ability of self- compacting concrete. The apparatus consists of a U-shaped Box and is divided by a middle wall into two compartments, as shown in fig.3.7An opening with a slide gate is fitted between the two sections. Reinforcing bars with nominal diameters of 13 mm are installed at the gate with centre to centre spacing of 50 mm. This creates clear spacing of 35 mm between the bars. The left hand section is filled with about 20 liters of concrete then the gate lifted and concrete flows upwards into the other section. The height of the concrete in both sections is measured.

Hardened Properties Of Scc:

A. Compressive Strength Test:

The compression strength of concrete i.e., ultimate strength of concrete is defined as the load which causes failure of the specimen divided by the area of the cross section in uniaxial compression, under a given rate of loading. The steel cube moulds were coated with mould oil on their inner surfaces and were placed on Plate. Concrete was poured in to the moulds. The top surface was finished using trowel. After 48 hours concrete cubes were demoulded and the specimens were kept for curing under water. The test results are tabulated.

B. Splitting Tensile Strength Of Concrete:

The bearing surfaces of the testing machine and of the loading strips shall be wiped clean. The test specimen shall be placed in the centering jig with packing strip and pieces are loaded carefully positioning along the top and bottom of the plane offloading of the specimen. The jig shall then be placed in the machine so that the specimen is located centrally. For cylindrical specimen it shall

be ensured that the upper plate is parallel with the lower plate

VIII. RESULT AND DISSCUSSION

Table 6: Fresh concrete tests for without fiber:

MIX	Mix-1	Mix-2	EFNARC (2005)
Slump flow(mm)	660	659	650-800
V-funnel (sec)	12	11	6-12
L-box (H_1/H_2 mm)	0.85	0.89	0.8-1.0
U-box (H_1-H_2 mm)	26	23	0-30

Table 7: Fresh concrete tests for with fibre

MIX	**Mix-1**	**Mix-2**	**EFNARC (2005)**
Slump flow(mm)	665	662	650-800
V-funnel (sec)	10	8.5	6-12
L-box (H_1/H_2)mm)	0.87	0.93	0.8-1.0
U-box (H_1-H_2 mm)	22	19	0-30

Table 8: Compressive strength of m30 concrete:

CURING IN DAYS	MIX PROPORTION	COMPRESSIVE STRENGTH (N/mm2)	
		WOF	WF
28 DAYS	MIX 1	29.7	31
	MIX2	23.6	30.6

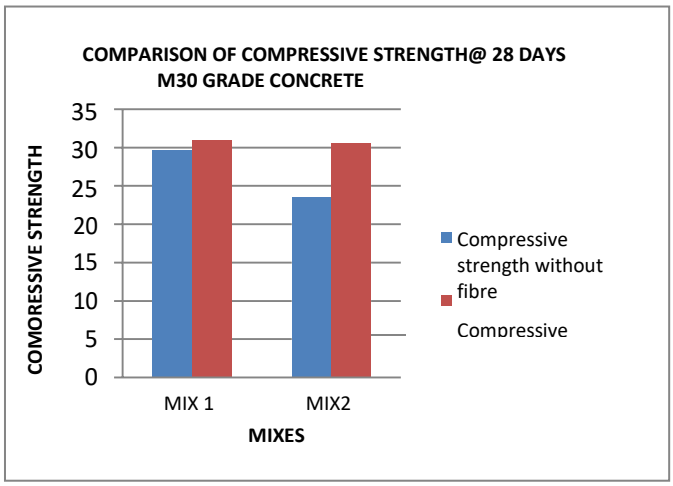
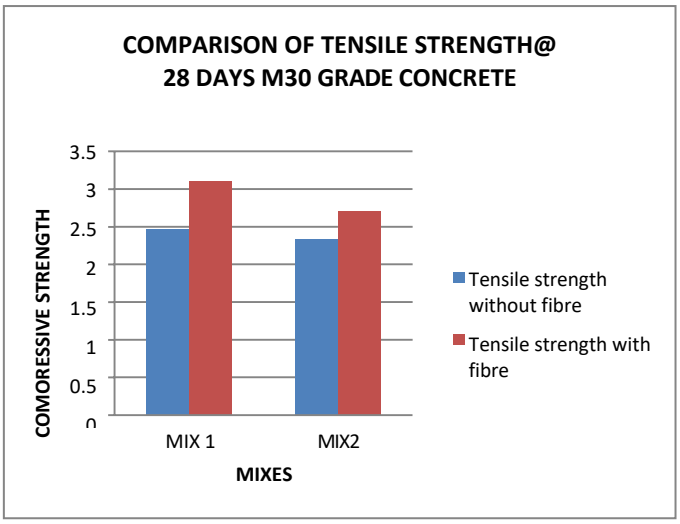


Table 9: Split tensile strength of m30 concrete

CURING IN DAYS	MIX PROPORTION	SPLIT TENSILE STRENGTH (N/mm2)	
		WOF	WF
28 DAYS	MIX 1	2.47	3.1
	MIX2	2.33	2.7



IX. CONCLUSION

This Based on experimental study the following conclusion can be drawn

- A mix design based on Nan su method can be successfully employed for achieving SCC.
- All the mix proportion developed satisfies the requirement of SCC specified by EFNARC.
- In this study it has been found that with the increase in super plasticizer dosage the workability increases, hence the required slump value fulfils the criteria of EFNARC.
- Higher paste content not only makes the mix cohesive but also increases the compressive strength and at the same time it is well suited for achieving good flowability when crushed angular aggregates are used.
- It is advantageous to mix the super plasticizers and water before hand and mix the constituents for a time period of six minutes to achieve better absorption on cement particles and to provide good results for the fresh property tests of concrete.
- The compressive strength of all the specimen increases for concrete with fibre when compared to concrete without fibre..
- The split tensile strength of all the specimen increases for concrete with fibre when compared to concrete without fibre.
- Specimen containing PP fibres shows great percentage of increase in compressive strength, flexural and split tensile strength.
- Similarly based on the experimental results, it can be concluded that SCC with addition of fibers will reduce the shrinkage and increase the cohesiveness of the mix and also helps to increase the strength of the concrete.

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A Study on Softwares Used in Project Planning and Management in Construction Projects in India

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ABSTRACT

Planning and scheduling is very important role in construction projects because of the increasing difficulties in this field. Construction Planning is the necessary warning to Scheduling and determining general sequence, defining labour tasks, construction methods and assigning responsibilities, inappropriate planning can lead to major delays in the project work. For the planning and scheduling work huge amount of paperwork, which makes the management very burdensome. These problems can be solved using a project management software which helps to give a planned approach to planning. Nowadays use of project management (PM) software as a tool for managing and organizing work has gained its importance in construction industry and continues to grow at a faster pace in all other industries also. In this study, an attempt is done to compare the project management software such as MS project, Primavera and BIM and their feasibility is studied.

Keywords : CPM, PRIMAVERA P6, MS PROJECT, EPS, Gantt chart, BIM

I. INTRODUCTION

In Project management software process involves estimation, sequencing the activities, resources allocation and timing. For construction schedule completing project in time and equal the resources with the allocated time. Different civil software like MS project and Primavera are widely used for planning and scheduling. Planning of big projects requires huge amount of paperwork, which can be reduced with the help of primavera and MS project software. The comparison is made to know the efficiency of each software. MSP and Primavera is the modern tool of Project Management that aid to beat the obstacles faced remaining to conventional way of Planning and organization. The optimal and resourceful organization of activities which helps to give the dream to complete the project in planned duration.

Project management software as a tool for managing and organizing work has grown and continues to grow at a rapid pace in all industries. In the construction PM software usage is important. As heavy users of PM software, professionals in the construction industry and other industries have a strong interest in improving the tools and techniques available for better project planning. Multiple studies demonstrated that construction professionals continue to be very interested in developing better methods for project planning and control. Few studies have considered the application of these tools in PM software. These studies demonstrated the rise in the

level of interest in effective and efficient methods for project planning and control. In this paper, patterns of PM software usage in the construction industry will be identified, addressing current usage.

I.1 MSP:

MSP is a project management software product, introduced & developed Microsoft. It assist a project manager in developing a planning, assigning resources to tasks, tracking progress, managing the budget, and analysing workloads. Project creates budgets based on assignment work and resource rates. Resources are assigned to tasks and work estimated. Program calculates the cost, equal to the work times the rate. Resource defines (people, equipment and materials) can be shared between projects using a shared resource pool. Each resource can have its own calendar, which defines days and shifts a resource is available. Resource rates are used to calculate resource assignment costs which are rolled up and summarized at the resource level. Each resource can be a signed to multiple tasks in multiple plans and each task can be assigned multiple resources. Schedules task work based on the resource availability as defined in the resource calendars. All resources can be defined in label without limit. Hence it cannot determine how many finished products can be produced with a given amount of raw materials. This makes MSp unsuitable for solving problems of available materials.

I.2 PRIMAVERA P6:

Primavera was launched in 1983 by Primavera Systems which was acquired by Oracle Corporation in2008. Primavera is an enterprise project portfolio management software. It includes project management, scheduling, risk analysis, opportunity management, resource management, control capabilities, and integrates with other enterprise software such as Oracle and SAP's ERP systems. This software is designed for project, program, and portfolio management. It is a powerful, easy to use solution for planning, managing and executing projects. Primavera has a huge performance and simply cannot be beat. Installing local software on PC cut's out the lag of web-based products and screen refreshes. It makes P6 professional tool for scheduling projects.

I.3 BIM Design 5

BIM is launched by Autodesk for designing and modelling. It is a process supported by various tools, technologies and contracts involving the generation and management of digital representations of physical and functional characteristics of places. BIM files containing proprietary data which can be extracted to support decision-making regarding a built asset. BIM software is used by individuals, businesses and government agencies who plan, design, construct, operate and maintain buildings and diverse physical infrastructures, such as water, refuse, electricity, gas, communication utilities, roads, railways, bridges, ports and tunnels.

II. LITERATURE REVIEW

T. Subramani (2015) says that the Primavera P6 software and advantages of Primavera P6 software, he says that Primavera P6 is a software which is not only used by project planners but also involved in project, i.e. managers, engineers, schedulers can use Primavera software, focusing on the advantages and comparison of construction estimate methods application in usefulness project. Primavera allows users to generate project templets, which can used for future project also. Primavera can also be used to group and view multiple project at the same time.

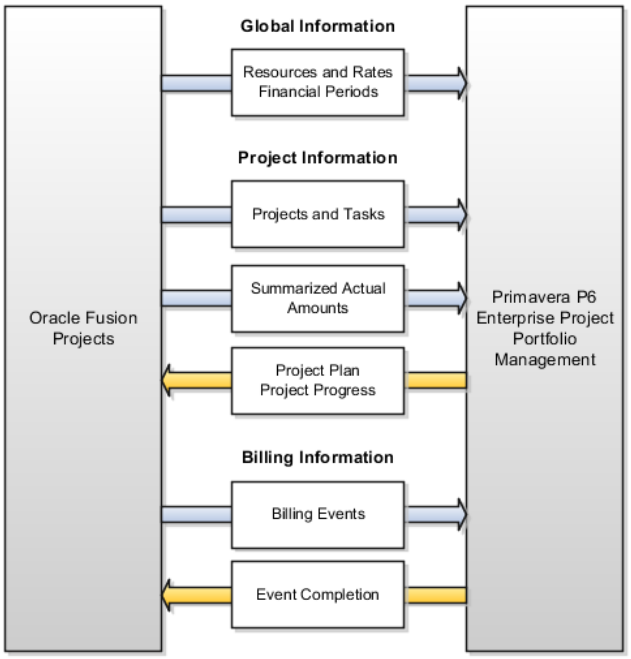
B.S.K REDDY (2015) says that resource plays important role in any construction project. It performance of any construction project directly depends upon resource management. The purpose of

resource optimization and levelling author choose primavera p6 software in ongoing construction project in Dubai at UAE. The main objective of this paper is to minimize under allocation of resources. Author concluded that there is 5.65% resource reduction by using Primavera

Castor (2008) Says and compares MSP & primavera, open workbench for resource levelling in two real time project and the result shows primavera gives most the critically unlimited number of criteria as priority rules. The process and activity of planning, organizing exciting and controlling resources, procedures, to achieve complete goals in scientific or daily problems that help to overcome the problems. It helps for the optimum and effective organization of activities to complete the project in planned duration and within the market.

T.Subramani (2014) compared time performance of the conventional method of construction for high-rise residential and commercial projects method by originate level measures of industry norms for overall construction period using scheduling simulation modelling. The positive changes include creating a healthy working environment among those involved directly in the construction industry. Improved Customer satisfaction whenever you get a project done on time and under budget. It helps easily plan and manage project activities, optimizes management of all resources and gives clear visibility of project allows quick and easy forecasting of WBS's, activities or projects.

Unmesh. Y. Polekar (2015) says that improper resource management and huge amount wastage due to improper resource management. This improper management of resources also causes increase in time duration. Using Primavera software, we can organize our project and recognize potential problems. Primavera software is used for making project management easier, especially in difficulties. Some of the study shared in flow charts which are globally practised. As seen in the integration diagram below, project managers are enabled to perform detailed project planning and scheduling by integrating Oracle Fusion Projects with Primavera software.



Source: Oracle Primavera Reference Book

Figure-1 Oracle Fusion Project Integration with Primavera P6

Table-1-Comparison between MSP and Primavera software

SL.No	Primavera Software	MS-Project Software
1	It supports unlimited baselines.	MS-Project supports 11 baselines.
2	Multiple users to work on a single project and the specific features to be used.	Multiple User Access doesn't allow multiple users to work on a single project
3	Allows issue and disk recording.	Lacks the feature of project issues and risk tracking.
4	P6 supports unique ID feature and is helpful in projects using activity ID systems.	Does not support unique ID feature and the activity ID is dependent on the position of the activity.

5	Activity sorting by different fields like sorting by date, activity id, etc.	Flexible activity control in which the individual activities can be moved from their positions to the position where you want it to display.
6	Allows adding different project expenses like training cost, traveling cost, etc. in addition to the project expenses.	Does not allow calculating other expenses.
7	The creation of WBS (Work Breakdown Structure) in which activities can be added.	Activities are made to appear or function like WBS.
8	Supports a larger number of activities.	Supports less number of activities when compared to Primavera.
9	Best suited for developed countries.	Best suited for developing countries.
10	Database based project management software.	File based project management software.

III. CONCLUSION

Planning and scheduling improves future conditions in implementing the project. Primavera and Msp Software provides user friendly options while performing any task. The cost of individual work breaks down can be known along with the duration. Thus decisions can be made sensibly by the management. In multiple projects resource levelling is very important to maintain proper resource allocation. For multiple projects under a single company such analysis should be done to check out for over allocation. Construction of building using Traditional way proves to be uneconomical and consumes more time with many complexity and enormous error which actual execution of the Project. Traditional way of planning doesn't sub divide the main task which future gets the hurdle of over allocation of resources, improper judgment of resources for particular activities etc.

MSP and Primavera is the modern tool of Project Management that overcomes the obstacles faced owing to traditional way of Planning and Management. It helps for the optimum and effective organization of activities which helps to give the vision to complete the project in planned duration and within the Economy.

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Impact of Urbanization on Land Use Land Cover – A Case Study of Banglore Rural Region Using GIS and Remote Sensing Techniques

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ABSTRACT

Remote sensing is one of the tool which is very important for the production of Land use and land cover maps through a process called image classification. The changes in land use and land cover help the planning Authority to identify imbalance in urban development, water resources, waste land and Agriculture. The LULC map Developed of the study region also helps to take corrective actions for the imbalances detected. For the image classification process to be successful, several factors should be considered including availability of quality Land satellite imagery and secondary data, a precise classification process and user's experiences and expertise of the procedures. The objective of this research was to classify and map land-use/land-cover of the study area using remote sensing and Geospatial Information System (GIS) techniques for the study area Bangalore rural district, which consists of four taluks Nelmangla, Hoskote, Devanhalli and Doddaballapura. This research includes Land use/Land cover (LULC) classification .In this study supervised classification was performed and The major LULC classified for the year 2000 were agriculture(82.00 %) , water body (5.05%), and built up areas (2.67%), forest (5.4%), waste land (4.9%) and for the year 2010 were agriculture(81.53%) , water body (4.545%), and built up areas (5.75%), forest (5.5%), waste land (2.46%). This study presents essential source of information whereby planners and decision makers can use to sustainably plan the urban growth.

Keywords : Geographical Information Systems (GIS), Land Use Land Cover (LULC), Remote Sensing

I. INTRODUCTION

Land use and land cover information is considered essential for policy making, business and administrative purposes. By considering spatial details like the data is very important for environmental protection and spatial planning. Land use classification is vital because it gives data which can be used as input for modelling, especially the one dealing with environment, for instance models deals with climate change and policies developments [1]. Hence the combined LULC grant a comprehensive means of understanding the interaction of geo-biophysical, socioeconomic systems behaviours and interactions [2]. To provide more useful information in land cover, Remote Sensing is often paired with Geographic Information System (GIS) technique.

Remote sensing is the main source for several kinds of thematic data critical to GIS analyses, includi9ng data on land use and land cover characteristics. Aerial and Landsat satellite images are also frequently used to evaluate land cover distribution and to update existing geospatial features. With the introduction of remote sensing systems and image processing

software, the importance of remote sensing in Geospatial Information System (GIS) has expanded significantly [3]. The faster usage of remote sensing data and techniques has made geospatial process faster and powerful, although the increased complexity also creates increased possibilities for error.

The objective of this research was to classify and map land-use/land-cover of the study area using remote sensing and Geospatial Information System (GIS) techniques.

II. STUDY AREA

Bangalore Rural district is located in the south-eastern corner of Karnataka. The district is covered with the latitudes 12°98'11" to 13°28'00" N and longitudes 77°57'46" to 77°60'00" E. The District has four taluks viz. Devanhalli, Doddballapura, Hoskote and Nelamangala. The district is surrounded by Tamil Nadu State on the East, Tumkur and Mandya districts on the West, Chamarajanagar on the South and Kolar and Tumkur districts on the North. Administrative Setup: The Bangalore rural district has 1061 village 185 Panchyat 22 hoblies covering area of 2298 sq km. Population: According to 2011 census, Bangalore Rural district population was 990,923 were 509,172 male and 481,751 female. The study area is shown in Figure 1.

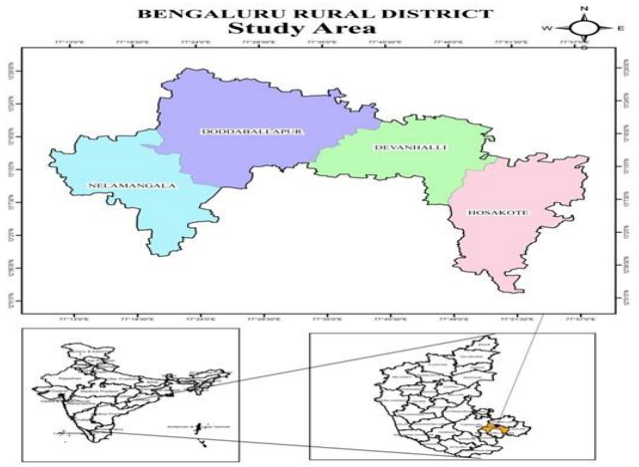

Fig 1: Location of study area Map

III. MATERIALS AND METHODS

The present research covers Land use/Land cover (LULC) classification. The land use/cover classification of the study area was carried out as per the methodology shown in the figure 2. Land use/ Land cover Classification Image Pre-Processing Classification process and analysis of the different LULC classes were done using Land sat satellite images. The Land sat images were downloaded from United States Geological (USGS) Earth Explorer (https://earthexplorer.usgs.gov/). The selection of the Landsat satellite images dates was influenced by the quality of the image especially for those with limited or low cloud cover. Each Landsat was geo-referenced to the WGS_84 datum and Universal Transverse Mercator Zone 35 North coordinate system.

