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PREPARATION OF PAVER BLOCK BY USING INDUSTRIAL WASTE

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ABSTRACT

In the past few decades, the rapid process of industrialization and urbanization has increased the generation of waste material at huge rates and landfills are filling up faster than the exploration of new sites. Disposal of industrial waste is one of the serious problems faced worldwide. There is now a significant interest to solve the environmental problem caused by industrial waste and other similar materials by adding such material in manufacture of concrete. The use of paver block technique has been introduced in construction a decade ago, for specific purpose namely footpath, parking area etc. but now being adopted extensively for different units where the conventional concrete of pavement using bituminous mix or cement concrete technique is not feasible or desirable. This study looked at the feasibility of Fly ash and waste rubber inclusion as partial cement and coarse aggregates replacement system. Properties of M30 grade concrete replacing waste rubber as coarse aggregate partial substitution around of 5%, 10%, 15%, 20% and 25% were investigated. Also the concrete replacing fly ash as partial substitution for cement amounts of 25% were investigated

1. Introduction

Concrete paving blocks has been extensively used in many countries for quite some time as a specialized problem solving technique for providing pavement in areas where conventional types of construction are less durable due to many operational and environmental constraints. This technology has been introduced in India in construction, a decade ago, for specific requirement namely footpaths, parking areas etc. but now being adopted extensively in different uses where the conventional construction of pavement using bituminous mix or cement concrete technology is not feasible or desirable. Concrete paver blocks were first introduced in Holland in the fifties as replacement of paver bricks which had become scarce due to the post-war building construction boom. These blocks were rectangular in shape and had more or less the same size as the bricks. During the past five decades, the block shape has steadily evolved from non-interlocking to partially interlocking to fully interlocking to multiply interlocking shapes. The main challenge before the Indian concrete industry now is to meet the demand of economical and efficient construction materials required by large infrastructure needs due to rapid industrialization and urbanization. All these call for use of good quality concrete with use of minimum resources (eg. Limestone, energy &money) and achieving maximization of strength, durability and other intended concrete properties. In recent years there has been an increasing worldwide demand of concrete paving blocks for the footpaths, roads and airfields which has led to a local depletion of aggregates. In some urban areas, the enormous quantities of aggregate that have already been used means that local materials are no longer available and the deficit has to be made up by importing materials from other locations. Most cities have areas of land covered by spoil heaps which are unsightly and prevent large areas of land being used for anything else. Concrete paving block is a versatile, aesthetically attractive, functional, and cost effective and requires little or no maintenance if correctly manufactured and placed.

2. LITERATURE REVIEW

Yole, R.C. and Dr. Varma, M.B. , they used rounded steel aggregate as a partial replacement of aggregate and used rubber pad at bottom for testing. They designed a nominal m ix i.e., by weight having ration of 1:1.84:2.76 of cement aggregate and water respectively. They prepared 5 different type of paving block by percentage replacing of aggregate with 0%, 10%, 20%, 30% and 40%. The rubber pad used at bottom was of a thickness of 10 mm. They performed impact test on these blocks with and without rubber pads. They noticed that as there is an increase in percentage of steel ball bearings or rounded steel aggregate the average impact value increases from 4.33 for 0% replacement to 6.33 for 30% replacement when tested without using rubber pad below the paving block. On further increasing the replacement of ball bearing to 40% the average impact value decreases to 5. By using the rubber pad at the bottom of thickness 10mm at bottom impact value shows a drastic increase of 500 % to 600 %. The value of impact test changes to 23.33 to 35 for 10% to 40% replacement with steel ball bearings respectively. For the increasing impact value they justified that it was due to increase in the density of paver block.

Aarti Ghude et al The degradation of plastic is very long process, it may take thousands of years. Hence, project is helpful in reducing the plastic waste .In this project, they have used plastic waste in different ratio with fine and coarse aggregate. The paver blocks were prepared and tested .The water absorption capacity of plastic paver block is less. The results showed more strength as compared to paver blocks.

Dr. Bhavin G Patel et al Plastic is an innovative material for using it in construction purpose. Plastic paver block is a productive way of disposal of plastic waste. It shows better results such as strength. Compressive strength is higher compared to conventional paver block. The cost of paver block is reduced by utilizing the plastic waste and copper slag when compared to that of concrete paver block. This method is suitable for the country which has difficult to dispose recycled the plastic waste. The results of compressive test shows that strength of paver block increases with respect to the percentage of copper slag added by weight of fine aggregate. Addition of copper slag increases the density and thereby self weight and hence it is suitable for bearing like Paver block. The workability enhanced with the mixing of copper slag. As copper slag is a high density materials it increases the self weight of paver block there by increases the strength and toughness against the various kinds of loads. By this it can also be stated that the property of toughness and rigidness can be increased in the paver block by using copper slag in it.

Sukhada R H et al The study includes experimental tests on rubber and aggregates used in the Paver Blocks. The papers attempts to carry out the study on the use of industrial rubber waste at 5%, 10%, 15% and 20% in the production of concrete paver blocks. After preparing the specimen according to mix proportions of M40 mix, curing was done at 7 days. From the results obtained, it is observed that as the percentage of rubber increases the slump value also increases this means that workability increases. From the test results Compressive strength has decreased as the percentage of rubber has increased. Compressive strength feared well initially at 5% and 10%. Later it started slightly decreasing. So the conclusion drawn from the present study is, fully replacement of the rubber is not possible. But partially replacement of the rubber is possible up to certain percentages. From the literature review and experimental studies it is concluded that despite of decrease in strength of concrete there is a very high demand of concrete so it can be used as a partial replacement. Inspite of decrease in the strength, partial replacement of rubber is possible and is very much beneficial according to environmental concern and can solve many disposal related problems easily.

Naveen Kumar N V, Naveen B M, Manjunatha R, Puru V, Darshan H A et al. As there is increase in the vehicles every year huge number of rubber tyre have hit the roads which is major environmental

concern. Waste rubber tyres have caused serious problems all around the globe. So the alternative used in the study is to use crumb rubber in concrete as partial replacement material with fine aggregates. The paper aims at preserving natural resources such as cement and aggregates and to overcome this problem waste is utilized and made best use of it. Materials used in the experimental study are Ordinary Portland cement of 43 grade, fine aggregates, coarse aggregates, crumb rubber and water. Basic tests of these materials are carried out to check its properties and characteristics. The process involved in the experimental study is basic test, mix design, casting, curing and testing of specimen. In an order to prepare the specimen crumb rubber is replaced with fine aggregates in different percentages that are 0%, 5%, 10% and 20%. The workability test and compressive strength test was carried out for M25 grade of concrete by replacing fine aggregates with crumb rubber. The results obtained were high workable concrete and compressive strength which initially increased and then later decreased. Therefore the investigation concludes that use of partial replacement of crumb rubber with fine aggregates. But Inspite of open disposal of rubber waste it can be used in the study for environment concern as it has good workability, thermal resistance and sustainability.

Partha Saika, Owais Mushtaq, and A.Arunya et al. The investigation is carried out by using rubber chips as replacement with coarse aggregate. Paper also explains about the statistics of rubber waste produced every year. Since there is an increase in the rubber tyre every year it has become serious environment concern. So measures were taken to use rubber chips in the experimental trials. Rubber chips were replaced with coarse aggregates at different percentages and Compressive Strength test and Split Tensile test was carried out. Four specimens with various percentages at 0%, 4%, 8% and 12% replacement of rubber chips with coarse aggregates was done. Experimental works involved in the study are mix design proportion, casting, curing, and testing of specimen. Workability of concrete was also carried out but results feared well when compared to compressive strength and tensile strength. Therefore study concluded by suggesting using the rubber chips as replacement material up to certain percentages to control the pollution and decrease the waste for our environment purpose.