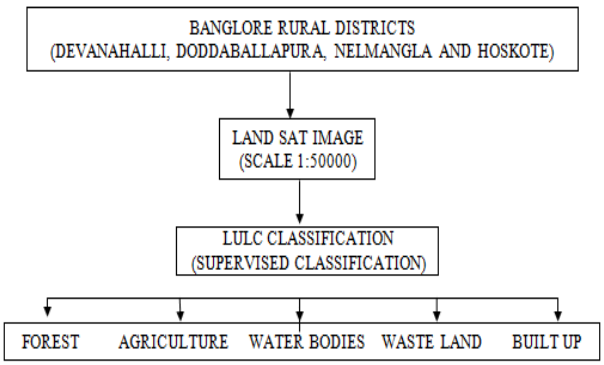

Fig. 2 Parameters for Land Use and Land Cover Classification

IV. LAND USE/ LAND COVER (LULC) CLASSIFICATION

For the Bangalore Rural District study area, supervised classification was carried out. As per this supervised classification Bangalore rural area comprises of four taluks Devanahalli, Doddaballapur Nelmangla and Hoskote. From this classification "the user develops the spectral signatures of known categories, such as forest, Agriculture, water bodies, waste land and Built up area. Then the software assigns each pixel in the image to the cover type to which its signature is most comparable". "Supervised classification is the process most frequently used for quantitative analyses of remote sensing image data".

The supervised classification was applied after defined area of interest (AOI) which is called training classes. More than one training area was used to represent a particular class. The training sites were selected in agreement with the Landsat Image, Google Earth and Google Map (Figure 3). The basic sequence operation followed on supervised classification was.

From this supervised classification it is observed that in Devanhalli taluk due to construction and industrial activities the land use and land cover has been impacted and converted from agricultural land to build up area and other public utilities have come up from the last ten years. Similarly in other taluks of Bangalore rural district Dodabbalpur , Hoskote and Nelmangla there is Dramatic increase in growth of urbanization , industrial activities And also in educational infrastructures. It is seen that waste land is converted to build up area and due to impact on urbanization there is decrease in water bodies also from the last 10 years.

3.1 Steps of Supervised Classification:

STEP 1:

Defining of Training Sites:The first step is to undertake supervised classification by defining areas which will be used as training sites for each land cover class. This is usually done by using the on-screen digitized features. The created features are called Area of Interest (AOI).The selection of the training sites was based on those areas clearly identified in all sources of images. In this study, one hundreds training sites were been identified.

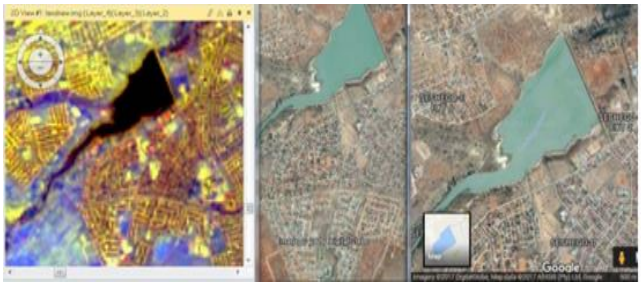

Fig. 3: Identification of training sites using Landsat image

STEP 2:

Extraction of Signatures: After the training site (AOI) being digitized, the next step was to create statistical characterizations of each information. These are called Signatures editors in ERDAS Imagine 2015. In this step, the goal was to create a signal (SIG) file for every informational class. The SIG files contain a variety of information about the land cover classes described.

STEP 3:

Classification of the Image (Supervised classification): The supervised classification has been applied after defined training classes. One or more than one training area was used to represent a particular class. During the supervised classification process, the entire Signature editor was selected in order to be used on the classification process. . Then the classify was selected from the Editor Menu bar, classify/supervised. Non Parametric Rule was used in this classification. The Image was classified into five classes namely; Agriculture, built up, forest, waste land and Water body.

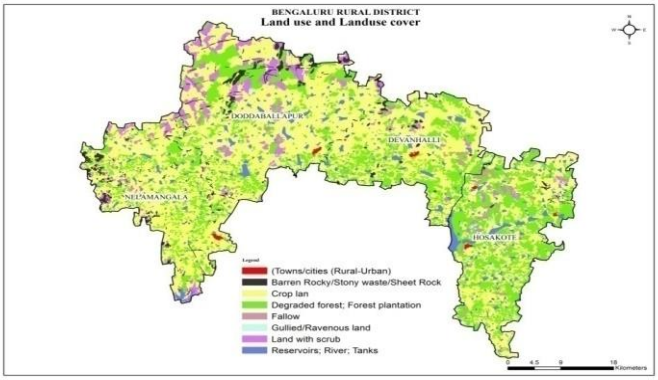

Fig.4: Classified map of 4-Taluk in Bangalore Rural District

V. CLASSIFICATION RESULTS AND DISCUSSION

Supervised classification was carried out for study area Bangalore Rural District. The area of each class was calculated taking into account the pixel count and total area (study area). Thus allocations of each classified area, (percentage) are tabulated in Table 1. The percentage of areas as classified are; for the year

2000 and 2010 were agriculture (81.53.00 %) , water body (5.05%), and built up areas (2.67%), forest (5.4%), waste land (4.935%) and similarly Agriculture (81.35.0%), built up areas (5.75%), Forest (5.4750%), waste land (2.46%) and water bodies (4.54%) respectively. Agriculture was found to be the dominant type of Land use classified which covers about 81.53% of the total study area, followed by Built-up areas while the least classified was waste land which accounts for 2.46% and it is also observed from the results there in more impact on land due to urbanization, industrial activities etc from the last 10years

Table- 1: Land use classes Classification of Doddaballapur, Devanhalli, Nelmangla and Hoskote (Bangalore Rural District) (2000)

Land cover	Area in Km²	Percent
Agriculture	1215177874	81.53
Built-up	12607144.28	2.67
Forest	24247086.03	5.5
Wasteland	26934626.87	4.935
Water Bodies	21055925.54	5.05

Table - 2: Land use classes Classification of of Doddaballapur, Devanhalli, Nelmangla and Hoskote (Bangalore Rural District) (2010)

Land cover	Area in Km²	Percent
Agriculture land	585333492.6	81.35
Built up land	32307320.56	5.75
forest	48261605.09	5.475
wasteland	17686031.54	2.46
water bodies	29128147.82	4.54

From Figure 5 is observed a pie chart of LULC for the year 2000 and the results for the year 2000 is shown in a pie chart covering agriculture, builup, forest, waste land and water bodies' categories of each area in percentage.

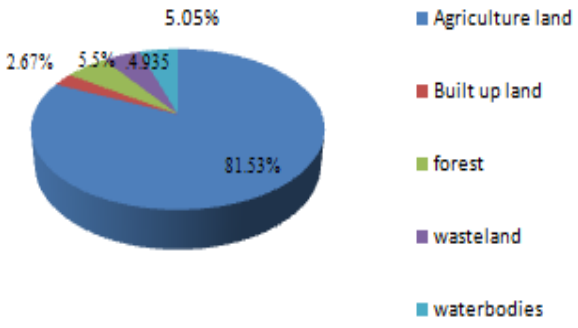

Fig. 5: Pie chart of LULC classification 2000

From Figure 6 is observed a pie chart of LULC for the year 2010 and the results for the year 2010 is shown in a pie chart covering agriculture, built up, forest, waste land and water bodies' categories of each area in percentage.

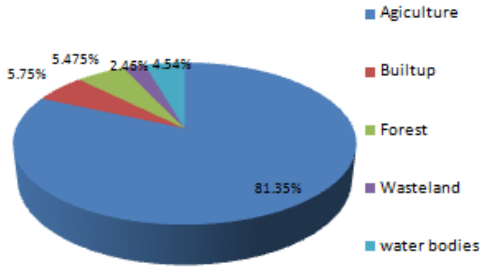

Fig.6: Pie chart of LULC classification (2010)

TABLE 3: LULC changes observed from the Results of Supervised Classification:

LAND COVER	2000	2010	Change
Agriculture land	81.53	81.35	-0.175
Built up land	2.67	5.75	+3.08
forest	5.5	5.475	-0.025
wasteland	4.935	-2.46	-2.475
Water bodies	5.05	4.54	-0.51

VI. CONCLUSION

The supervised classification was performed for four Taluks of Bangalore rural district using Non Parametric Rule.

i. The image is classified in to 5 classes; Agriculture land, Built up land, forest, waste land and water bodies.
ii. Agriculture was found to be the dominant type of Land use classified which covers about 81.53% of the total study area, followed by Built-up areas while the least classified was waste land which accounts for 2.46% and it is also observed from the results there in more impact on land due to urbanization, industrial activities etc from the last 10years.
iii. From the classification it is observed that there is increase and decrease in land use and land cover pattern taken place from the last 10 years.
iv. The changes are due to International Air Port at Devanahalli taluk. In Devanahalli it is seen that majority of the waste land is converted to built up area and there by decrease in the agriculture activities.
v. In other three taluks of Bangalore rural slight variations are observed due to increase in growth of urbanization, industrial activities and many educational infrastructures are brought from the last 10years.
vi. The changes which is observed in LULC pattern brings changes in socio-economic conditions of people connected with different land cover and also in the usage of land changes, in the social production relations (that people must enter into in order to survive, to produce, and to reproduce their means of life).

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Sustainable Approach to Inland Freight Transportation

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ABSTRACT

Sustainability is the ability to exist constantly. In the 21st century, it refers generally to the capacity for the biosphere and human civilization to co-exist. It is also defined as the process of people maintaining change in a homeostasis balanced environment, in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations. In this paper we discuss about the economic, social and environmental impacts of freight transportation. Also we discuss about the constraints within the implementation of inland water transportation as it is the most sustainable form.

Keywords : Economic, Social and Environmental Impacts, Human Civilization, Biosphere

I. INTRODUCTION

Sustainability is the ability to exist constantly. In the 21st century, it refers generally to the capacity for the biosphere and human civilization to co-exist. It is also defined as the process of people maintaining change in a homeostasis balanced environment, in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations. Sustainability can also be defined as a socio-ecological process characterized by the pursuit of a common ideal. An ideal is by definition unattainable in a given time and space. There are mainly three pillars of sustainability and they are:

- Society
- Economy
- Environment

Sustainable transport refers to the broad subject of transport that is sustainable in the senses of social, environmental and climate impacts.

Components for evaluating sustainability include the particular vehicles used for road, water or air transport; the source of energy; and the infrastructure used to accommodate the transport. Transport operations and logistics as well as transit-oriented development are also involved in evaluation. Transportation

sustainability is largely being measured by transportation system effectiveness and efficiency as well as the environmental and climate impacts of the system.

Short-term activity often promotes incremental improvement in fuel efficiency and vehicle emissions controls while long-term goals include migrating transportation from fossil-based energy to other alternatives such as renewable energy and use of other renewable resources. The entire life cycle of transport systems is subject to sustainability measurement and optimization.

Sustainable transport systems make a positive contribution to the environmental, social and economic sustainability of the communities they serve. Transport systems exist to provide social and economic connections, and people quickly take up the opportunities offered by increased mobility with poor households benefiting greatly from low carbon transport options. The advantages of increased mobility need to be weighed against the environmental, social and economic costs that transport systems pose.

Transport systems have significant impacts on the environment, accounting for between 20% and 25% of world energy consumption and carbon dioxide emissions. The majority of the emissions, almost 97%, came from direct burning of fossil fuels. Greenhouse gas emissions from transport are increasing at a faster rate than any other energy using sector. Road transport is also a major contributor to local air pollution and smog

Transitioning to a sustainable transport system requires innovation in the form of new vehicles, vessels, fuels and service configurations. It is equally important that there is demand for such innovations. The project "Sustainable inland shipping – public procurement as a catalyst" combines the analysis of product and service development on the supply side with the opportunities for public procurement to increase the demand for innovative solutions for local and regional freight transport. Inland shipping can make the transport of goods more ecological.

II. MODERN APPROACH TO SUSTAINABILITY

It can be stated that our future depends not only on the needs of economy and society and impact of our activity on the environment, but also on the use of natural resources of our planet. The economic use of natural resources depends greatly on the built systems and on the applied technology. But if one has a look around Europe or the world he or she can find that considering the above aspects we are far, sometimes very far from sustainability. It can be stated that the economic aspects are well over the two (or five) other. Lower costs, greater profit is the determining factor at the moment. A good sign is that on the governmental level we are aware of this and actions have been taken to change the intolerable situation. So, for sustainable development and transport it is essential to have clear laws, stability in financial support, developed taxation system (pricing), well-defined priorities, etc. but – as we think – it must be based on technology development including the total innovation process from education through research, development, engineering and production to operation (services provided) and recycling. Only the usage of such a philosophy can result that the continuously increasing needs of the economy and society can be covered besides using not more, even less natural resources and generating less impact on the environment

III. SHARE OF INLAND SHIPPING IN FREIGHT TRANSPORT

There is no general answer to this question because the situation differs from country to country and from river to river. If we concentrate

on the Austrian part of the Danube, only 15% of the available capacity is used. In the Netherlands, inland navigation accounts for 34% of goods transport. An often-mentioned counterargument is the lack of a river connection. This means that shipping is connected to another mode of transport. As a rule, it is the truck that travels the first and last mile. This leads to extra costs.

IV. THE STRENGTHS OF CONNECTING INLAND SHIPPING TO THE TRANSPORTATION NETWORK

Shipping is generally regarded as a very ecological mode of transportation, but its engines do not use the most environmentally friendly fuels, resulting in huge emissions. Calculated in tonnages of transported goods, however, they are lower than in freight transport. The project also considers the type of propulsion of the ships and seeks alternatives to marine diesel, such as liquefied natural gas (LNG), which has lower CO2 emissions. But the ship already has a smaller ecological footprint and is almost unbeatable in terms of transport costs. Approximately 250 trucks would be needed for the amount transported on them. This, of course, also leads to lower personnel costs, as only one captain and a few sailors are needed. In addition, the ship is more efficient and consumes less fuel. If you add to that the external costs that society has to pay – CO2 emissions, noise pollution and particulate matter from braking – then the ship performs much better.

V. ESSENTIAL NEEDS TO ACHIEVE SUSTAINABILITY

There are four essential needs to attain sustainability

- Clear laws
- Stability in financial support
- Developed taxation system
- Well-developed priorities

VI. INDICATORS OF SUSTAINABILITY

Indicators are mainly of three types:

- Economic indicators
- Environmental indicators
- Social indicators

VII. ECONOMIC INDICATORS

TRANSPORT OPERATION COSTS : Transport prices

PRODUCTIVITY / EFFICIENCY: Utilisation rates, Energy consumption efficiency of transport sector, Energy efficiency

COSTS TO ECONOMY: Infrastructure costs, External transport costs, Final energy consumption

BENEFITS TO ECONOMY: Gross value added, Benefits of transport

VIII. ENVIRONMENTAL INDICATORS

RESOURCE USE: Consumption of solid raw materials, Land take

EMISSIONS TO AIR: Transport emissions of greenhouse gases, Greenhouse gas emissions from manufacture and maintenance, Transport emissions of air pollutants, Air pollutant emissions from manufacture and maintenance

EMISSION TO SOIL AND WATER: Polluting transport accidents, Runoff pollution from transport infrastructure, Wastewater from manufacture and maintenance of transport infrastructure, Discharges of oil, Discharges of wastewater and waste

NOISE: Exposure to transport noise

WASTE: Generation of non-recycled waste

IX. SOCIAL INDICATORS

SAFETY AND SECURITY: Accident related fatalities and serious injuries, Security of cargo

THREE TIER CLASSIFICATION OF SUSTAINABILITY INDICATORS

MacRae, proposed a three-tier classification system for sustainability indicators, which we summarize as follows.

1. First-tier indicators focus largely on minimizing the impacts of existing methods, activities or processes (efficiency measures)
2. Second-tier indicators measure the extent to which older methods, technologies, or processes with high negative impacts are being replaced by newer ones with less negative impact (substitution)
3. Third-tier indicators help to measure the extent in which rules and procedures are reconsidered with sustainability as a foundation (redesign)

First-tier performance improvements generally result in early successes (e.g. energy reduction, fuel efficiency). Possible second-tier improvements are conversion from fossil fuel to biodiesel or electricity, whereas a third-tier improvement may be to shift to an innovative transport mode.

SUCCESSFUL WATERWAY PROJECTS AND FACTORS CONTRIBUTING TO ITS SUCCESSFUL IMPLEMENTATION

Project	Factors
Franprix Paris-Containers on Barge	Close cooperation of stakeholders Short lines of communication Financial support from the region Legislation providing foundation for operational help Location of distribution centre and inland waterway port Dense distribution of shops in city centre High volumes to cover fixed costs
Vert chez Vous-Floating Distribution Centre	Avoidance of eco tax for heavy vehicles Avoidance urban tolls Compliance to limitations in air priority zones Financial support from inland waterway administration Extended time to enter city centre for deliveries
The Beer Boat Electric Barge Utrecht	Avoidance of two-tons axle restriction Extended time to enter city centre for deliveries Avoidance of congestion Avoidance of one way traffic Public subsidies
Mokum Mariteam-Electric Barge Amsterdam	Extended time to enter city centre for deliveries Applicability of reverse logistics

COMPARISON OF NORMAL FREIGHT TRANSPORTATION AND SUSTAINABLE INLAND FREIGHT TRANSPORTATION THROUGH WATERWAYS

NORMAL FRIEGHT TRANSPORTATION	SUSTAINABLE INLAND FREIGHT TRANSPORTATION THROUGH WATER WAYS
More consumption of energy	Least consumption of energy
Require more number of trucks	Single ship could conduct goods that 250 trucks can
Less environment friendly	Environment friendly
More land use	Least land use
Can induce congestion	Can reduce congestion
Contributes to major share of transportation	Least share of transportation

X. CONCLUSION

This paper reviews intensively about the great potential of biological method, using the bacteria capable of precipitating ncrete can produce cost effective strong or durable structures.

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Study on Effect of Partial Replacement of Natural Sand by Copper Slag and Foundry Sand in Concrete

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ABSTRACT

The word wide consumption of sand as fine aggregate in concrete is very high and several developing countries have encountered some stain in the supply of natural sand in order to meet the increasing needs of infrastructural development in recent years, which is responsible for increase in price of sand and cost of concrete. This demand for sand has lead construction industry to look forward for best alternate construction material to fulfill the sand demand.