Rohit Sharma, shalika Mehta et al. The unique method is used to replace rubber with fine aggregates. The paper includes the experimental study done by using rubber at various percentage replaced with fine aggregates along with silica fumes to alter the bonding properties of rubber in the positive manner. The paper also aims that by using this rubber tyre waste it decreases the environmental related issues. The main objective of the paper was to find the Compressive strength, Split Tensile strength, and Flexural strength. To find the properties of rubberized concrete experimental test procedures are done. Procedure involves, mix proportion design, compressive test, flexural strength, and split tensile test. Mix design was done according to IS-Code 10262-2009 and mix was obtained. Crumb rubber at various percentages of 5%, 10%, and 15% was replaced with fine aggregates. Preparation and details of specimen includes casting, curing and testing. Thus paper concluded that workability of the concrete increased with increase in crumb rubber but Compressive strength, split tensile strength and flexural strength decreased with increase in crumb rubber. To overcome this problem and maintain positive way of using rubber in concrete silica fumes were added as admixture to strengthen the concrete and use it efficiently to maintain durability, suitability and control environment issues.

O. Kayali, studied about Fly ash lightweight aggregates in high performance concrete and obtained that concrete produced using fly ash aggregates is around 22% lighter and at the same time 20% stronger than normal weight aggregate concrete. Drying shrinkage is around 33% less than that of normal weight concrete. Moreover, the aggregates possess high durability characteristics that are required for high performance in structures. There are numerous research and journals which clearly explains behavior of fly ash and its properties in concrete that can help and guide many research areas

like addition of fly ash to improve soil fertility and crop yield production which requires proper basic knowledge of fly ash.

Rafat Siddique, studied the behavior of fly ash by replacing sand and obtained result which says that compressive strength, splitting tensile strength, flexural strength, and modulus of elasticity of fine aggregate (sand) replaced fly ash concrete specimens were higher than the plain concrete (control mix) specimens at all the ages.

Charles Berrymana .et.al., studied fly ash replacement for cement in reinforced concrete pipe with the water reducing admixtures and the results revealed that the maximum 7 days compressive strength was observed for the replacement of 35% Class C and 25% Class F fly ash. An increase of 15 % in durability and strength tests is observed in the concrete mixes containing 65% replacement of cement by Class C fly ash.

Niyazi Ugur Kockal .et.al., reveals the utilization of fly ash by replacing coarse aggregates with fly ash and concluded that durable high-strength air-entrained lightweight concretes could be produced using sintered or cold-bonded lightweight fly ash aggregates having comparable performance with the normal weight concretes. Fly ash aggregate lightweight concretes and the normal weight concrete, being air-entrained, were all highly resistant to freeze and thaw cycles, with a minimum durability factor.

Ritesh Mall et al, In this Compressive Strength analysis of Paver Block with 0%, 5%, 10%, 15%, 20%, 25%, 30%, fly ash are tested and graph shown that at 25% fly ash is partially replaced with OPC 43 grade give higher strength as compared to conventional mix i.e., is 0%. Then at 25% fly ash give economic value as compared to conventional mix i.e., is 0%. Replacement of cement by Fly Ash up to 25% by weight has a negligible effect on the reduction of any physical and mechanical properties like compressive strength, flexural strength etc.

3. OBJECTIVE AND METHODOLOGY

3.1 Objective

The objective of this Project is given below

- Here Paver Block is manufactured by using design mix M30 and makes the paver block more durable and effective.
- Study on strength characteristics of M30 grade concrete paver blocks with replacement of 25% cement by fly ash and replacement of 5%, 10%, 15%, 20% and 25% coarse aggregate by crumb rubber (10mm – 4.75mm).
- Study the Compressive Strength of Paver Block in 7 days, 14 days and 28 days respectively.
- To determine the Shape and size test, water absorption test, fire ignition, Colour test and Structure test for concrete.

3.2 Methodology

During this experimental study we are going to perform various test on fine aggregate, coarse aggregate, crumb rubber, Fly ash and various strength test on Interlocking paver blocks designed by decided mixes of M30. We are performed following tests on materials:

a) On Coarse Aggregate: Specific Gravity, Sieve analysis, Water Absorption Test

b) On Fine Aggregate & crumb rubber: Specific Gravity, Sieve analysis and Water Absorption Test

c) On Fly Ash: Specific Gravity, Fineness Module

d) On Cement: Specific Gravity, Finesse Test, Consistency, Initial and Final Setting Time

We are going to perform following procedure on modified mixed concrete Paver Block:

We have to use dry waste material (fly-ash and crumb rubber).

Then, we split the rubber waste in small particles (10mm-4.75mm

Mix I : 25% of cement replacing with fly ash, coarse aggregate, cement and fine aggregates, w/c ration kept constant.

Mix II : Coarse particles of crumb rubber partially replacing with coarse aggregates, 25% of cement replacing with fly ash and fine aggregates, w/c ration kept constant.

We can mix it properly and make a uniform mixes I & II.

We poured the mix into moulds.

Keep it the moulds for dry up-to 24hrs.

And compare the compressive strength for mix I & II, and conclusions

EXPERIMENTAL WORK

4.1 Materials Used

For the preparation of paver blocks by using concrete, we are used Cement, fly ash, crumb rubber, Coarse aggregates, Fine aggregates and water.

4.1.1 Cement

Cement is used right from ancient periods in construction industry. In the most general sense of the word, cement is a binder, a substance which sets and hardens independently, and can bind other materials together. The word "Cement" traces to the Romans, who used the term "opus caementicium" to describe masonry which resembled concrete and was made from crushed rock with burned lime as binder. Te volcanic ash pulverized Paver block additives which were added to the burnt lime to obtain a hydraulic binder were later referred to as cementum, cimentum, cament and cement. Cements used in construction are characterized as hydraulic or nonhydraulic. The most important use of cement is the production of mortar and concrete – the bonding of natural or artificial aggregates to form a strong building material which is durable in the face of normal environmental effects. Cement used in the investigation was found to be Ordinary Portland Cement (53 grade) confirming to IS : 12269 – 1987. The properties of cement was given in below table.

Property	Values
Fineness of cement	5%
Standard consistency	35%
Initial setting time	40min
Final setting time	400min
Specific gravity	3.06

Fig. 1: Properties of Cement.

Water

According to IS 456 : 2000, water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Potable water is generally considered satisfactory for mixing concrete. The pH value of water shall be not less than 6.

Fine aggregates

It is the aggregate most of which passes 4.75 mm IS sieve and contains only so much coarser as is permitted by specification. According to source fine aggregate may be described as:

Natural sand-it is the aggregate resulting from the natural disintegration of rock and which has been deposited by streams or glacial agencies.

Crushed stone sand-it is the fine aggregate produced by crushing hard stone.

Crushed gravel sand-it is the fine aggregate produced by crushing natural gravel.

The specific gravity value is 2.43

The water absorption value is 0.8%

Weight of sample taken = 1000 gm					
S.NO	**IS Sieve (mm)**	**Wt. retained (gm)**	**% Retained**	**% Passing**	**Cummulative % Retained**
1	4.75	14.5	1.45	98.55	1.45
2	2.36	37	3.70	94.85	5.15
3	1.18	246.5	24.65	70.20	29.80
4	600 µ	205.5	20.52	49.65	50.35
5	300 µ	287.5	28.75	20.90	79.10
6	150 µ	177	17.70	3.2	96.80
	Pan	32	3.2	-	
	Total	1000		SUM	262.65
				FM	2.62

Fig. 2: Sieve Analysis of Fine aggregates.

Coarse aggregates

It is the aggregate most of which is retained on 4.75 mm IS sieve and contains only so much finer material as is permitted by specification. According to source, coarse aggregate may be described as:

Uncrushed Gravel or Stone– it results from natural disintegration of rock

Crushed Gravel or Stone– it results from crushing of gravel or hard stone.

Partially Crushed Gravel or Stone– it is a product of the blending of the above two aggregate.