An attempt is made with an experimental investigation to evaluate the mechanical properties of concrete mixtures in which sand is partially replaced with industrial waste such as copper slag and foundry sand. Sand is replaced at 0 to 100% at the increment of 10% by mixture of copper slag and foundry sand in equal ratios. Tests were conducted for strength and workability properties of concrete.

The results indicate significant improvement in the strength properties of concrete and with slight increase workability by the inclusion of industry waste products as partial replacement of sand.

The replacement of sand at 50% with Copper Slag and Foundry Sand shows the optimum strength characteristics and it can be effectively used in structural concrete.

Keywords : Aggregate, Copper Slag and Foundry Sand

I. INTRODUCTION

The construction industry has a huge demand for fine aggregates. This demand has triggered the sand mafia by over exploiting the river basins and causing the depletion of water holding capacity of rivers. This over exploitation reduces the ground water replenishment also, which is a serious issue for the next generations.

Valuable lands are being converted into dumping yards of industrial waste products and in turn affecting the quality of ground water resources. Thus, increase in the depletion of natural resources and generated industrial wastes are forcing towards sustainable development.

On the other hand, this demand for sand is being met by the alternate materials in the form of manufactured sand. Exploration of other alternate materials for sand is urged by the construction industry. Therefore, an attempt is made in the present study to explore the feasibility of using industrial waste products such as copper slag and foundry sand as alternate materials for natural sand.

II. LITURATURE REVIEW:

Brindha et al., (2010) have studied the strength properties of concrete with partial replacement of sand by copper slag and found that strength increases up to 40% replacement level. Mosoni et al., (2010) have studied the impact of foundry sand in mortars and concrete and suggested that structural mortar and concrete can be manufactured with used foundry sand. Ishimaru et al., (2005) used class II fly ash and copper slag as fine aggregate in concrete and found substitution of copper slag or fly ash up to 20% in volume as fine aggregate achieved higher compressive strength.

III. MATERIALS AND METHODOLOGY

3.1 Materials:

Copper slag is the by-product material obtained during the process of manufacturing copper. Foundry sand is high quality silica sand with uniform physical characteristics, is a by-product of ferrous and non-ferrous metal casting industries. Copper slag and foundry sand used in the present study it is obtained from Bangalore. Fine aggregates used in present study are shown in fig 1. Ordinary Portland cement of 43 grade is obtained from a local distributer. Locally available crushed aggregates and natural sand conforming to IS:383-1970 are used. Water fit for drinking is used for making concrete. Physical properties of the materials used are shown in table 1.

a) Natural sand

b) Copper slag

c) Foundry sand

Fig 1: Fine aggregates

Table 1: Physical Properties of Materials Used

Material	Cement	Coarse aggregate	Natural sand	Copper slag	Foundry sand
Specific gravity	3.15	2.80	2.54	3.51	2.48

3.2 Methodology

Control mix is prepared by using 100% natural sand. Sand is replaced with a mixture of copper slag and foundry sand in equal proportions at 10% replacement levels up to 100% replacement.

Workability and strength properties are studied for these blends and compared with control mix.

M30 grade of concrete is proportioned as per IS: 10262-2009. The mix ratio is 1:1.55:2.91 with water-cement ratio as 0.45. Mixing, casting and curing of specimens is carried out in conventional manner.

IV. RESULTS AND DISCUSSIONS

Sand is replaced at an increment of 10% by weight with copper slag and foundry sand in equal proportion. Strength and workability properties are studied and compared with control mix concrete.

4.1 Grading:

Grading analysis is carried out for the natural sand and the sand replaced with mixture of copper slab and foundry sand in equal proportion as per IS:383-1970 and is shown in fig 2.

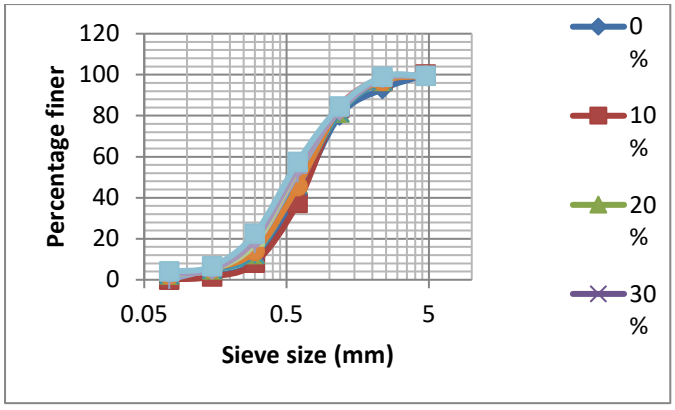

Fig 2: Gradation of fine aggregates

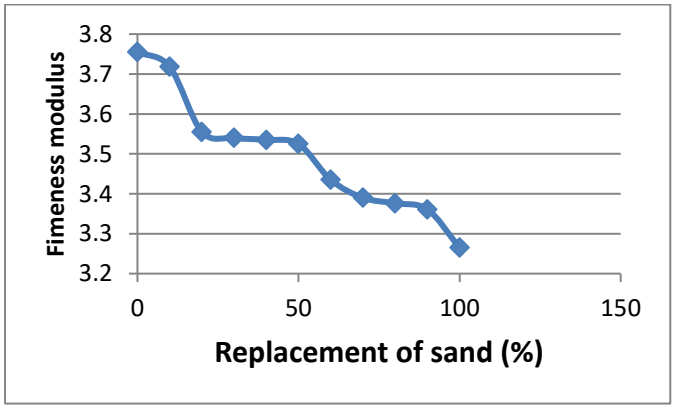

Fig 3: Variation of fineness modulus of fine aggregates

Grading of natural sand with copper slag and foundry sand conforms to Zone-II for replacement levels. Variation of fineness modulus is shown in fig 3. It varies from 3.75 to 3.26. Fineness modulus decreases as replacement level increases. As the fineness modulus of copper slag is more than natural sand and also fineness modulus of foundry sand is less than natural sand, the mixture of copper slag and foundry sand results in grading of Zone-II.

4.2 Workability:

Workability of fresh concrete is measured by compaction factor test and V-B consistometer test according to IS: 1199-1959 and it is shown in fig 4.

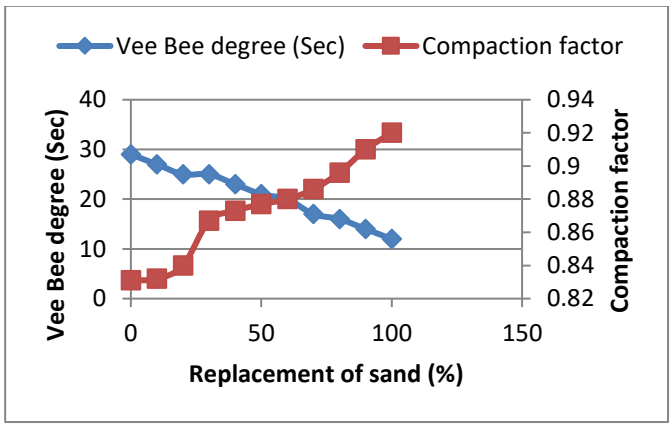

Fig 4: Variation of workability of fresh concrete with blended sand

The fig 4, shows that compaction factor increases and Vee-Bee degree in seconds decreases, with the increase in replacement level, which shows that workability of fresh concrete increases as replacement levels increase. This may be due to, the higher value of fineness modulus of natural sand, indicates that aggregates are coarser in nature, which reduces workability and also as replacement level increases the mixture will have lower fineness modulus, which results in more paste and making the concrete easier to work with thereby increases workability.

4.3 Strength properties:

Strength of hardened concrete is measured by compressive strength test and flexural strength test according to IS: 516-1959 (Reaffirmed in 2004), split tensile strength test according to IS: 5816-1999, shear

strength test according the procedure proposed by C.D. Modhera and N. K. Bairagi and impact strength test according the procedure proposed by ACI committee 544 (ACI 544.2R-89). Results of strength characteristics are shown in table 2. Variation of strength characteristics is shown in figure 5.

Table 2 : Strength Properties Results

Percentage replacement of sand	Compressive strength (MPa)	Split tensile strength (MPa)	Flexural strength (MPa)	Shear strength (MPa)	Impact strength at Final failure (kN-m)
0	31.48	3.48	5.53	21.29	3.58
10	32.29	3.53	6.13	21.48	2.85
20	33.55	3.58	6.2	21.56	3.31
30	34.37	3.63	7.06	21.66	6.22
40	35.47	3.67	7.33	21.78	7.44
50	36.88	3.81	7.86	22.4	11.47
60	28.29	3.67	7.06	21.66	7.49
70	27.4	3.58	5.8	21.11	5.29
80	26.81	3.58	5.4	20	2.26
90	25.19	3.34	5.33	20	2.01
100	24.14	3.34	5.4	20	2.32

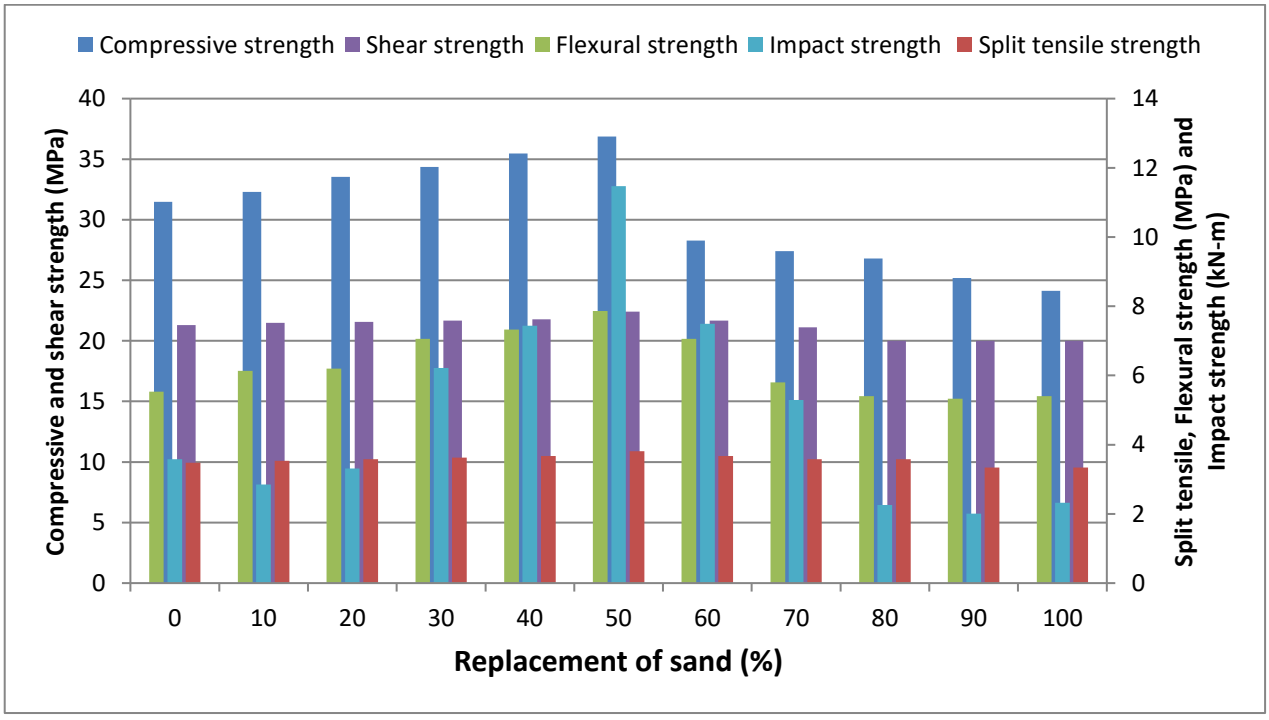

Fig 5: Variation of strength properties of concrete with blended sand

From the table 2 and fig 5, it is observed that strength properties such as compressive strength, split tensile strength, flexural strength, shear strength and impact strength increases up to 50% replacement of natural sand with equal proportion of copper slag and foundry sand, beyond which strength decreases. This may be due to 50% replacement of natural sand with mixture of copper slag and foundry sand in equal proportion produces optimum blend for fine aggregates, filling the voids and producing the dense concrete.

The increase in strength properties for 50% replacement are 17%, 9%, 42% and 5% in case of compressive strength, split tensile, flexural and shear strength respectively.

V. CONCLUSION

Based on the experimental work carried out, following conclusions are drawn.

- Grading of the mixture with 0-100% replacement of natural sand with copper slag and foundry sand, which conforms to Zone-II lies in the well graded range.
- Fineness modulus of blended sand decreases as replacement level increases.
- Workability of fresh concrete increases with the increase in replacement levels.
- Strength properties increase up to 50% replacement level, further replacement results in decrease in strength.
- Optimum blend of natural sand with copper slag and foundry sand in equal proportion is obtained at 50% replacement level.

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Investigation of the Suitability of Waste Glass and Recycled Concrete Aggregate for Structural Concrete

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ABSTRACT

Environmental pollution and increase in manufacturing and storage costs in our era, has driven humans to recycle wastes. This study examines the possibility of using waste glass as glass powder and glass aggregates and recycled aggregates. Recycled aggregate was made by crushing the waste concrete of laboratory test cubes and pre-cast concrete columns. The result showed a better compressive strength of the concrete containing waste glass and recycled aggregates.

Three types of concrete mixtures were tested. Concrete made with natural aggregate as a control concrete and two types of concrete made with natural fine and recycled coarse aggregate. In this it is necessary to use quality recycled concrete coarse aggregate and to follow the specific rules for design and production.

The specimen containing both waste glass and recycled concrete gave better result than the one containing only waste glass. The results indicate that recycled brick aggregates can be used for new construction works instead of normal brick aggregates.

Key words : Recycling, Waste Glass Powder, Waste Glass, Coarse Aggregate, Recycled Aggregates.

I. INTRODUCTION

The use of partial cement replacement materials obtained from waste or by-product streams of other industries is favoured in concrete production due to their advantages in improving some or all of the properties of concrete, the economic incentives in using a waste or by-product material, and the environmental implications. High contents of silica in glass make it a potentially pozzolanic material. Glass constitutes about 5% of the municipal solid waste stream and only 20% of this is recycled.

Utilization of waste glass and recycled aggregates is very important for human development because huge amount of glass waste produce by human increases the need of land to get rid of use up previous landfill space, decreasing possible area that can be used for landfills of other waste increasing the need to establish new expansive landfills.

Demolition of old and deteriorated buildings and traffic infrastructure, and their substitution with new ones. The main reasons for replacements are changes of purpose, rearrangement of a city, expansion of traffic directions and increasing traffic load, natural disasters etc,. Now a day's

production and utilization of concrete is rapidly increasing consumption of aggregates, therefore these are to be recycled. Recycled concrete aggregate(RCA) is generally produced by two-stage, crushing of demolished concrete and screening and removal of

contaminates such as reinforcement, paper, wood plastics and gypsum.

II. LITERATURE REVIEW.

Glass is a readily recyclable material,(1,2,3,4) in that it can be returned to the glass making furnace with minimal reprocessing. In many cases quantities of recovered glass can arise which are not recyclable.

The most important properties of recycled concrete aggregate
(RCA) are briefly presented when demolished concrete is crushed, a certain amount of mortar and cement paste from the original concrete remains attached to stone particles in recycled aggregates. This attached mortar is main reason for lower quality of RCA compared to natural aggregate (6).

RCA compared to NA has following properties

i. Increased water absorption
ii. Decreased bulk density
iii. Decreased specific gravity
iv. Increased abrasion 12ss
v. Increased crushability
vi. Increased quality of dust particles

To obtain the desired workability of RCA it is necessary to add a certain amount of water to saturate recycled aggregate before or during mixing. The additional water quantity is calculated on the basis of recycled aggregates.

Recycled aggregates (5, 6) are broken down into two main categories, which are coarse and fine aggregates, coarse aggregates in general are larger than 2mm in diameter and fine aggregates are defined to be smaller than 2mm. When concrete is formed, the coarse aggregates with its large portion of the coarse aggregate and reduce the amount of cement required. When fresh aggregates are used to mix concrete, the aggregates themselves also contain some moisture either from water condensing on the particles or the aggregates was washed in some way with water

NATIONAL STATUS:

Research on the use of RCA for structural concrete dates back to 10- yearS. The research scholars at IIT Kharagpur and IIT Delhi have worked on RCA which was mainly manually broken coarse aggregates, not machine crushed (2008).
However, the construction industry in India is yet to take note of the potential of RCA. More research is needed to popularize RCA in India. The fact that it can be used as an efficient replacement up to 100% of natural coarse aggregate is not appreciated in India yet. The concrete mix design needs to be modified to use RCA. The technical and economic benefits of manually recycled RCA over machine recycled RCA needs to be established through experimental research as it has good potential for structural application.

III. Research significance

Recycling, disposal and decomposing of water glass possess major problems for municipalities. This problem can be greatly eliminated by re-using waste glass as cement replacement in concrete. There is a limit on the availability of natural aggregate and minerals used for making cement and it is necessary to reduce energy consumption and emission of
CO2 resulting from construction processes. The solution of this problem is sought through usages of glass as partial replacement of sand and aggregates. The concrete containing waste glass powder needs to the investigated by replacing glass with sand and coarse aggregates. Also the use of recycled aggregates is made.

IV. Methodology

We have identified a single source of a old demolished concrete within Jain Global campus and the waste coarse aggregate and broken glass (mainly clear glass) are collected for the experiments.

In this experimentation, an attempt has been made to find out the strength behaviour of concrete produced by replacing the cement with waste glass, glass aggregate and recycled concrete aggregate. Ordinary Portland Cement (OPC) 43 grade, locally available sand and coarse aggregates were used in this experiments. The sand used was a Zone-III had the specific gravity of 2.62. The specific gravity of the coarse aggregate was 2.93. The coarse aggregate used were 20mm and down size. The glass powder was obtained by crushing waste glass pieces. The 475-micron passing fraction and glass aggregates of 20mm in size were used for the experimentation. Old concrete waste was crushed in the Jaw crusher and sieved to prepare recycled coarse aggregate.

Various compositions used for the experiments are as follows:

A1- Cement + Sand + Recycled Coarse aggregate + Glass powder (15% replacement of sand by weight)

A2- Cement + Sand + Coarse aggregate + Glass (15% replacement of coarse aggregate by weight)

A3- Cement + Sand + Coarse aggregate + Glass aggregate (15% replacement of sand by weight) + Glass powder (15% replacement of sand by weight)

B1- Cement + Sand + Coarse aggregate + Recycled concrete aggregate (15% replacement of cement by weight) + Glass powder (15% replacement of sand by weight)

B2- Cement + Sand + Coarse aggregate + Recycled concrete aggregate + Glass aggregate (15% replacement of coarse aggregate by weight)

Table-1

Quantities of materials applied to the specimens:

Mix	Description	Cement (Kg)	Sand (Kg)	Coarse Aggregates (Kg)
A1	With 15% glass powder	2.60	4.05	8.50
A2	With 15% glass aggregate	2.60	4.76	7.2303
A3	With 15% glass powder+ 15% glass aggregate	2.60	4.05	7.2303
B1	RCA 15% + 15% glass aggregates	2.213	4.76	7.2303
B2	With 15% RCA + 15% Glass powder + 15% glass aggregate	2.213	4.05	7.2303

Mix	Description	Glass Powder (Kg)	Coarse glass Aggregate (Kg)	RCA (Kg)
A1	With 15% glass powder	0.714	-	-
A2	With 15% glass aggregate	-	1.274	-
A3	With 15% glass powder+ 15% glass aggregate	0.714	1.274	-
B1	RCA 15% + 15% glass aggregates	-	1.274	0.390
B2	With 15% RCA + 15% Glass powder + 15% glass aggregate	0.714	1.274	0.390

Fig1: Glass aggregate being prepared

Fig 2: Addition of glass powder

Fig 3: Addition of glass aggregates

V. RESULT

Table-2 Observed compressive strength of the specimens

Mix design (M20)	Compressive strength at 14- day (MPa)	Compressive strength at 28-day (MPa)
Conventional concrete	16.8	24.15
A1	21	23.1
A2	18.58	20.37
A3	16.27	16.8
Conventional concrete	16.8	24.15
B1	20.26	25.20
B2	21	27.93

Fig. 4: Prepared moulds

Fig 5: Specimens after compression testing.