Hard crushed granite stone, coarse aggregates confirming to graded aggregate of size,10mm as per IS:383-1970 was used in the study.

The specific gravity value is 2.67

The water absorption value is 1.2%

Fig. 3: Coarse aggregates.

Weight of sample taken = 3000 gm (NMAS = 20mm)					
S.NO	**IS Sieve (mm)**	**Wt. retained (gm)**	**% Retained**	**% Passing**	**Cummulative % Retained**
1	80	0	0	100	0
2	40	0	0	100	0
3	20	68.5	2.28	97.72	2.28
4	10	2776.5	92.55	5.17	94.83
5	4.75	113.5	3.78	1.38	98.62
6	Pan	0	0	0	-
	Total	300		Sum	195.73 + 500 = 695.73
				FM	6.95

Fig. 4: Sieve Analysis of Coarse aggregates.

Crumb rubber

In this work, the crumb rubber is taken from the nearby motor cycle repair shop.

The properties of iron slag are

Colour: Black

Specific gravity : 1.8

Water absorption : 0%

Fly ash

The Fly ash collected from NTPC Ramagundem, Telangana. The collected waste crushed into small pieces with passed from IS sieve 10mm.

The specific gravity value is 2.12

The Fine ness modulus value is 2.0%

4.2 Mix design

Adopted Grade was M30 for preparation of concrete Paver blocks

Following are the site considerations used for the mix design for nominal concrete in our experimental work

Concrete Grade	: M30
Type of Cement	: OPC 53
Type of aggregate	: 20mm Sub rounded
Exposure Condition	: Severe
Specific Gravity Of Cement	: 3.14
Specific Gravity Of Fine Aggregate	: 2.61

Specific Gravity Of Coarse Aggregate : 2.83

Zone Provision : Zone II

Workability : 75 mm (slump)

Step 1: Calculation of Target Mean Strength

$f'_{ck} = f_{ck} + 1.65$ s

Where s = standard deviation

f_{ck} = Characteristic compressive strength at 28 days

f'_{ck} = Target mean compressive strength at 28 days

Standard deviation value for M30 grade concrete = 5.0 N/mm2

Therefore f'_{ck} = 30 + 1.65 x 5.0

= 38.25 N/mm2

Step 2: Selection of W/C Ratio

From table 5, W/C ratio obtained is 0.45 and the maximum W/C ratio for plain cement concrete for a severe exposure condition is 0.50.

Hence W/C ratio of 0.45 is taken as a value satisfying both the conditions.

Step 3: Calculation of Water Content

The average nominal size of aggregate taken is 20mm and the water content given in table 8 for 20mm aggregate is 186 litres (this is for 50mm slump). (our assumed slump 75mm we need to revised the water content. For 25mm slump → increase 3% water)

Water content: 186 + 3% of 186 = 191.58 litres.

Therefore, water content obtained is 191.58 litres.

Step 4: Calculation of Cement Content

Cement content = $\frac{\text{water content}}{\text{water}-\text{cement ratio}}$

$= \frac{191.58}{0.45}$

= 425.73 kg

The cement content obtained should be greater than the limiting cement content as given in durability criteria which is satisfactory for the above obtained value and the exposure conditions adopted.

Hence, cement content is 425.73 kg

Step 5: Volume of fine aggregates and coarse aggregates

Sieve analysis of fine aggregates taken for the experimental work conformed the fine aggregates into zone II and hence volume of coarse aggregate per unit volume of total aggregate obtained is 0.62 from table 5 (IS10262-2019)

Since the values given in table 5 are for W/C ratio 0.45, suitable corrections were applied for the volume of coarse aggregate (CA) per unit volume of total aggregate (TA) as follows

i.e., Volume of CA per unit volume of TA = 0.62 + (0.01 x 1)

= 0.63

Therefore, the volume of FA per unit volume of TA =1-0.63 = 0.37

Step 6: Mix Calculations

Volume of Concrete = 1 m3

Volume of Cement $= \frac{\text{weight of cement}}{\text{specific gravity of cement}} \text{ X } \frac{1}{1000}$