VI. CONCLUSION

The following conclusions can be highlighted from the output of this research and can be summarized as follows:

1. The data obtained in this project show that there is great potential for the utilisation of waste glass in concrete in the form of coarse aggregate and glass powder and also recycled concrete aggregate along with it. It is considered that the latter form would provide much greater opportunities for value adding and cost recovery, as it could be used as a replacement for expensive materials. The use of glass powder in concrete would prevent expansive Alkali Silica

Reaction (ASR) in the presence of recycled concrete aggregate.

2. This study is an initial effort to propose the concept of concrete of concrete with waste glass together with recycled concrete aggregate.

3. Concrete specimens containing waste glass showed lesser strength in comparison to the specimens containing both waste glass and recycled concrete aggregate

4. Concrete containing glass as coarse aggregate and glass powder can achieve comparable strengths (even better for Compositions A1 & B2) to that of natural sand and coarse aggregates (Table-2).

5. Increase in strength of the concrete was found when recycled concrete aggregate was added to the specimen containing waste glass.

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A Comparative Study on Multistage Orifice Assembly with Experimental and CFD Analysis

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ABSTRACT

The single restriction orifice plate cannot be used for very high pressure drop or flow control due to inception of cavitation and choking conditions. To overcome the challenge of controlling high pressure drop or high flow rate an efficient method is suggested using multistage orifice plates. This paper details out experimentation done using single stage, two stage, and three stage orifice plates to adjudge the efficiency of multistage orifice plates as compared to single stage. This basic experimental work will help to evolve better design by considering the variables involved in the flow control. The experimental results are compared with CFD simulation analysis. The developed guidelines can be used in flow control of small hydropower installations and high pressure gas pipelines.

Keywords : Cavitation, Choking, Flow Rate, Multistage Restrictions, Orifice Plate, Pressure Drop, Hydropower

1. INTRODUCTION

Orifice plates are majorly used to reduce the pressure and to measure discharge in closed conduit flow. The pressure drop at orifice plates is considerably very high which accounts for cavitation and choking in fluid flow. The pressure drop produced depends on orifice hole. Multistage restriction orifice plate may required to achieve the desire pressure drop by preventing Cavitation, Flashing, and High Noise and Vibrations. A volatile fluid like oil, gas, chemicals are used under different conditions like pressure variations, temperature change. The flowing fluid can be measured using differential pressure equipment.

This project details out the conditions when multiple restriction orifices are to be considered and the basic physical arrangement of the multiple restriction plates. The experimental results are compared with simulation method using Computational Fluid Dynamics (CFD) tool. It further explains the method by which they can be sized. The design limitations are discussed.

Due to lack of information on this area, the experimental implantation is difficult in terms of standardization in design. This project is an attempt to focus on the issues and hope for more research in future, followed by sharing of information so that

vendor specific approach is minimized and there is higher level of confidence in expected performance in different stages of orifice.

1.1 Multiple Restrictions

Flow measurement of liquid, gas and steam according to the differential pressure principle has been recognised principle for very many years using orifice plates, venture-tubes and flow nozzles. A restriction in the pipeline creates a pressure drop if the fluid flows. The pressure drop is determined by the velocity of the fluid.

Multiple step reductions may involve multiple restriction orifices, control valves or combinations of both. A typical set up may include a control valve with a restriction orifice downstream. The restriction orifice then provides the backpressure on the control valve to prevent cavitation through the valve. However, the restriction orifice itself must also be correctly sized to prevent cavitation.

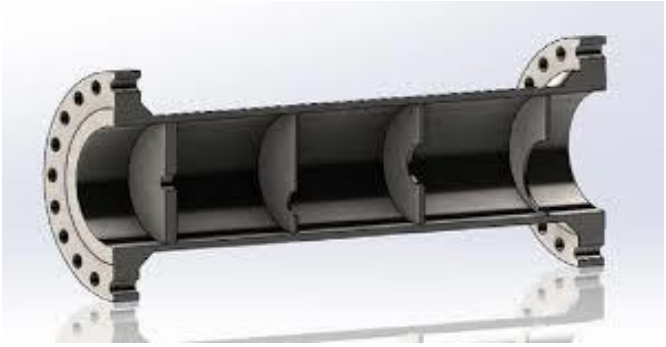


Fig.1: Multistage restriction orifice
Source: Datasheet, Deltafluid, Rev.2 April 2016
(Rototherm, 2008)

1.2 Computational Fluid Dynamics

The solution of any fluid flow problem would involve solving for the various flow parameters at each location in the flow domain. In order to do this, a set of governing equations of motions need to be solved subject to the appropriate boundary conditions. These governing equations are obtained by invoking basic laws that govern the fluid flow (like conservation of mass, momentum principle, first law of thermo dynamics etc). These will yield a set of coupled non linear partial differential equations which are not amenable to analytical solutions. Hence, they are solved numerically using Computational Fluid Dynamics (CFD) tool.

In the present study, ANSYS FLUENT software version 19.1 is used for analysing the flow. The flow is assumed to be steady and axisymmetric. The fluid is incompressible and follows Newton's law of viscosity. Thus, the governing equations consist of conservation of mass and Navier-Stokes equations. The flow domain is discritized into a large number of small volumes which are called as elements. The mesh has to be fine enough and the number has to be sufficiently large in order to ensure accuracy and convergence. The basic laws are applied to each sub domain by using finite volume technique. These differential equations are converted into algebraic equations which are solved iteratively until the required convergence is achieved.

2. Methodology

An experimental approach has been used to determine the effect of single stage, two stage and three stage orifice characteristics.

It is planned to conduct detail experiments by varying the orifice size, Number of stages and the gape length between the stages. Primarily it is planned to use water as a fluid medium with a re-circulating facility, It is also planned to model the flow parameters in multistage orifice plates using computational fluid dynamics tool, the fluid parameters like pressure drop, velocity and flow rate will be modeled and validate for each type of arrangement and the optimum solution will be given to the flow industry for use of multistage orifice plate as flow control device, without choking.

Fig. 2: Experimental setup

Fig. 3: Pressure gauge arrangements for 1-stage, 2-stage & 3-stage assembly

3. Data Analysis

Experimental data is collected from various combinations in pipeline diameter. The following are the data considered for the analysis

a. Pipeline diameters D = 25.4mm, 19.05mm & 12.7mm
b. Beta ratio β = d/D = 0.4884
c. Series= 3 (N, M2 and M3 Series – 1-Stage, 2-Stage and 3-Stage respectively)
d. 26mm/12.7mm orifice assembly connected to various diameter of pipe – 25.4mm, 19.05mm & 12.7mm
e. Discharge is observed using flowmeter
f. Reynold's number is given by

$$\mathrm{Re} = \frac{\rho V D}{\mu} \qquad (1)$$

For CFD analysis the following data are given input in ANSYS Fluent with combinations different pipeline diameter

a. Input as pressure inlet, value as per experimental data shown in Table 1

Table 1: Data input to the ANSYS Fluent for simulation

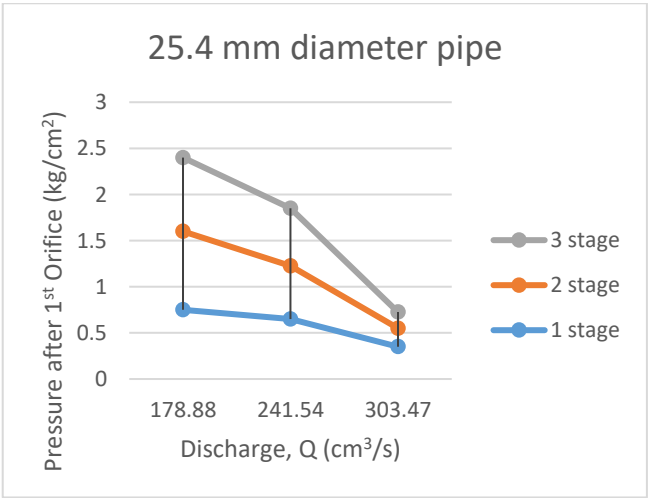
Inlet pressure (kg/cm²)			
Diameter of pipe	**25.4mm**	**19mm**	**12.7mm**
1-stage	0.875	0.7	0.775
2-stage	0.875	1.05	1.15
3-stage	1.1	0.975	1.2

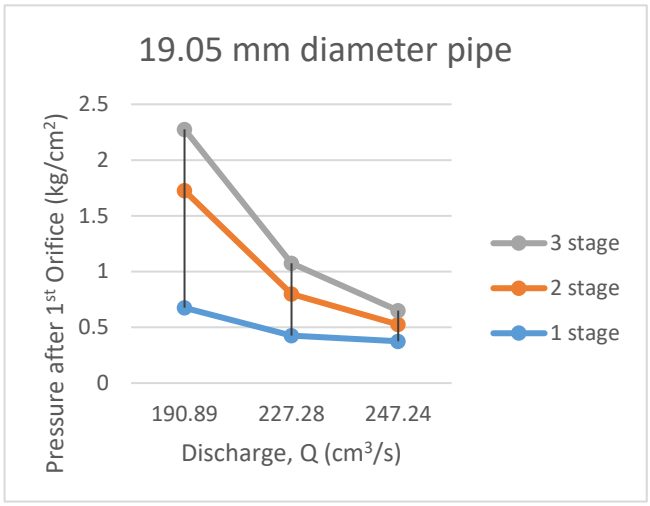
b. Viscous model k-epsilon (2 eqn) with standard wall functions
c. Boundary conditions: wall-surface body and pressure-inlet is used
d. Solution method: Least Square cell based, turbulent kinetic energy

4. Discussion

4.1 Variation of Pressure after first orifice with discharge

The pressure variation from the graph between pressure after first orifice and common discharge at 25.4mm, 19.05mm & 12.7mm diameter clearly shows about downward trend. The behaviour of 3-stage pressure line is higher compared with other stage pressures. This indicated 3-stage orifice plate assembly could be better control over the pressure.





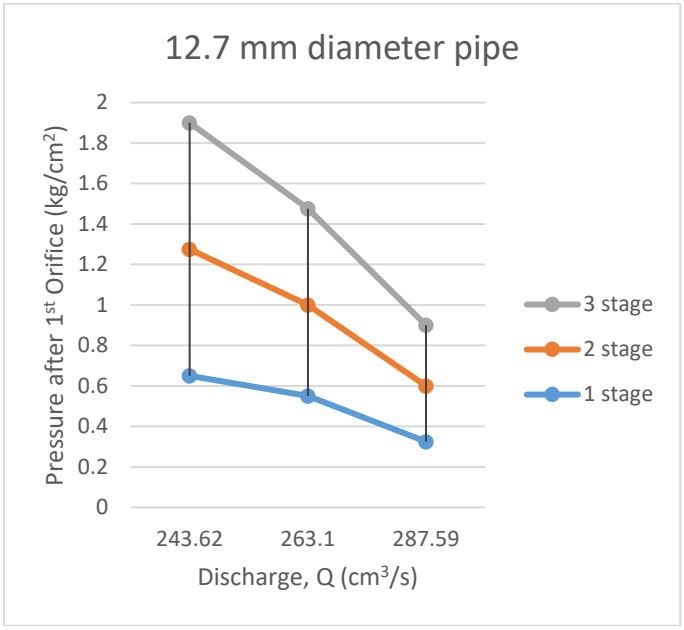


Fig. 5: Experimental results on variation of Pressure after first orifice with discharge in 25.4mm, 19.05mm & 12.7mm pipeline

4.2 Variation of pressure along the flow direction – post processing output from ANSYS

The pressure variation along the length of pipeline is observed from ANSYS Fluent. The trend seems acceptable pressures from inlet to outlet. The pressure variation versus length of the pipe is considered 3-stage for the discussion as other stage variations seems susceptible in terms of variation in graphs. The input value to the CFD tool is made use from the experimental results for better validation. The cavitation is observed after third orifice as negative pressure further achieving nil pressure at outlet.

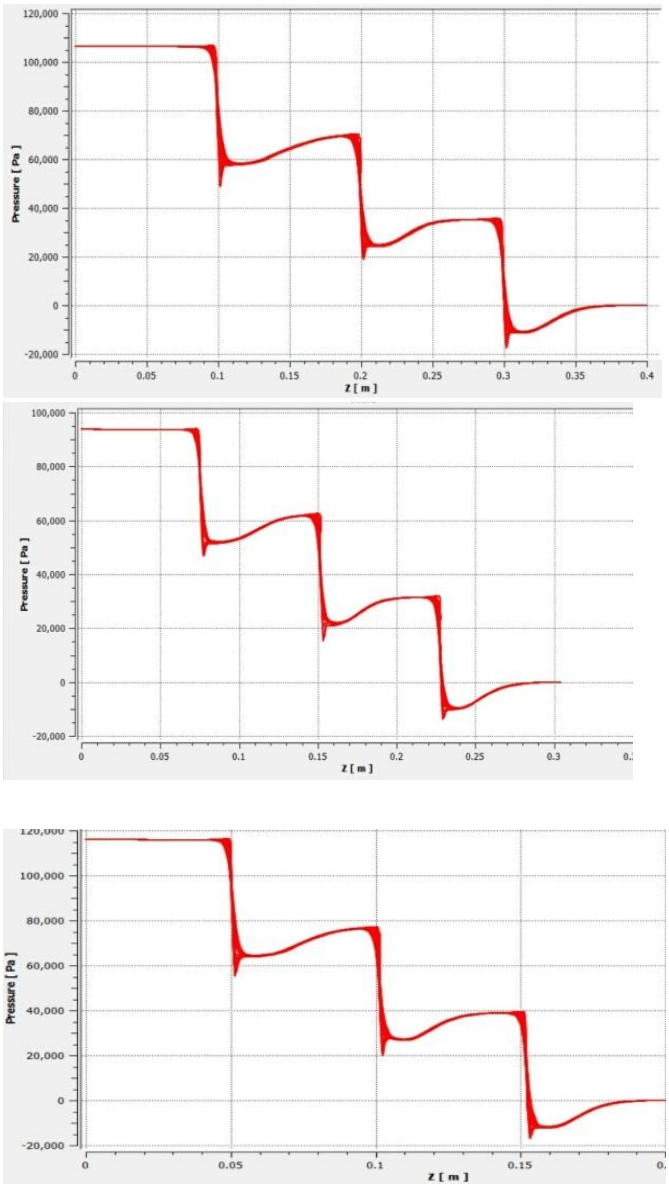


Fig. 6: Post processing graphs of pressure variation in 25.4mm, 19.05mm & 12.7mm pipeline from CFD

4.3 Velocity contour along the length of pipeline

The velocity variation along the length of pipeline is observed in 25.4mm, 19.05mm and 12.7mm diameter pipeline. The highest velocity observed as 10.38 m/s in 19.05mm diameter pipe at orifice junctions and lowest occurred 9.288 m/s in 12.7mm diameter pipe. At downstream of each orifice it is observed some turbulence due to cavitation.

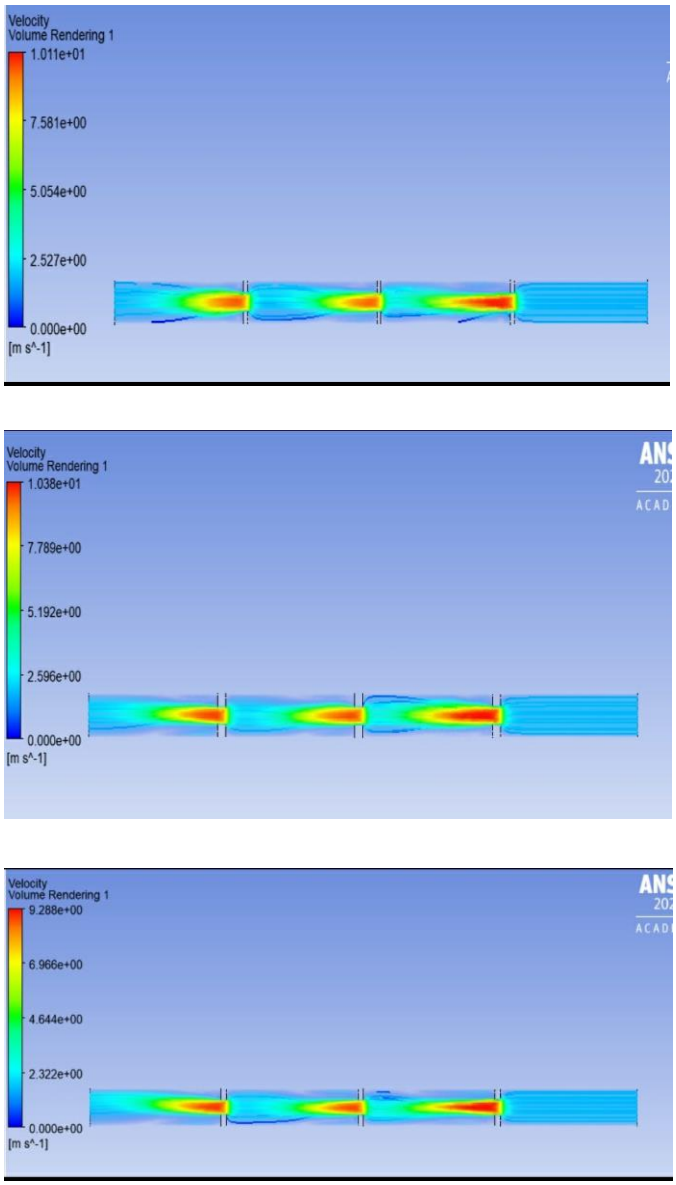


Fig. 7: Post processing velocity contour in 25.4mm, 19.05mm & 12.7mm pipeline from CFD

5. Conclusion

a. Stepwise Flow control can be achieved for small hydropower installations and high pressure gas pipelines.
b. The main claim is that the multistage orifice paltes improves the flow control compared to normal orifice.
c. The 3-stage orifice palte assembly is better control compared to 1-stage and 2-stage
d. The CFD methodology is used for validation for flow through orifice plate assemblies as long as certain precautions on fineness of mesh is followed.
e. Velocity departure out of single orifice have more volumetric flow rate compared to multiple orifice plates.
f. The velocity can be minimized in case of more multistages in pipeline.
g. The negative pressure is observed in CFD simulation as shown in fig.6. This leads to cavitation at minimum level compared with single stage orifice.
h. Overall cost savings due to reduced pressure loss in multistage configuation.

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An Experimental Investigation on Partial Replacement of Fine Aggregate by Glass Powder

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ABSTRACT

Glass waste creates chronic environmental problems, mainly due to the inconsistency of waste glass stream. Glass is widely used in our lives through manufactured products such as sheet glass, bottles, glass ware and vacuum tubing. Glass is an ideal material for recycling. The use of recycled glass helps in energy saving. Leaving the waste material to the environment directly can cause environmental problems. Hence the reuse of waste material has been emphasized. Waste can be used to produce new products or can be used as admixtures so that natural resources are used more efficiently, and the environment is protected from waste deposits. One of its significant contributions is to the construction field where the waste glass was reused for concrete production. The properties of concretes glass dust waste were investigated in this study. Glass dust waste was used as a partial replacement for M-sand at 10%, 20%, and 30% of concrete mixes. Compression strength for 7, 14- and 28-days concrete of age were compared with nominal conventional block made with 0% of glass dust waste.

Keywords : Glass powder, compressive strength, split tensile strength, fine aggregate and coarse aggregate

I. INTRODUCTION

In India, 0.7% of total urban waste generated comprises of glass. Waste glass is crushed into specified sizes for use as aggregate in various applications such as water filtration, grit plastering, sand cover for sport turf and sand replacement in concrete. Concrete is most widely used man made construction material and its demand is increasing day by day.

Population levels around the globe are increasing rapidly, resulting in unprecedented levels of waste material. New and innovative methods of recycling need to be established in order to ensure that we do not run out of room for storage. Glass, being non-biodegradable, is one such material that is not suitable for addition to landfill. Fortunately, glass can be recycled indefinitely without any loss in quality, but first needs to be sorted by colour. This is an expensive process, and subsequently waste glass is increasingly being used in applications where mixed colour is not an issue, such as an aggregate in civil construction.

The proportion of raw materials is based on availability, chemical and physical consistency, sizing, purity and cost. The goal is to use the most economical and high-quality raw materials available. Glass containers are commonly made with a combination of various oxides or oxygen-based compounds and are commonly referred to as “Soda-

Lime" glass. The combining of raw materials creates glass containers that are durable, strong, impermeable, easily shaped, and inexpensive. Some oxides will form glass without adding any other elements and are known as network formers. The most common of these is silica (SiO^2).

The land filling of waste glasses is undesirable because they are not biodegradable, which makes them environmentally less friendly. There is huge potential for using waste glass in the concrete construction sector. When waste glasses are reused in making concrete products, the production cost of concrete will go down. Glass concrete products can be categorized as commodity products and value-added products. For simple commodity products, the primary objective is to utilize as much waste glass as possible. This research has been conducted to identify the suitable composition of glass dust waste as fine aggregate replacement material in concrete and to study the compressive strength of concrete.

The using of waste glass as fine aggregate in concrete creates a problem in concrete due to ASR (Alkali Silica Reaction). The reaction between alkalis in Portland cement and silica in aggregates forms silica gel. This gel is prone to swelling. It absorbs water and the volume of the gel increases. Under confinement by cement matrix and aggregate, the swelling of the ASR gel generates hydrostatic pressure. If the reaction continues and internal pressure exceeds the tensile strength of the matrix, cracks will form around the reactive aggregate particles [5]. Ground waste glass was used as fine aggregate in concrete and no reaction was detected with fine particle size, thus indicating the feasibility of the waste glass reuse as fine aggregate in concrete. In addition, waste glass seemed to positively contribute to the mortar micro-structural properties resulting in an evident improvement of its mechanical performance

Hence the size of waste glass used was in the range 0-1.18mm. In this research, fine aggregates were partially replaced by waste glass as 10%, 20%, and 30%, by weight. Concrete specimens were tested for compressive strength. The results obtained were compared with results of normal M-20 concrete mix and it was found that maximum increase in compressive strength occurred for the concrete mix containing 20% waste glass as fine aggregate. With increase in waste glass content, in durability. This paper summarized the behaviour of concrete involving replacement of fine aggregates by waste glass as 10%, 20%, and 30%, by weight which may help to reduce the disposal problems of waste glass and enhance properties of concrete.

II. LITERATURE SURVEY

1. Dr. Aparna srivastav etal (2016): In this research, fine aggregates were partially replaced by waste glass as 5%, 10%, 15% and 20% by weight. Concrete specimen was tested for compressive strength. the results obtained were compared with result of normal M-25 concrete mix and it were found that maximum increase in compressive strength occurred for the concrete mix containing 10%waste glass as fine aggregate. (With increase in waste glass content, water absorption decreased indicating increase in durability). This paper summarized the behaviour of concrete involving replacement of fine aggregate by waste glass as 5%, 10%, 15% and 20% by weight which may help to reduce the disposal problem of waste glass and enhance the properties of concrete.
2. D.Elavarasan etal (2016): In this paper fine aggregate were replaced by waste glass powder as 0%, 10%, 20% and 30% and by weight for M-20 mix. While using waste glass powder as a fine aggregate replacement, 7th day and 28th day compressive strength is found to be marginally increased up to 10% replacement level. the result obtained by testing are 3.3% increment in the compressive strength is found at 10%

replacement of fine aggregate by waste glass powder, at 28th day when compare to normal concrete and 39.55% increment in the split tensile strength is found at 20% replacement of fine aggregate by waste glass powder at 28th when compare to normal block.

3. M.Adaway etal (2015): The paper gives about the effects on compressive strength by using the glass powder as a partial replacement in the structural concrete. The project aimed to determine the level, for glass replacement proportions of 15,20,25,30 and 40% compressive strength was found to increase up to a level 30%, at which point the strength developed was 9% and 6% higher than the control after 7 and 25 days respectively. of glass replacement resulting in optimal compressive strength. Three concrete samplers were tested at 7 and 28 days This demonstrates that concrete containing up to 30%. Fine glass aggregate exhibits higher compressive strength. Development than traditional concrete.
4. Prajakta N. Haramkar etal (2018): This paper investigates and study about the partial replacement of fine aggregate by using glass powder as 10%, 20%, 30% or concrete mixes. The compressive strength for 7, 14 and 28 days. Concrete of age were compared with those of concrete made with natural fine aggregate. The result proved that highest strength activity given by glass dust waste after 28 days.
5. Priyadarshini (2017) Ast. Prof: The need to add value to waste the opening towards use of sand replacement material both in mortar and concrete, with the purpose of promoting increased sustainability of building material where the ground for this work that aims this formulation of mortar with the crossed glass aggregate. The test result shows that the replacement of fine aggregate by fine glass at level of 20% by weight effect on the compression strength of the mortar block as compared the control sample because of pozzolanic nature of fine glass results indicate pozzolanic reactivity of this waste and open possibility for the use of this material in mortar

III. OBJECTIVES

The utility of glass powder as a partial replacement of fine aggregate in concrete the performance conventional concrete and glass powder in concrete the effectiveness of the glass powder concrete in strength enhancement. The waste glass is collected from the shops and used the collected glasses are crushed to sand size and could be used an alternative material for M-sand as partial replacement the utilization of the glass as fine aggregate will turn this waste material into the valuable resource.

- To study and compare the performance of conventional concrete cubes and glass powder concrete cubes.
- To understand the effectiveness of glass powder in strength enhancement.
- The percentage of glass powder which gives maximum strength when compare to concrete.

To evaluate the utility of glass powder as a partial replacement of fine aggregate in concrete

IV. MATERIAL

A. Cement

cement is a binder, a substance used for construction that sets, hardens and adheres to other materials, binding them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together. Cement is used with fine aggregate to produce mortar for masonry, or with sand and gravel aggregates to produce concrete. Cements used in construction are usually inorganic, often lime or calcium silicate based, and can be characterized as being either hydraulic or non-hydraulic,

depending upon the ability of the cement to set in the presence of water. Ordinary Portland cement of 53 grade conforming to IS: 12269-1987 [9] will be using in concrete.

B. Fine Aggregates and coarse aggregate

Fine aggregate 4.75mm size M-sand and glass powder

coarse aggregate of size 20mm

GLASS POWDER:

Here glass powder will be using as partial replacement of fine aggregates by waste glass as 10%, 20%, 30% and 40 % by weight which may help to reduce the disposal problems of waste glass and enhance properties of concrete. The glass powder will be obtaining from JJ Glastronics adugodi Bangalore. The specific gravity of glass powder is 2.44.

Physical properties:

Crushed glass(culets) partials are generally angular in shape and can contain some flat elongated particles. The degree of angularity and the quantity of flat and elongated particles depend on the degree of processing, smaller particles resulting from extra crushing will exhibits somewhat less angularity and reduced quantities of flat and elongated particles. Proper crushing can virtually eliminate sharp edges and the corresponding safety hazards associated with a manual handling of the product.

Chemical properties

The following Table gives the chemical composition of glass powder:

Composition (% by mass)/property	Glass powder
Silica (Si02)	72.5
Alumina (Al2O3)	0.4
Iron oxide (Fe2O3)	0.2
Calcium oxide (Cao)	9.7
Magnesium oxide (MgO)	3.3
Sodium oxide	13.7
Potassium oxide	0.1
Sulphur trioxide	-
Loss on ignition	0.36
Fineness, % passing (sieve size)	80 (45 microns)

Mechanical properties: Glass is a brittle material the fractures from tensile stress, the internal friction angle or shear strength and the bearing capacity of crushed glass blended

with conventional aggregates is relatively high, and its compatibility is relatively insensitive to moisture content.

TESTING RESULTS AND DISCUSSION

COMPRESSIVE STRENGTH OF CONCRETE

7 DAYS STRENGTH

CUBE DESIGNATION 150*150*150	GLASS %	SAND%	COMPRESSIVE STRENGTH N/mm^2
Conventional cube 1	0%	100%	15.66
Glass cube 2	10%	90%	17.77
Glass cube 3	20%	80%	19.75
Glass cube 4	30%	70%	16.29

T 1: 7 days results of compressive strength

T 2: 7 days results of compressive strength

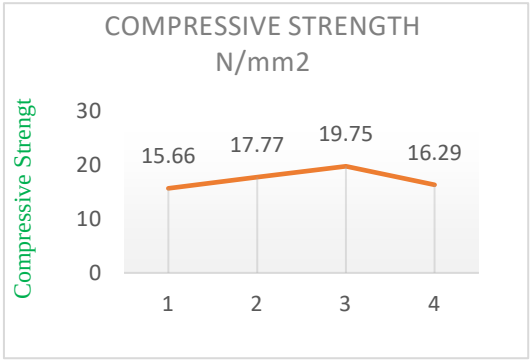
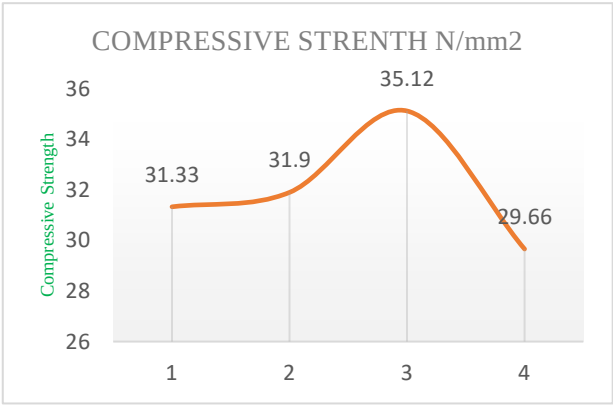


Fig 2: 14 Days compressive strength value value

fig 2: 14 Days compressive strength

28 DAYS STRENGTH

CUBE DESIGNED 150*150*150	GLASS %	SAND %	COMPRESSIVE STRENTH N/mm^2
Conventional cube 1	0%	100%	31.33
Glass cube 2	10%	90%	31.9
Glass cube 3	20%	80%	35.12
Glass cube 4	30%	70%	29.66



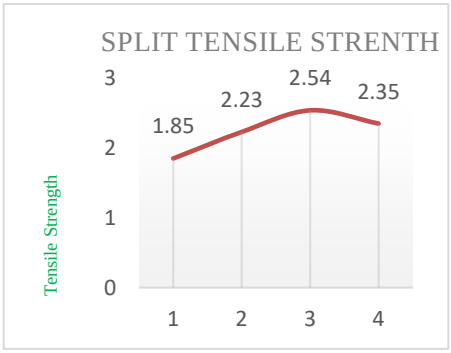
T 3: 28 Days compressive strength value

Fig 3: 28 Days compressive strength value

SPLIT TENSILE STRENTH OF CONCRETE

7 DAYS

CUBE DESTINATION 150*150*150	GLASS %	SAND%	SPLIT TENSILE STRENTH
Conventional cube1	0%	100%	1.85
Glass cube 2	10%	90%	2.23
Glass cube 3	20%	80%	2.54
Glass cube 4	30%	70%	2.35



T 4: 7 Days compressive strength value

Fig 4: 7 Days compressive strength value

28 DAYS

CUBE DESTINATION 150*150*150	GLASS %	SAND%	SPLIT TENSILE STRENTH
Conventional cube 1	0%	100%	2.30
Glass cube 2	10%	90%	2.52
Glass cube 3	20%	80%	3.21
Glass cube 4	30%	70%	3.10

T 5 : Split tensile strength for 28 Day

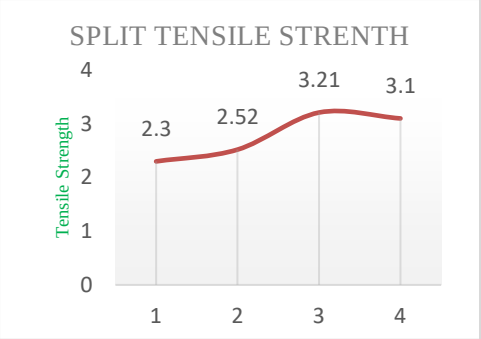


Fig 5: Split tensile strength for 28 Day

V. CONCLUSION

Based on the experimental observations, the following conclusions are drawn

- Compressive strength increases with increase in percentage of glass powder up to 20% replacement and beyond 20% strength decrease and Split tensile strength increase with increase in percentage of glass powder up to 20% replacement and beyond 20% strength decrease. Considering the strength criteria, the replacement of fine Aggregate by glass powder is feasible. Therefore, we can conclude that the utilization of waste glass powder in concrete as M-sand replace is possible.
- By using glass powder with partial replacement of fine aggregate up to 20% is possible to achieve the durability properties through the use of glass material.

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Comparing the Standards of Coarse Aggregate in Bidar with Morth Specification

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ABSTRACT

The prime purpose of a pavement is to transmit loads to the base, sub base and underlying soil. The properties of aggregates used in pavement depends on gradation and type. In this study the information about the quarries available in the Bidar district are collected. Every quarry site was inspected and its locations are identified using GPS. The samples are collected from Humnabad, Bhalki, Aurad, Basavakalyan and Bidar district and tested for its material properties. The properties of coarse aggregates available in the district are compared with the standards of Dense Bituminous Macadam and Bituminous Concrete as per MORTH specifications. The mobile application is developed which fetches all the information about aggregates available and its location for the contractors, engineers and any other customers.

Keywords : Gradation, BC, DBM

I. INTRODUCTION

Bituminous mixes are used as base and wearing courses in a pavement structure to distribute stresses caused by loading and to protect underlying unbound layers from the effects of water. Designing a bituminous mixture to meet the needs of a particular paving project requires careful selection of the aggregate and bitumen to be used. A compatible aggregate source and gradation chosen must meet the needs of the project, because which will affect the overall performance of the bituminous mixture. Bituminous mixture is composed of approximately 95% by weight, or 80% by volume, mineral aggregate. Therefore it is important to see how aggregate gradation can affect the fundamental properties of bituminous mixture. The Bituminous Concrete mix is better than Dense Bituminous Macadam mix in term of indirect tensile strength(ITS), horizontal tensile strain(HTS), and the compressive strength, while Dense Bituminous Macadam mix is better in terms of shear strength and rut resistance.(Haider et.al 2012)

The aggregate comprising particles of various sizes should be such that the smaller particles fill the voids between the larger particles. Aggregate gradation determines the void content within the structure of aggregate. The optimization of aggregate gradation improves the rheological, mechanical and durability properties of concrete (Pawar et. al 2016). Hence it is necessary to know the quantity of coarse aggregates available and their quality standard as per requirements in a particular area is very important. Therefore the properties of coarse aggregates available

in Bidar district and their data availability to the customers is very important before selection.

3. Development of App to get the information about number of quarries available, its location, size of aggregates and its quality standard in BIDAR District.

1.1 MORTH SPECIFICATION

TABLE 1.1 SPECIFICATION OF MORTH FOR GRADATION

	As per MORTH % passing	
	BC	DBM
IS Sieve size(mm)	NAS=19mm	NAS=37.5mm
40		100
37.5		95-100
26.5	100	63-93
20	90-100	-
13.2	59-79	55-75
10	52-72	-
4.75	35-55	38-54
2.36	28-44	28-42
1.18	20-34	-
0.6	15-27	-
0.3	10-20	7-21
0.075	2-8	2-8

TABLE 1.2 SPECIFICATION OF MORTH FOR DIFFERENT TESTS OF AGGREGATE

SI.NO.	TESTS	STANDARD MORTH VALUES	
		DBM	BC
1.	Specific Gravity	2.5-3	2.5-3
2.	Water Absorption	2%	2%
3.	Impact Test	35%	24%
4.	Flakiness and Elongation index	35%	35%
5.	Abrasion Test	40%	-

1.2 OBJECTIVE OF THE PRESENT STUDY

From the detailed literature review carried out the following objectives were set.

1. Determining the strength and gradation of coarse aggregates available in BIDAR District.
2. Comparing the standards of aggregates with requirements of dense bituminous macadam and bituminous concrete as per MORTH specification.

II. METHODOLOGY

1. Procurement of coarse aggregate samples from BIDAR district. (Bidar, Humnabad, Bhalki, Aurad, Basavakalyan).

Locations:

In Bidar district there are totally 5 talukas.

1. Bidar
2. Humnabad
3. Bhalki
4. Aurad
5. Basavakalyan

Figure 1 : Map of Bidar District and talukas

2. The samples so collected will be tested for gradation (sieve analysis), specific gravity test, water absorption and impact test.
3. Analyzing and comparing the results obtained with MORTH specification.

4. If the results are not agreeable with MORTH values then the blending of aggregate of different quarries for the construction are also suggested.
5. Mobile App is developed to give the information for the consumers about number of quarries available, its location, size of aggregates and its quality standards in Bidar District.

III. RESULTS

Tests are concluded on the aggregate collected from various quarries of the Bidar district. The test results are compared with requirement standards of Dense Bitumen Macadam (DBM) and Bituminous concrete (BC) mixes. That studies were carried out on aggregates available in Bidar, Humnabad, Bhalki, Aurad and Basavakalyan Taluks. The methodology and test adapted for all quarries are similar and the details tabulated in following Table 3.1.