$= \frac{425.73}{3.14} \text{ X } \frac{1}{1000}$

= 0.1355 m3

Volume of Water =0.1915 m3

Total Volume of Aggregates = 1-(0.1355+.1915)

= 0.6729 m3

Volume of FA = 0.37 x 0.6729

=0.2489 m3

Material	Quantity
Cement (grade 53)	425.73Kg/m^3
Water	191.58 liters
Fine aggregate	649.63 kg/m^3
Coarse aggregate	1199.92 Kg/m^3
Water: cement	0.45

Fig. 5: Quantities of materials in cement concrete.

Fly ash and Crumb rubber replacement in concrete Paver blocks

For 1 Paver block making (25% Replacement of cement with Fly ash and 0% to 25% replacement of Coarse aggregates with crumb rubber).

Volume of block = 1.1 X (0.27 X 0.16 X 0.08) = 0.0038 m3

MIX	FLYASH – CRUMB RUBBER	CEMENT	FLYASH	FA	CA	CRUMB RUBBER	CA	WATER
1	0-0	1.617	0	2.468	4.56	0	1.32	730 ml
2	25 - 0	1.213	0.404		4.56	0		
3	25 – 5				4.332	0.228		
4	25 – 10				4.104	0.456		
5	25 – 15				3.876	0.684		
6	25 – 20				3.648	0.912		
7	25 -25				3.42	1.14		

Fig. 6: Quantities of materials for 1 Block

4.3 Sample Production

Control mix: The cement, fine and coarse aggregates were weighted according to mix proportion of M30. All are mixed together in a bay until mixed properly and water was added at a ratio of 0.45. The water was added gradually and mixed until homogeneity is achieved. Any lumping or balling found at any stage was taken out, loosened and again added to the mix.

Fly ash based Concrete paver block: The cement, fly ash (25% of cement weight replacement), fine and coarse aggregates were weighted according to mix proportion of M30. All are mixed together in a bay until mixed properly and water was added at a ratio of 0.45. The water was added gradually and mixed until homogeneity is achieved. Any lumping or balling found at any stage was taken out, loosened and again added to the mix.

Fly ash & Crumb rubber based concrete paver block: The cement, cement (25% of cement weight replacement), coarse aggregates, fine aggregates, and crumb rubber (0% - 25% with interval of 5% replacement of fine aggregates) were weighted according to mix proportion of M30. All are mixed together in a bay until mixed properly and water was added at a ratio of 0.45. The water was added gradually and mixed until homogeneity is achieved. Any lumping or balling found at any stage was taken out, loosened and again added to the mix.

A 0.0038 m3 volume of paver block specimens were casted for all above various types of concrete mixes. The samples were then stripped after 24hours of casting and are then be water for curing 7days, 14days, 28days. As casted, a total of 90 paver block specimens were produced.

4.4 Experimental Procedure

In this section, the test setup and experimental procedure for conducting various tests are discussed.

Compressive strength test (IS 516-1989)

Compressive strength of concrete is the most important characteristic and it is an indexing property as concrete is designed to carry compressive loads.

This test is conducted to determine the variation of strength of the specimens with varying ratios of fine aggregate and cement with crumb rubber & fly ash. Compressive strength test machine (CTM)

with 2000KN capacity is used to conduct the test on block. After placing the cube between the plates in the CTM, load is applied until the crack is observed on the specimen. The load at the point of cracking is considered as failure load and it is noted. The compressive strength is calculated by

Compressive Strength (σ) = Failure load / Cross sectional area of specimen.

Fig. 7: Testing of paver block specimen.

Efflorescence test

The presence of alkalies in Paver blocks is harmful and they form a grey or white layer on the Paver block surface by absorbing moisture. To find out the presence of alkalis in Paver blocks this test is performed. In this test, a Paver block is immersed in fresh water for 24 hours and then it's taken out of the water and allowed to dry in shade. If the whitish layer is not visible on the surface it proofs that absence of alkalis in Paver block.