Table 3.1.Details of all quarries of Bidar District

Place	Name and address	Size of the aggregates	Location	Specific gravity	Water absorption%	Impact test %
Aurad	Almaje Stone Crusher	40mm 20mm 10mm	18°00'23"N 77°26'53"E	2.6	2.01%	24%
	KHOBA STONE CRUSHER	20mm 10mm 8mm	18°02'59"N 77°28'15"E	2.5	2%	28%
Bhalki	Khandre Stone Crusher	40mm 10mm 8mm	17°59'45"N 77°19'06"E	2.65	2%	21.9%
Chillargi - Bidar	Sapna Stone Crusher	40mm 20mm 8mm	17°59'41"N 77°37'47"E	2.45	1.99%	25%
Chickpet – Bidar	Nagrey Stone Crusher-	20mm 16mm 10mm	17°57'05"N 77°31'22"E	2.5	2%	28%
Janwada - Bidar	Taj Stone Crusher	20mm 10mm 8mm	18°00'18"N 77°29'49"E	2.65	2.02%	28%
Beneknalli - Bidar	Kori Stone Crusher	20mm 16mm 8mm	18°00'43"N 77°30'12"E	2.6	2%	24%
Janwada - Bidar	Sana Stone Crusher	40mm 10mm 8mm	17°24'55"N 78°15'43"E	2.5	2%	22%

Chillargi - Bidar	Patil Stone Crusher	40mm 10mm 8mm	17°59'40"N 77°37'47"E	2.64	1.95%	24%
Noubad - Bidar	Latecrete Stone Crusher	40mm 16mm 10mm	17°55'34"N 77°28'40"E	2.5	2%	27%
Humnabad	Khoba Stone Crusher	40mm 20mm 16mm	17°45'54"N 77°15'23"E	2.52	2%	30%
	KORI STONE CRUSHER	20mm 10mm 8mm	17°49'39"N 77°11'34"E	2.6	2%	27%

Similarly the graduation requirements are given in Table 3. 2 are compared with the obtained test results of all quarries.

Table 3.2 Gradation details of all quarries

	As per MORTH % passing		Almaje Stone Crusher	KHOBA STONE CRUSHER	Khandre Stone Crusher	Sapna Stone Crusher	Nagrey Stone Crusher-	Taj Stone Crusher	Kori Stone Crusher
	BC	DBM							
IS Sieve Size (mm)	NAS=19 mm	NAS=37.5mm	% finer	% finer	% finer	% finer	% finer	% finer	% finer
40		100	100	100	100	100	100	100	100
37.5		95-100	100	100	100	100	100	100	100
26.5	100	63-93	100	100	100	100	100	100	100
20	90-100	-	42.44	39.45	44.42	43.44	45.44	39.44	42.24
13.2	59-79	55-75	22.44	20.44	24.47	22.54	26.44	20.44	22.48
10	52-72	-	14.96	15.96	13.97	14.90	16.96	16.96	14.96
4.75	35-55	38-54	7.80	8.12	7.96	896	8.96	8.94	7.96
2.36	28-44	28-42	7.50	8.10	7.48	8.48	8.48	8.48	7.48
1.18	20-34	-	-	-	-	-	-	-	-
0.6	15-27	-	-	-	-	-	-	-	-
0.3	10-20	7-21	-	-	-	-	-	-	-
0.075	2-8	2-8	-	-	-	-	-	-	-

Table 3.3 Gradation details of all quarries

	As per MORTH % passing		Sana Stone Crusher	Patil Stone Crusher	Latecrete Stone Crusher	Khoba Stone Crusher	KORI STONE CRUSHER
	BC	DBM					

IS Sieve Size (mm)	NAS=19 mm	NAS=37.5mm	% finer	% finer	% finer	% finer	% finer
40		100	100	100	100	100	100
37.5		95-100	100	100	100	100	100
26.5	100	63-93	100	100	100	100	100
20	90-100	-	40.46	42.46	48.44	43.44	42.88
13.2	59-79	55-75	23.45	22.32	23.32	22.54	22.40
10	52-72	-	15.90	16.72	14.94	14.90	18.96
4.75	35-55	38-54	7.88	8.54	7.94	7.94	8.60
2.36	28-44	28-42	7.23	7.92	7.44	7.42	8.38
1.18	20-34	-	-	-	-	-	-
0.6	15-27	-	-	-	-	-	-
0.3	10-20	7-21	-	-	-	-	-
0.075	2-8	2-8	-	-	-	-	-

Development of App: The details about quarries available at Bidar district are made to available for customers though the Mobile app. the screen shot of that is as shown in Fig 3.1

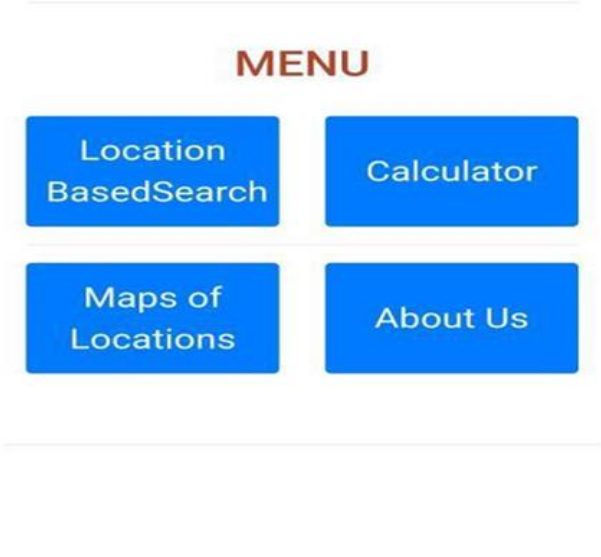

Fig. 3.1 Screen shot of the App developed for Quarry details of Bidar district

IV. CONCLUSIONS

From the study conducted following are the conclusions drawn. Almost all aggregate satisfies the strength requirements of the aggregates for BC and

DBM. But the gradation of the aggregates are not as per MORTH. Hence require blending of aggregates. The Mobile App developed will give the information about quarries of aggregates which is handier for the costumer to select the aggregate type as per requirement.

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Spot Speed Study

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ABSTRACT

Approximately 48 percent of traffic accidents on urban roads in Bidar, city of india, were endorsed due to speedy. Over 4.8 lakh accidents were recorded, leading to 1.5 lakh average deaths in last five years in India due to speed. In this study, spot speed data were analyzed using data collected at 4 urban roadway sections in bidar. The stretches roadway sections are selected based on the number and fatality of accidents that happened in last 3 years (2016-2019) Bidar Traffic Police Station records. From the study, it is found that the condition of road, spot speed, traffic volume, carriageway conditions and negligence of the people are the main parameters causing the accidents. It was also seen that slow moving traffic were creating hazards for fast moving traffic as it always occupied the innermost lane of the roads.

Keywords : Urban Roadway Sections In Bidar City, Spot Speed, Speed Limit, Design Speed.

1. INTRODUCTION

Urban transport facilities in most of the Indian cities are inadequate and deteriorating over the years. The development of the public transport system has not kept pace with the traffic demand both in terms of quality and quantity. As a result, the use of undesirable modes such as personalized transport, mainly two-wheelers, and intermediate public transport, mainly three-wheelers, is growing at a rapid speed. Roads and footpaths today are heavily encroached by parked vehicles, hawkers, and roadside business forcing pedestrians to walk on the road. This results not only in restricting the traffic flow, but also putting the pedestrians' life at a great risk. Besides encroachment, it is found that road surface in most of the cities is substandard. Besides, lane markings and traffic signs are usually missing and the intersections often require geometric correction. Wholesale goods centers are usually located in the center of the city, which attracts substantial goods traffic on congested city roads. Congestion results in delays and time losses. An inevitable result of the growth of traffic has been the increase in road accidents, which take a great toll on human life every year. Each year nearly 1.3 lakh people die as a result of a road traffic collision, more than 3000 deaths each day and more than half of these people are not travelling by car. Over 4.8 lakh accidents were recorded, leading to 1.5 lakh deaths in the year 2016 which reduced to 1.46 lakh deaths from 4.5 lakh accidents in the year 2017, which shows the percentage reduction of about 3% in India. Which again in 2018 4.61 lakh road accidents leading to 1.49 lakh deaths. In road safety management, an accident

blackspot or black spot is a place where road traffic accidents have historically been concentrated. It may have occurred for a variety of reasons, such as a sharp drop or corner in a straight road, so oncoming traffic is concealed, a hidden junction on a fast road, poor or concealed warning signs at a crossroads. For some decades treatment of accident black spots (e.g. by signage, speed restrictions, improving sightlines, straightening bends, or speed cameras) was a mainstay of road safety policy, but current thinking has it that the benefits of these interventions are often overstated. Effects such as regression to the mean risk compensation and accident migration combine to reduce the overall benefit. In some cases, it has been claimed that the result is an increase in overall casualties. In one notable experiment, several accident blackspots were "treated" with a null treatment placement of a garden gnome according to some reports. Accident rates at these points were found to have decreased significantly in the following period, a finding which is taken as clear evidence supporting the theory of regression to the mean.

1.1 Scope of Project

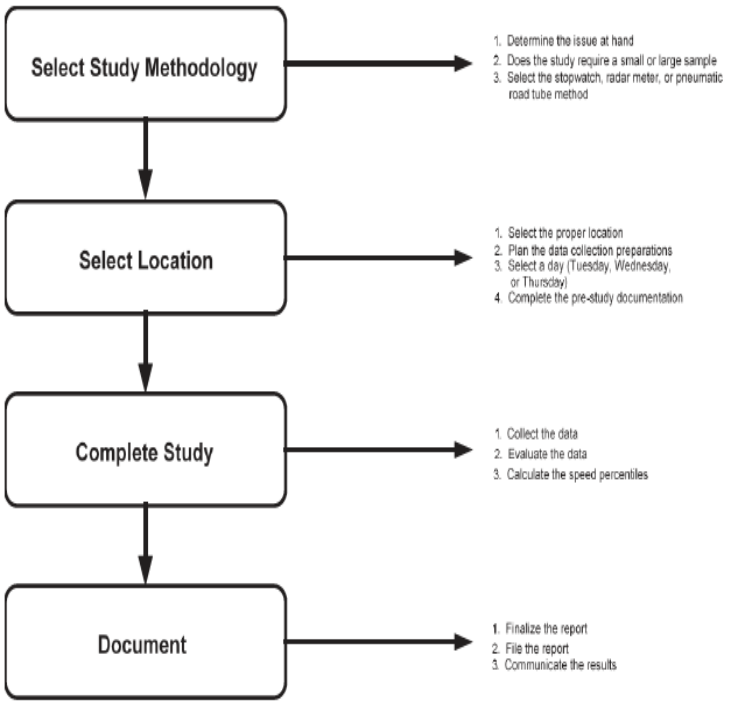
The problem of the accident is very acute in highway transportation due to complex flow patterns of vehicular traffic, presence of mixed traffic and pedestrians. Traffic accidents may involve property damages, personal injuries or even casualties. One of the main objectives of traffic engineering is to provide safe traffic movements. Road accidents cannot be prevented, but by suitable traffic engineering and management measures, the accident rate can be decreased considerably. Therefore the traffic engineer has to carry out systematic accident studies to investigate the causes of accidents and to take preventive measures in terms of design and control. It is essential to analyze every individual accident and to maintain zone-wise accident records.

1.2 OBJECTIVE OF THE PRESENT STUDY

From the detailed literature review carried out the following objectives were set.

1. To study the causes (details) of accidents and to suggest corrective treatment at potential locations.
2. Determine vehicle speed percentile.
3. Ease in planning traffic control.
4. To carry out spot speed study using distance-time method.

2. METHODOLOGY



2.1 Key Steps to a Stopwatch Spot speed study

A stopwatch spot speed study includes five key steps:

1. Obtain appropriate study length.
2. Select proper location and layout.
3. Record observations on stopwatch spot speed study data form.
4. Calculate vehicle speeds.
5. Generate frequency distribution table and determine speed percentiles.

1. Obtain Appropriate Study Length

The study length is important because it is used in the calculation of vehicle speeds. Table 4.2 provides

recommended study lengths, which are based on the average speed of the traffic stream. Using these recommended study lengths makes speed calculations straightforward and less confusing. If these lengths are not appropriate, another length can be used assuming it is long enough for reliable observer reaction times.

2. Select Proper Location and Layout

Figure 4.1 illustrates a typical layout for conducting a spot speed study using a stopwatch. When selecting a location and layout, care must be exercised so that the observer can clearly see any vertical reference posts. The observer should be positioned higher than the study area and be looking down. The position could be on a bridge or a roadway back slope. The observer should use reference points to aid in collecting the elapsed time it takes a vehicle to travel through the study area. The reference point to start timing may be a brightly colored vertical post. The reference point to end timing may be a tree or a signpost in the observer's sight line. An accurate sketch of the site should be documented, including number of lanes, position of observer, and description of reference points (see Figure 4.1 for an example).

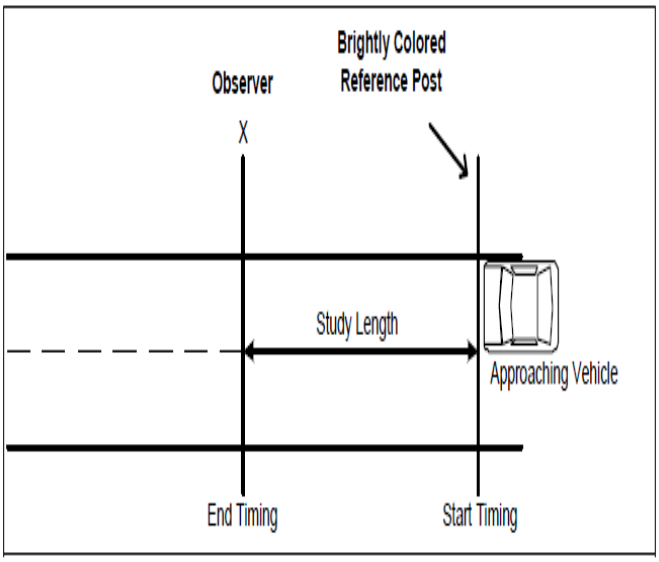


Figure2.1 Stopwatch Spot Speed Study Layout

3. Record Observations on Stopwatch Spot Speed Data Form

On the stopwatch spot speed data form the observer records the date, location, posted speed limit, weather conditions, start time, end time, and down time. As the front wheels of a vehicle (or only the lead vehicle in a group) cross a mark or pavement crack at the beginning of the predetermined study length, the observer starts the stopwatch. The watch is stopped when the vehicle's front wheels pass a reference line in front of the observer. A slash is recorded on the data form corresponding to the elapsed time observed.

4. Calculate Vehicle Speeds

To calculate vehicle speed, use the predetermined study length and the elapsed time it took the vehicle to move through the course (as recorded on the stopwatch data form) in the following formula (Robertson 1994):

$$V = \frac{D}{1.47T}, \quad (2.2)$$

where V = spot speed (mph), D = length (feet), and T = elapsed time (seconds). In the equation, 1.47 is a constant that converts units of feet per second into miles per hour. For example, if the spot speed study length is 100 feet and the motorist's elapsed time is 2.5 seconds, the motorist is traveling at

$$\frac{100 \text{ feet}}{1.47(2.5 \text{ seconds})} = 27 \text{ mph.}$$

5. Generate Frequency Distribution Table and Determine Speed Percentiles

Determine the 50th and 85th speed percentiles using a frequency distribution table and calculations as described earlier.

Example Stopwatch Spot Speed Study

The city of Cottonwood Glen received a complaint of afternoon traffic speeding in a residential area. The city suspected this was related to students leaving a nearby high school. The first action taken by the city

was to quantify the facts by conducting a spot speed study. The city decided to use the stopwatch method because of their limited resources.

A location was selected near the intersection of 4th Street and University Avenue, approximately two blocks from the high school and where the city had received multiple speeding complaints from residents. The posted speed limit is 30 mph. The study was conducted on a Wednesday and started at 3:00 p.m. The time was selected to correspond to the period when most high school students leave the school. The study continued until a sample size of 100 vehicles was measured. The study length of 176 feet was used because the posted speed limit is between 25 and 40 mph, as shown in Table 4.3. The study layout is illustrated in Figure 4.2.

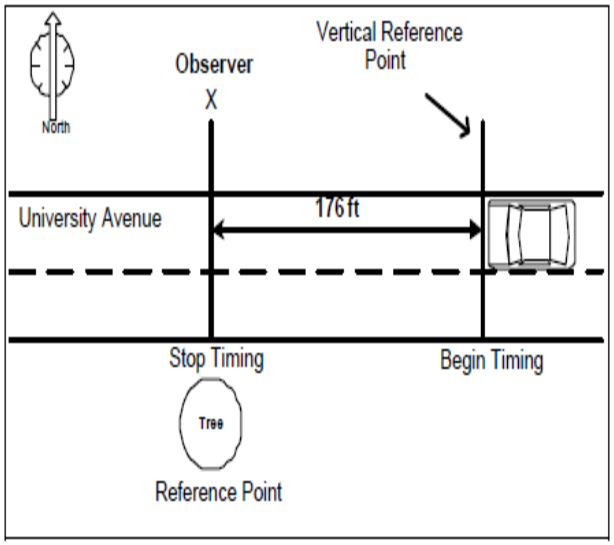


Figure 2.2. Example Stopwatch Spot Speed Study Layout

The vertical reference point is the begin timing‖ reference. A tree is the stop timing‖ reference point. This vertical reference point helps with the accuracy of timing by providing a line-of-sight to aid the observer. The results of the study are shown in Figure 2.3 (data form) and Table 2.4 (distribution table). Figure 2.3 shows elapsed time in predetermined 0.2-second intervals (Robertson 1994).

The study shows that the 50th percentile or median speed falls between 27.2 and 28.9 mph, and the 85th percentile of speed falls between 33.3 and 35.2 mph.

Equation 2.1 is used to find the exact speeds for the 50th and 85th percentiles of speed. For the 50th percentile of speed,

PD =50%, *P*max = 54%, *P*min = 41%, *S*max = 28.9 mph, and *S*min = 27.2 mph, so

SD = ((50% – 41%)/ (54% – 41%))(28.9 mph – 27.2 mph)+ 27.2 mph = 28.4 mph.

2.2 DATA COLLECTION AND ANALYSIS

We have selected the stretches in Bidar city under the guidance of Bidar Traffic Police Station. The stretches are selected based on the number and fatality of accidents that happened in last 3 years (2016-2019).

1. Near Railway track,Naubad road,Bidar.
2. Near Jhira conventional hall,Chickpet,Bidar.
3. Near Allamaprabhu petrol pump,Gumpa ring road,Bidar.

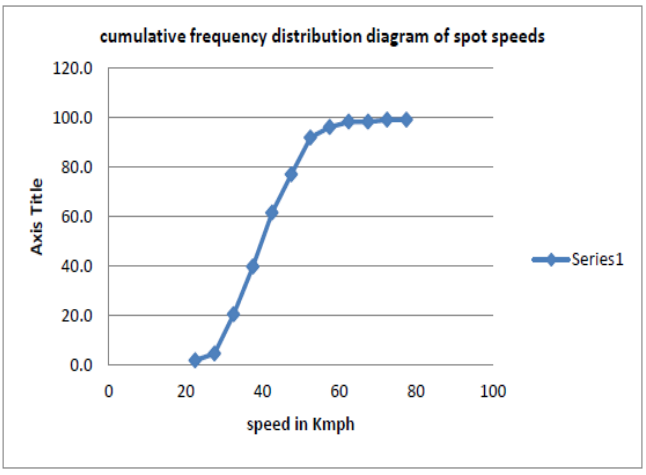
1. Near Railway track,Naubad road,Bidar.