If the whitish layer visible about 10% area of the Paver block surface then the presence of alkalis is in the acceptable range. If that is about 50% of surface area then it is moderate. If the alkali's presence is over 50% of the Paver block surface area then the Paver block is severely affected by alkalies.

Fig. 8: No Efflorescence present on Paver block.

Shape and Size Test

Shape and size of Paver blocks are very important consideration. All Paver blocks used for construction should be of same size. The shape of Paver blocks should be purely rectangular with sharp edges. Standard Paver block size consists length x breadth x height as 100mm x 100mm x 100mm.

Fire Resistance Test

The external fire, applied on Paver block to test the fire resistance test. Concrete Paver blocks all materials are act like insulation. If there is no change in the structural properties of Paver blocks up to

1800 above which visible cracks are seen and the Paver blocks deteriorate with increase in temperature.

Hardness test

A good Paver block should resist scratches against sharp things. So, for this test a sharp tool or finger nail is used to make scratch on Paver block. If there is no scratch impression on Paver block then it is said to be hard Paver block.

Drop test

When Paver blocks are dropped from the height of 1 to 1.2m (4 feet), it should not crack or break. This ensures the durability and quality of Paver blocks.

Structure of Paver blocks

To know the structure of Paver block, pick one Paver block randomly from the group and break it. Observe the inner portion of Paver block clearly. If there are any flaws, cracks or holes present on that broken face then that isn't a good quality Paver block.

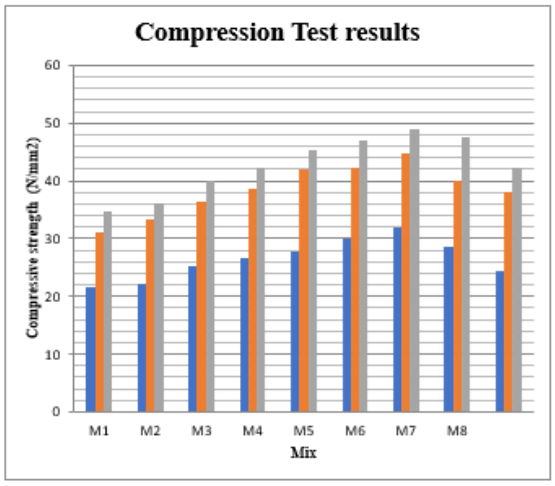

Fig. 9: Compressive strength test results graph

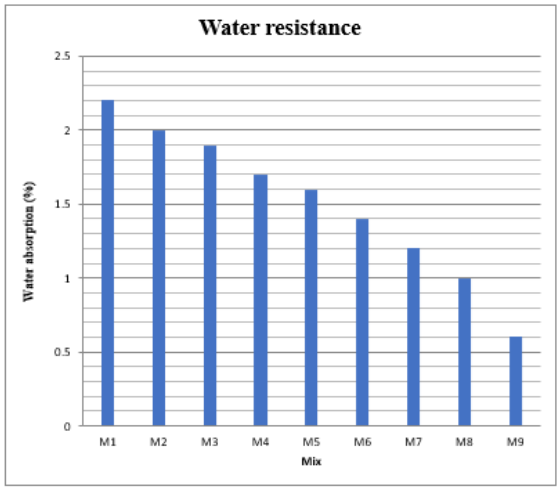

Fig. 10: Water absorption test results graph.

6. SMMARY AND CONCLUSIONS

6.1 Summary

Comparative study on Crumb rubber aggregate concrete and normal aggregate concrete has thrown the lights on following results :

Many private enterprises picks up waste from designated sites segregates and processes Constructional and demolished waste in to various aggregates which are then used to make building products such as paver blocks, kerb stones etc.

Acceptability of crumb rubber & fly ash was found amongst the paver blocks manufacturers only if uninterrupted supply is guaranteed at lower rates than that of virgin aggregates.