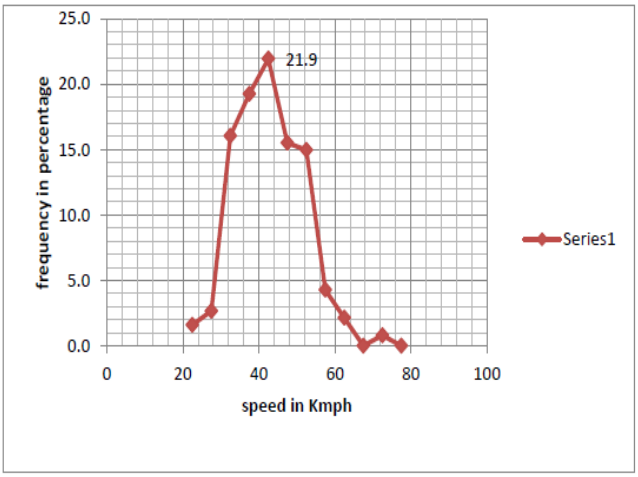
Spot Speed Study Details (Distance-Time Method)

Time taken by the different vehicles at corresponding spots

Day 1

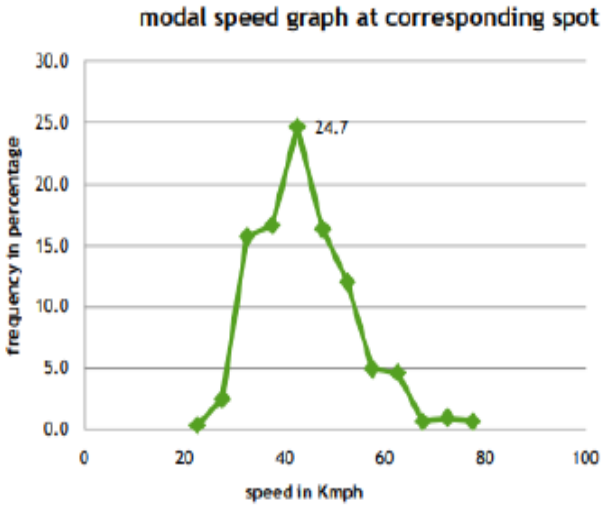
Cumulative frequency calculation

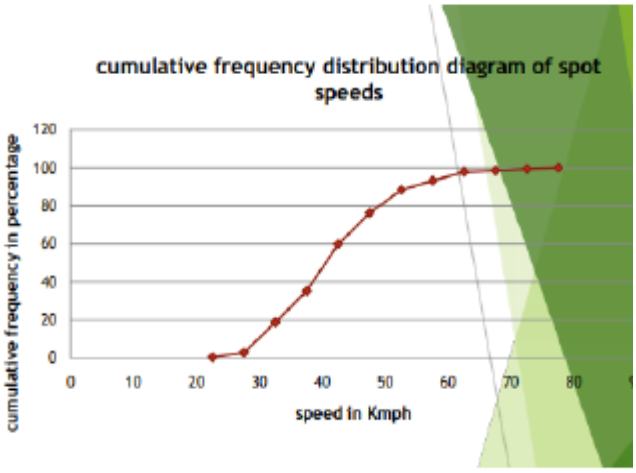




Day 2

Cumulative frequency calculation





Problems Observed By Visual Inspection

1. No proper maintenance of roads (accumulation of wastes near the edges of roads, accumulation of dust on the surface of roads).
2. Accumulation of waste near the edges of roads
3. Sign boards are not properly visible (accumulation of dust/smoke on sign boards).
4. Poor highway lightings.
5. Pavement undulations

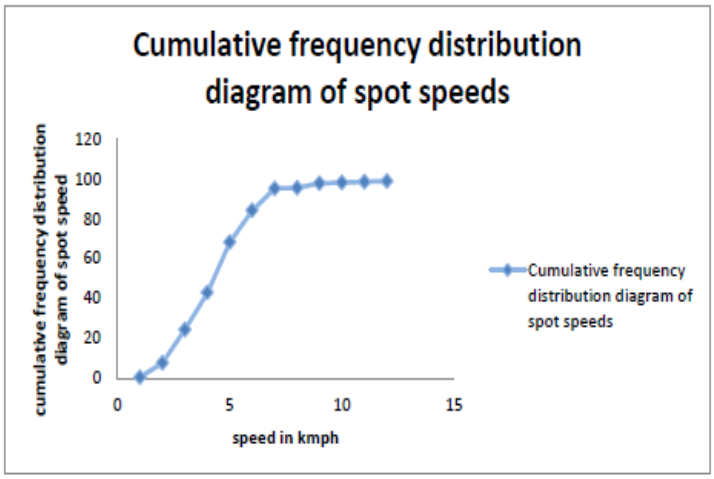
2. Near Jhira conventional hall,Chikpet,Bidar.

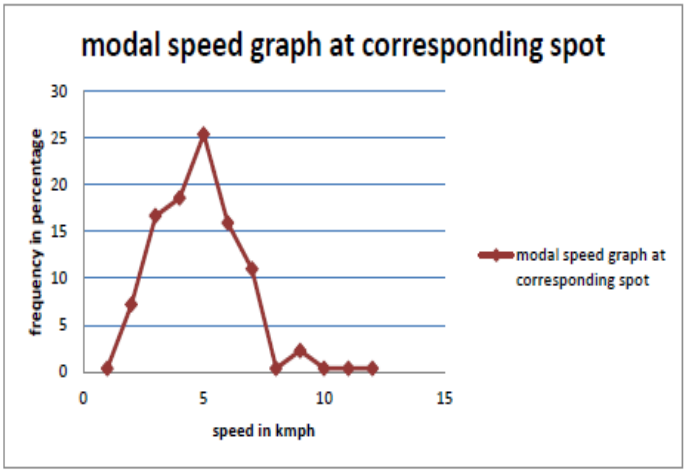
Spot Speed Study Details (Distance-Time Method)

Time taken by the different vehicles at corresponding spots

Day 1

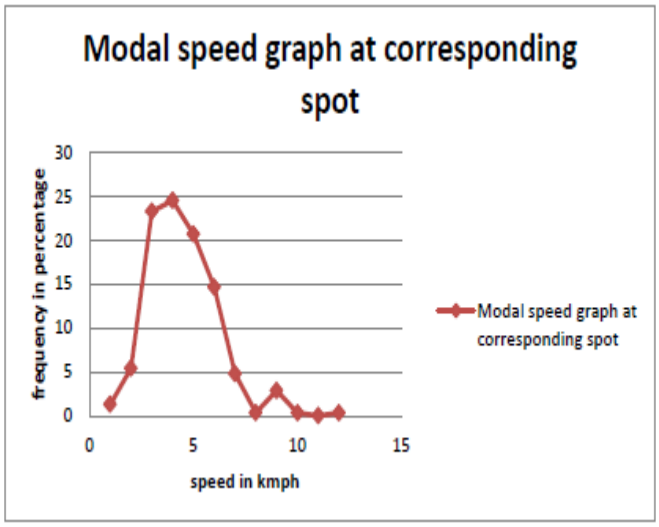
Cumulative frequency calculation

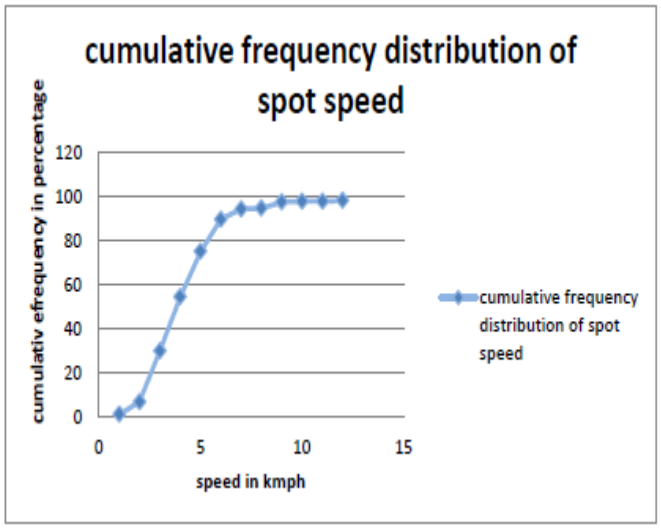


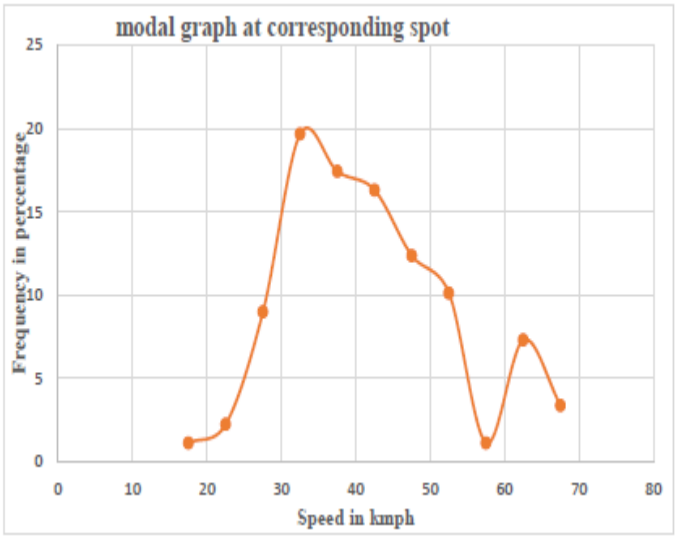


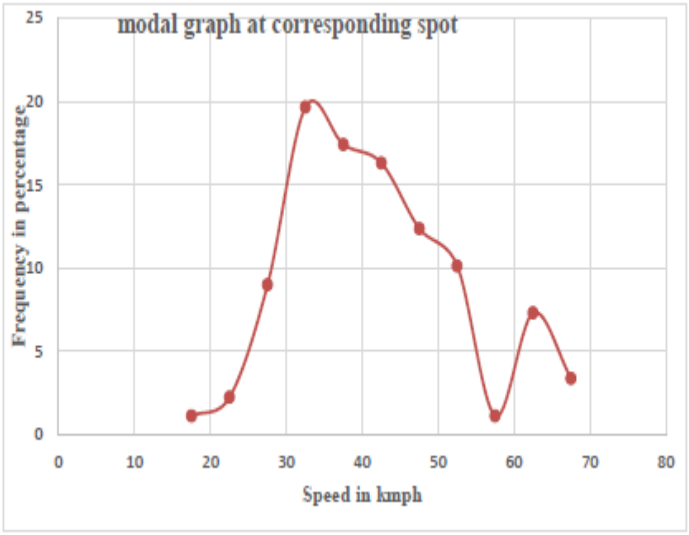
Day 2

Cumulative frequency calculation









Problems Observed By Visual Inspection

1. No proper maintenance of roads (accumulation of wastes near the edges of roads, accumulation of dust on the surface of roads).
2. Accumulation of waste near the edges of roads
3. Sign boards are not properly visible (accumulation of dust/smoke on sign boards).
4. Poor highway lightings.

3. Near Allamaprabhu petrol pump,Gumpa ring road,Bidar.

Spot Speed Study Details (Distance-Time Method)

Time taken by the different vehicles at corresponding spots

Cumulative frequency calculation

Problems Observed By Visual Inspection

1. No proper maintenance of roads (accumulation of wastes near the edges of roads, accumulation of dust on the surface of roads).
2. Sign boards are not properly visible (accumulation of dust/smoke on sign boards).
3. Poor highway lightings.
4. Pot holes.
5. Rise of chambers above the ground

3. CONCLUSION

Road accidents cannot be totally prevented, but the accident rates can be decreased considerably. There is a scope for prevention of accidents. From the study, it

is found that the condition of road, spot speed, traffic volume, carriageway conditions and negligence of the people are the main parameters causing the accidents. It was also seen that slow moving traffic were creating hazards for fast moving traffic as it always occupied the innermost lane of the roads.

The main goal of accident study is to determine what corrective measures and actions needs to be taken to prevent any further occurrences. To prevent accidents, 4 E's of road safety should be followed which are formed by The Ministry of Road Transport and Highways. 4 E's of road safety are Education, Enforcement, Engineering and Emergency care as per New Motor Vehicles Act 2018.
From the present study these are the following outcomes

1. Since Vehicles move greater than the speed limit, hence it is necessary to construct speed breaker to ensure the vehicles are moving within speed limit.
2. Identify possible locations of black spots and traffic control for everyday changing traffic trends.
3. Calculated percentile speeds on selected road.

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Photocatalytic Degradation Studies of Textile Industrial Effluent Using Nano Tungstate

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ABSTRACT

Untreated dye effluents from the textile industries and other industries such as paper, paint etc., poses a serious threat to the environment which creates enormous health hazards to the living beings. Tremendous efforts are been made by the researchers for an amicable solution for this serious issue. Semiconductor based photocatalysis has emerged as a prominent technology for decolorization of dye pollutants due to appreciable photocatalytic properties, especially binary semiconductor oxides such as ZnO,TiO_2,Cu_2O etc., However, further quest in enhancing the catalytic properties led to exploration of the ternary oxides. Therein, in this project, we have prepared nanostructured ternary tungstate i,e $FeWO_4$ by hydrothermal method with help of hydrazine hydrate as mineralizing agent. The prepared compound was characterized by Power- X- ray diffraction for structural analysis and Scanning electron microscope (SEM) for morphology and size analysis. The characterizations revealed pure nanocrystalline $FeWO_4$ was formed. Photocatalytic studies using prepared $FeWO_4$ were carried for Methylene Blue (MB) as model dye pollutant and the results were summarized.

Index terms : Textile effluent, Nano tungstate $FeWO_4$, Scanning electron microscope, Model dye Methylene blue.

1. INTRODUCTION

1.1 WATER POLLUTION BY TEXTILE INDUSTRIES

Color the earth beautiful and kill it with sweet poison!! The art of color application to enhance our self appearance and the world around us has been known to man since time immemorial. Historical records of the use of natural dyes extracted from vegetables, fruits, flowers, certain insects and fish dating back to 3500 BC have been found. Color is the main attraction of any fabric. No matter how excellent its constitution, if unsuitably colored it is bound to be a failure as a commercial product. Fabric was earlier being dyed with natural dyes. These however gave a limited and a dull range of colors. Besides, they showed low color fastness when exposed to washing and sunlight. As a result they needed a mordant to form a dye complex to fix the fiber and dye together thus making the dyers' work tedious. The discovery of synthetic dyes by W. H. Perkins in 1856 has provided a wide range of dyes that are color fast and come in a wider color range and brighter shades. As a result "dye application" has become a massive industry today.

1.2 CAUSES OF WATER POLLUTION BY TEXTILE INDUSTRIES

The industry is using more than 8000 chemicals, Many of these chemicals are poisonous and damaging to human health directly or indirectly. Large quantities of water are required for textile processing, dyeing and printing. The daily water consumption of an average sized textile mill having a production of about 8000 kg of fabric per day is about 1.6 million liters. 16% of this is consumed in dyeing and 8% in printing. Specific water consumption for dyeing varies from 30 - 50 liters per kg of cloth depending on the type of dye used. The overall water consumption of yarn dyeing is about 60 liters per kg of yarn. Dyeing section contributes to 15% - 20% of the total waste water. It takes about 500 gallons of water to produce enough fabric to cover one sofa. The World Bank estimates that 17 to 20 percent of industrial water pollution comes from textile dyeing and finishing treatment given to fabric. Some 72 toxic chemicals have been identified in water solely from textile dyeing, 30 of which cannot be removed5. This represents an appalling environmental problem for the clothing and textile manufacturers.

1.3 EFFECT OF WATER POLLUTION

Textile effluent is a cause of significant amount of environmental degradation and human illnesses. About 40 percent of globally used colorants contain organically bound chlorine a known carcinogen. All the organic materials present in the wastewater from a textile industry are of great concern in water treatment because they react with many disinfectants especially chlorine. Chemicals evaporate into the air we breathe or are absorbed through our skin and show up as allergic reactions and may cause harm to children even before birth.

1.4 TREATMENT OF EFFLUENT FROM TEXTILE INDUSTRY

Effluent treatment methods can be classified into physical, chemical and biological methods; (Table 1.2). Exclusive treatment by one of these three methods has proved to be insufficient in removing color and other effluent from textile industry wastewater. While some dyes are difficult to biodegrade few, particularly the hydrolyzed reactive and certain acidic dyes are not readily absorbed by active sludge; hence they escape treatment. Combination of various effluent treatment methods can remove more than 85% of unwanted matter.

Physical	Chemical	Biological
Sedimentation	Neutralization	Stabilization
Filtration	Reduction	Aerated Lagoons
Floatation	Oxidation	Trickling Filters
Foam Fractionation	Catalysis	Activated Sludge
Coagulation	Ion Exchange	Anaerobic Digestion
Reverse Osmosis	Electrolysis	Fungal Treatment
Solvent Extraction	-	Flocculation
Ionization Radiation	-	-
Adsorption	-	-
Incineration	-	-
Distillation	-	-
Membrane Treatment		

1.5 PHOTOCATALYST METHOD

Photocatalysis is the acceleration of a photoreaction in the presence of a catalyst. In catalysed photolysis, light is absorbed by an adsorbed substrate. In photogenerated catalysis, the photocatalytic activity (PCA) depends on the ability of the catalyst to create electron–hole pairs, which generate free radicals (e.g. hydroxyl radicals: •OH) able to undergo secondary reactions. Its practical application was made possible by the discover of water electrolysis by means of titanium dioxide (TiO_2).

1.5.1 MECHANISM OF PHOTOCATALYSIS

When photo catalyst Iron Tungstate ($FeWO_4$) absorb ultraviolet radiation from sunlight or illuminate light source, it will produce pair of electron and hole.The electron of the valence band of fewo4 become excited when illuminated by light.The excess energy of this excited electron promoted the electron to the conduction band of the $FeWO_4$ therefore creating the negative electron (e-) and positive hole (h+) pair.This stage is referred as the semiconductor's photo-excitation state. The energy difference between the valence band and the conduction band is known as the band gap.The positive hole of $FeWO_4$ break apart the water molecule to form hydrogen gas and

hydroxyl radical.The negative electron reacts with oxygen molecule to form super oxide anion.This cycle continues when light is available.Wavelength of the light necessary for photo-excitation is 1240/3.3ev = 375.7nm

1.6 FeWO4 STRUCTURE

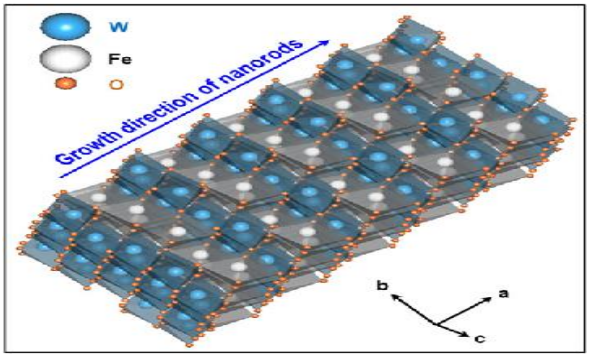


Fig 1.2 $FeWO_4$ structure

- Phase Label(s): $WFeO_4$
- Classification by Properties: antiferromagnet AFM
- Mineral Name(s): ferberite
- Pearson Symbol: *mP*12
- Space Group: 13
- Phase Prototype: $MgWO_4$

1.6.1 CHARACTERISTIC OF FEWO4

Color	Black, dark brown in transmitted
Crystal habit	Bladed crystals; massive
Twinning	Contact or interpenetrant or
Cleavage	Perfect on {010}; partings on
Fracture	Uneven
Tenacity	Brittle
Mohs	4–4.5
Luster	Submetallic to metallic
Streak	Brownish black
Diaphaneity	Nearly to entirely opaque
Specific gravity	7.58
Optical properties	Biaxial (+)
Refractive index	$n_\alpha = 2.255$ $n_\beta = 2.305$ $n_\gamma = 2.414$
Birefringence	$\delta = 0.159$
2V angle	Measured: 66°
Other	Slightly magnetic

1.7 PREPARATION OF NANO CATALYST

Following are the chemical methods widely used to prepare nano catalyst.

1. chemical precipitation.
2. Sol-Gel Technique
3. hydrothermal synthesis.

1.8 Hydrothermal synthesis

It includes the various techniques of crystallizing substances from high-temperature aqueous solutions at high vapor pressures; also termed "hydrothermal method". Advantages of the hydrothermal method over other types of crystal growth include the ability to create crystalline phases which are not stable at the melting point. Also, materials which have a high vapour pressure near their melting points can be grown by the hydrothermal method. The method is also particularly suitable for the growth of large good-quality crystals while maintaining control over their composition. Disadvantages of the method include the need of expensive autoclaves, and the impossibility of observing the crystal as it grows if a steel tube is used. There are autoclaves made out of thick walled glass, which can be used up to 300°C and 10 bar.

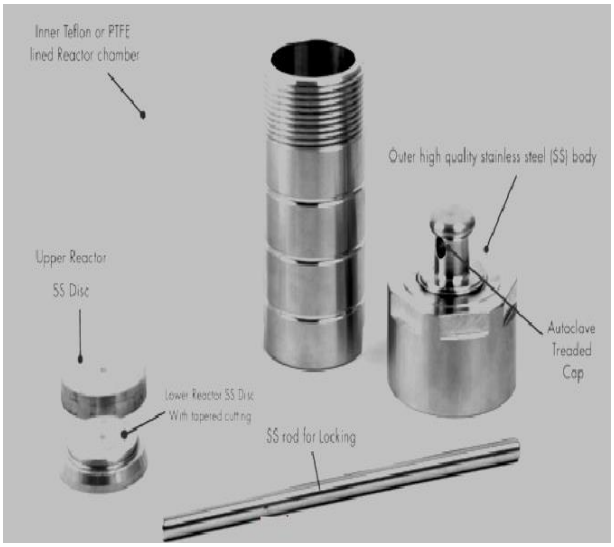


Fig 1.3 Hydrothermal Bomb

1.9 PROPERTIES OF NANOMATERIALS

1.9.1 Physical Properties of Nanomaterials.

1. Nanomaterials may have a significantly lower melting point or phase transition temperature and appreciably reduced lattice constants, due to a huge fraction of surface atoms in the total amount of atoms.
2. Mechanical properties of nanomaterials may reach the theoretical strength, which are one or two orders of magnitude higher than that of single crystals in the bulk form..
3. Optical properties of nanomaterials can be significantly different from bulk crystals. For example, the optical absorption peak of a semiconductor nanoparticle shifts to a short wavelength, due to an increased band gap.
4. Electrical conductivity decreases with a reduced dimension due to increased surface scattering. However, electrical conductivity of nanomaterials could also be enhanced appreciably, due to the better ordering in microstructure, e.g. in polymeric fibrils.

1.9.2 Chemical properties of nanomaterials.

1. The preponderance of surface is a major reason for the change in behaviour of materials at the nanoscale. As up to half of all the atoms in nanoparticles are surface atoms, properties such as electrical transport are no longer determined by solid-state bulk phenomenon.
2. The atoms in nanomaterials have a higher average energy than atoms in longer structures, because of the larger proportion of surface atoms. For example, catalytic materials have a greater chemical activity per atom of exposed surface as the catalyst is reduced in size at the nanoscale.
3. Defects and impurities may be attracted to surfaces and interfaces, and interactions between particles at those small dimensions can depend on the structure and nature of chemical bonding at the surface.
4. Molecular monolayers may be used to change or control surface properties and to mediate the interaction between nanoparticles.

2. INSTRUMENTATION:

2.1 Structural characterization - Powder X-Ray Diffraction

Fig 2: Powder X-Ray diffractometer

The crystallographic nature of a sample very well influences its electrical and optical properties. X-ray

diffraction (XRD) studies are generally used for structural analysis. The advantage of the technique is that it discloses the presence of a substance, as that substance actually exists in the sample and not in terms of its constituent chemical elements. Hence, diffraction analysis is useful whenever it is necessary to know the state of chemical combination of the elements involved or the particular phase in which they are present. Compared with ordinary chemical analysis the diffraction method has the advantage that it is usually much faster, requires only very small quantity of sample and is non-destructive.

In the present study X-ray diffraction analyses were performed using a Philips X'Pert vertical goniometer with Bragg–Brentano geometry. Nickel-filtered Cu Kα radiation and a step-by-step technique were employed (steps of 0.05° 2θ), with collection times of 10s/step. The size of the crystallites was evaluated by Scherer method.

2.2 Morphological analysis - Scanning Electron Microscope (SEM)

Surface morphology and particle size plays a vital role on properties; the characterization tools used to study about the surface of the prepared TCO material is described below.

Instrument - Scanning electron Microscope

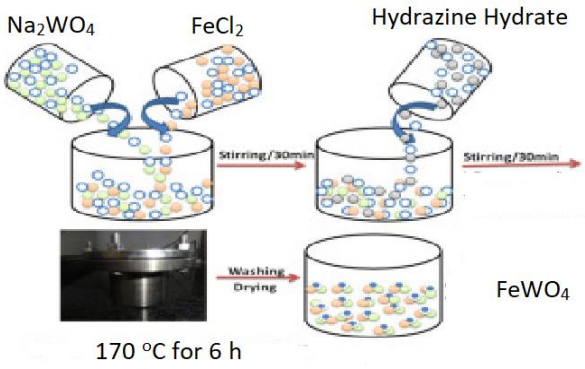
The scanning electron microscope (SEM) uses electrons rather than light to form an image. SEM has several advantages over an ordinary light microscope . The SEM has a large depth of field, which allows a large amount of the sample to be in focus at a time. The SEM also produces images of high resolution, which means that closely spaced features can be examined at a high magnification. Preparation of the samples is relatively easy since most SEMs only require that sample should be conductive. The combination of higher magnification, larger depth of focus, greater resolution, and ease of sample observation makes the SEM one of the most heavily used instruments in current research areas.

In the present studies, JEOL JSM 5600 was used for SEM analysis.

3. EXPERIMENTAL WORK

3.1 Preparation of $FeWO_4$ by hydrothermal method with support of hydrazine hydrate

0.1 M of Na_2WO_4. $3H_2O$ and $FeCl_2$ solutions were prepared using double distilled water. 20 ml of the each stock solution was mixed along with 20 ml of Hydrazine hydrate. The mixed solution was taken in 80ml Teflon lined hydrothermal bomb. The hydrothermal bomb was heated to 170 °C for 6 hrs in the muffle furnace.



Pictorial image- illustrate the preparation of $FeWO_4$

3.2 Photocatalytic studies

Photocatalytic activity for the prepared $FeWO_4$ was carried out in the open space expose to sunglight for Methylene Blue (MB) as a model dye pollutant. In this experiment, 25 mg of $FeWO_4$ was suspended in 250ml of 25 ppm Methylene Blue solution. The suspension was magnetically stirred in the dark for 30 min to attain adsorption-desorption equilibrium.

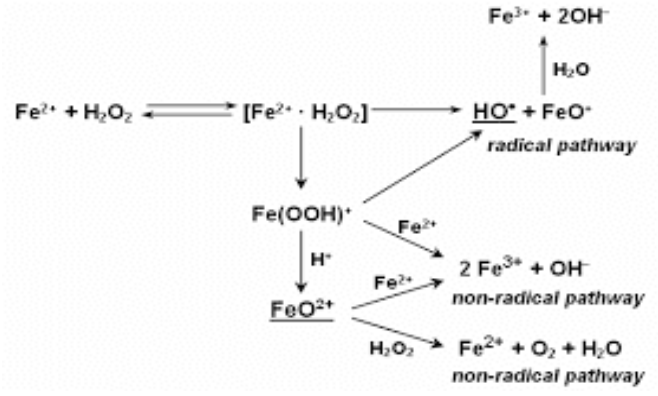
Then the suspension was placed in the sun light. During photocatalysis process approximately 5 ml of dye solution was withdrawn at regular irradiation interval of time. And quantified the MB dye in the solution by recording the absorbance using the UV-vis spectrophotometer.

The efficiency of the CFO catalyst degrading the MB dye under UV irradiation was calculated using the equation:

% Degradation = (C0 - Ct)/C0 × 100, Where, C0 = initial absorbance and Ct = absorbance at time 't'.

3.3 Photo-Fenton studies

Photo- Fenton studies were done to have increased dye degradation. In this experiment, 25 mg of $FeWO_4$ was mixed with 2ml of H_2O_2 and the mixture was suspended in 250ml of 25 ppm Methylene Blue solution. The suspension was magnetically stirred in the dark for 30 min to attain adsorption-desorption equilibrium. Then the suspension was placed in the sun light. During photocatalysis process approximately 5 ml of dye solution was withdrawn at regular irradiation interval of time. And quantified the MB dye in the solution by recording the absorbance using the UV-vis spectrophotometer and percentage of degradation was calculated

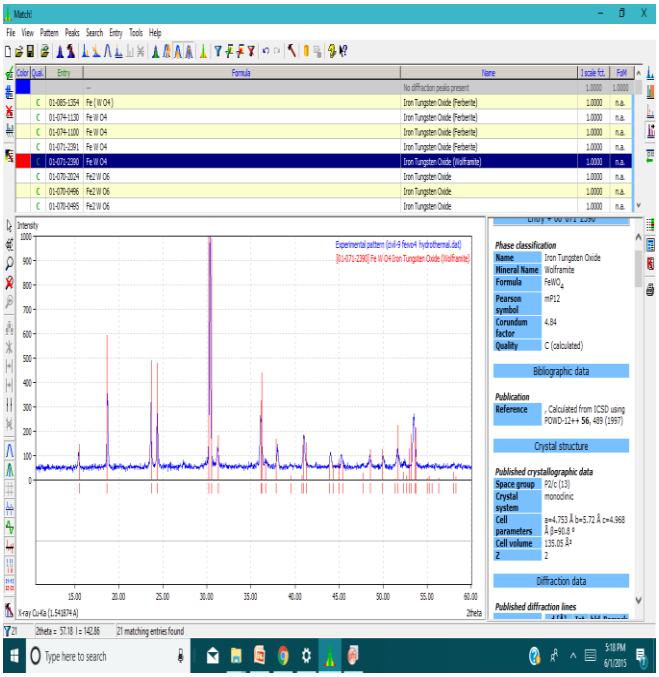


4. RESULTS AND DISCUSSIONS:

4.1 Powder X-Ray diffraction

Prepared compound was characterized by Powder – X-ray diffraction to study the phase of the compound. XRD was recorded using BRUKER D2 Phaser with Cu Kα radiation (α=0.15418 nm).

Figure___ shows the recorded XRD pattern of the hydrothermal method prepared $FeWO_4$ compound. The red line are the diffraction pattern of the standard data (International Centre for Diffraction Data - card No. 71-2390) of the $FeWO_4$ and the blue lines are the XRD data of the recorded pattern.

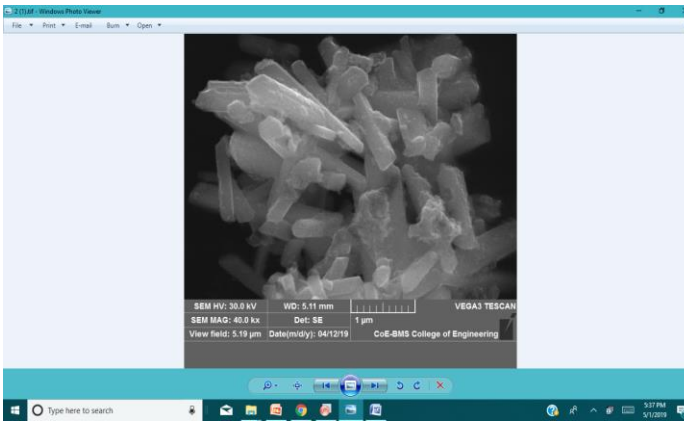


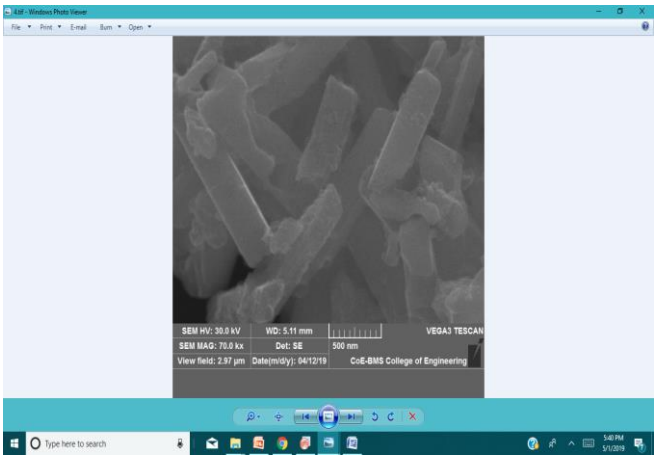
XRD pattern of hydrothermal method prepared $FeWO_4$.

Recorded XRD pattern well match with the standard data which confirms pure $FeWO_4$ formed. Crystallite size for the prepared compound of Copper iron oxide and Copper Chromium oxides were calculated using Scherrer equation , Crystallite size = $0.9\lambda / B\cos\theta$

Where B – Full width half maximum of the peak, θ is the angle of the diffracted peak. Crystallite sizes were calculated as 70 – 90 nm.

4.2 Morphological studies - Scanning Electron Microscope



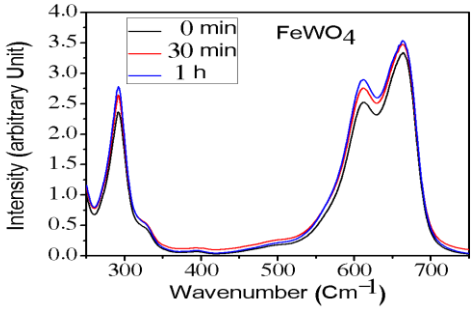


Scanning electron micrograph of the $FeWO_4$

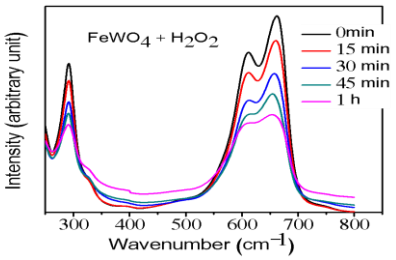
the SEM micrograms of prepared $FeWO_4$. The particles were crystallized in rod shape morphology of the length and breadth in the range of 1 - 2 µm and 200 – 300 nm. respectively.

4.3 Photocatalytic activity

The MB solution drawn at different time during the photo- Fenton studies of $FeWO_4$ in the exposure of visible light. The picture clearly shows the decrease in the colour of the dye.

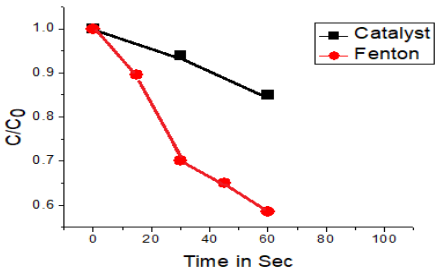


Time-dependent UV–Visible absorption spectra for the photodegradation of MB in the presence of $FeWO_4$ catalyst



Time-dependent UV–Visible absorption spectra for the photodegradation of MB in the presence of H_2O_2 & $FeWO_4$ (Fenton)

MB degradation results in the presence of $FeWO_4$ and H_2O_2 - $FeWO_4$ (Fenton studies) respectively. The intensity of MB absorption peak at 662 nm wavelength is observed significantly decreased with increase in the visible light illumination time with the presence of the $FeWO_4$ catalyst and $FeWO_4$ plus H_2O_2 (Fenton). The concentration of the dye at different time is proportional to the absorbance of the dye solution. Therefore, exponential nature of absorbance vs. time (C/Co vs. t) plot confirms the first order kinetics of the reaction.



Plots of C/Co versus irradiation time for the photo degradations of Methylene Blue

Dye degradation reaction was also carried out in the dark condition in the presence of catalysts which observed that there is no marginal change in the concentration of MB dye even after 30 min.

4.4 Mechanism of Photocatalysis

The justifiable photocatalytic degradation mechanism of MB as a model dye mediated by $FeWO_4$ is explained below.

The illumination of visible light on $FeWO_4$ having greater energy than the band gap of $FeWO_4$ generates the electron – hole pair i.e electrons in the conduction band (eCB-) and holes (hVB+) in the valence band. Holes (hVB+) in the valence band could form the reactive hydroxyl radical (·OH) while oxygen produces the superoxide radical by accepting an electron. These free radicals possess high chemical activity. The MB dye is decomposed through oxidation by ·OH radical and O. -2 radicals.

$FeWO_4 + h\upsilon$ ----------> eCB- + hVB+

hVB+ + H_2O ----------> H+ + ·OH

eCB- + O_2 ----------> O. -2

O. -2 + · OH + MB ----------> CO_2 +H_2O

4.5 Mechanism of Photo-Fenton studies

Fe^{2+} present in the $FeWO_4$ is oxidized by hydrogen peroxide to iron(III), forming a hydroxyl radical and a hydroxide ion in the process. Iron(III) is then reduced back to iron(II) by another molecule of hydrogen peroxide, forming a hydroperoxyl radical and a proton.

The net effect is a disproportionate of hydrogen peroxide to create two different oxygen-radical species, with water (H+ + OH–) as a byproduct. These free radicals possess high chemical activity. The MB dye is decomposed through oxidation by ·OH radical and O. -2 radicals.

Fe^{2+} ($FeWO_4$) + H_2O_2 → Fe^{3+} + HO• + OH–

Fe^{3+} + H_2O_2 → Fe^{2+} ($FeWO_4$) + HOO• + H+

· OH + MB ----------> CO_2 +H_2O

5. CONCLUSION

We have prepared pure nanocrystalline $FeWO_4$ catalyst by hydrothermal method using hydrazine hydrate as mineralizing agent. The prepared compound was characterized by powder X-ray diffraction and Scanning electron microscope for structural and morphological analysis. Photocatalytic dye degradation and Photo-Fenton studies were carried using prepared FeWO4 catalyst to assay the catalytic effect. Photo -Fenton studies shown effective degradation of methylene Blue dye due to more number of hydroxyl radicals in created in the

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