There are many paver block manufacturing clusters in Hyderabad which can use aggregates processed from industrial waste. A survey of manufacturers in two such clusters revealed that there is acceptability of recycled industrial waste aggregates if there is regular supply at rates lower than natural aggregates. It was also found that price of natural aggregates is directly proportional to distance of crumb rubber or fly ash from paver block manufacturers.

Paver block manufacturers situated close to the crumb rubber are paying less for per unit of aggregate than those situated far from them. The opportunity thus lies for a industrial waste mobile processing unit or standalone processing unit of small capacity in dump sites near to the paver block manufacturers.

The study identified two clusters of designated dump sites where such units can be set up. Recommendations discussed on this work include effective utilization of industrial waste collected from dumping site through decentralized approach, increasing the sanctioned capacity of the existing plant, providing logistics support to existing processing plant through differential tipping fees, enhancing awareness among entrepreneurs in Pune towards the use of industrial waste to be a secondary raw material and its potential to generate income. Other recommendations on improving product quality made out of Constructional and demolished waste such as introduction of preferential procurement, green labeling and other certification provided by National level 2 organizations and the need for more research and development activities focused on use of fine particles (silt and clay) were also discussed.

Waste is unavoidable by product which is in various forms such as demolished building materials. Reducing and reuse of building materials like concrete waste, debris and old demolished structure and convert it into new usable product is the need in metropolitan cities due to rapid urbanization, development of elegance structure and also natural disaster like earthquakes, floods, wars etc.

Thus to reduce stresses of natural resources, recycling is need of hour for country like India. As the price of building material goes on increasing continuously due to development in rural and urban areas, a partial replacement material reduces the cost of construction.

Production of concrete paver block

Meticulous care, good rules of production was made for production of good concrete paver block. Quality control was done at every stage of production. Initially the dry materials Cement, Aggregates & Sand are mixed. The liquid component of the mixture was then added to the dry materials and the mixing continued for further about 4 minutes to manufacture the fresh concrete paver block. The fresh concrete was cast into the moulds immediately after mixing, in three layers for cube specimens. For compaction of the specimens, each layer was given 60 to 80 manual strokes using a rodding bar, and then vibrated for 12 to 15 seconds on a vibrating table. Addition of 10 % extra cements to cater the quality of concrete. Hand mixing is done. Hand mixing was done in a tray. The maximum size of bag

in hand mixing was one. The study provides an analysis and evaluation of waste of construction and industrial management situation in Hyderabad and proposes suitable strategies to industrial enhance the processing and utilization of waste.

6.2 Conclusions

The aggregates are vital elements in concrete Paver blocks. The usage of enormous quantities of fine aggregates results in excavation of rivers causing geological and environmental imbalance. The environmental impacts of extracting river sand and crushed stone aggregates become a source of increasing concern in most parts of the Country. Pollution hazards, noise, dust, blasting vibrations, loss of forests and spoiling of natural environment are the bad impacts caused due to extraction of aggregates. Landslides of weak and steep hill slopes are induced due to unplanned exploitation of rocks.

Considering the depletion of natural sources and the effect on environment, the disposal problems involved in disposing crumb rubber and fly ash. This waste used in concrete Paver blocks manufacturing gives good mechanical properties.

Trying to replace coarse aggregate by crumb rubber partially to make concrete structure more economic along with good strength criteria. This can be useful for construction of low-cost housing society. Solves problems of disposal of industrial waste of crumb rubber and fly ash.

Up to 35% of coarse aggregate replaced by crumb rubber waste and 25% of cement replaced by fly ash is good according to strength and cost wise.

Up to 25% of coarse aggregate replaced by crumb rubber waste and 25% of cement replaced by fly ash gives higher compressive strength compare to control mix.

The water resistance value is decreasing by increasing crumb rubber waste replacement by coarse aggregates. The structure test, soundness test, drop test, Colour test, Size and shape test the properties are similar to good quality Paver blocks. And this Paver blocks are very lesser cost compare to normal concrete and fly ash – crumb rubber-based Paver blocks.

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