EXPERIMENTALINVESTIGATIONTOIMPROVERIGIDPAVEMENT BY ARTIALREPLACEMENTOFFINEAGGREGATE WITH STONE DUST AND BRICK DUSTMIXTURES

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***Abstract*—Now a day's fine aggregate(sand) is very expensive; so that by adding admixtures like brick dust and stone dust as partial replacement in fine aggregate would give better saving and environment free. This project consists of a partial replacement of fine aggregate with stone dust and brick dust in cement concrete for rigid pavement. In this project I have added two types of admixtures named as brick dust and stone dust in cement concrete mix. Here brick dust and stone dust is added in cement concrete mix with a percentage variation of 5%, 10%, 15%, 20% and 25%. By adding brick dust and stone dust there was a variation in test results of compressive strength, flexural strength and tensile strength. The strength increased when the admixtures content increased up to 20% replacement in cement concrete. Therefore it is better admixture to use in a rigid pavement construction in civil engineering and also overall cost may also reduce to 14.64% cost of cement concrete.**

***IndexTerms*—Brick dust, Coarse aggregate, Compressive strength, Fine aggregate, Flexural strength, Spilt tensile strength, Stone dust.**

I. INTRODUCTION (HEADING 1)

Now a day the purpose of finial greater is very rapidly used in civil engineering constructions like apartments, water tanks, different types of roads etc. Fine aggregate was found from lakes, rivers, once an etc. Will affect o the environment because it will be excavated and transported thefine aggregate withtones of load therefore there was a disturbance in below the layers of earth crestproblem identified to the environment. So that if we add brick dust and stone dust(waste material) in fine aggregate there was a reduced quantity of fine aggregate and the total quantity off in eagle gate will also be reduced. In rigid pavement construction and this material environmentally better to use. The waste material do not poured in to the dumping yard, so that this material was help full for partial replacement in fine aggregate but also it environmentallyfree.

By replacing the brick dust and stone dust on rigid pavement constructionwould give better result. In cement concrete mix the percentage of fine aggregate wasreplaced in 20% there was an increased strength in compressive strength, flexural strength and tensile strength of concrete. In a rigid pavement there was a three components namely sub-grade, base, surface course when compared to flexible pavement there were four components so that the cost of rigid pavement is less whencompared to the flexible pavement. The rigid pavement will be constructed at ruralareas but in flexible pavement not suitable. Therefore finally it is very economical tousein rigid pavement construction.

BrickDust

In developing countries bricks are still one of the most popular construction materials. India is the second largest producer of fired clay bricks after china. India isestimated to have more than 100,000 brick kilns, producing about 150-200 billionbricks annually, employing about 10 million and consuming about 25 million Tons ofcoal annually. For brick making availability of good soil is crucial. Recently numberof additives are added and replaced with clay to increase the performance of bricks including flyash, bagasseash, ricehuskash etc. The utilization of waste from different industrial sector is appreciable for the environment and for the economy ofthe state also. The waste from the brick production facilities is also a cause of concernas the brick Sector of India is unmanaged and has poor worker skill which causes highwaste generation.The waste generated from the brick production can be broadlyclassified as

- Brick dust or Surkhi
- Deformed bricks
- Over burnt bricks
- Broken bricks
- Fly ash

The fly ash generated is being utilized by various other industries. Brick dustis a waste product obtained from different brick kilns and tile factories. There arenumerous brick kiln which have grown over the decades in an unplanned way in different part of the country. Tons of waste products like brick dust or broken pieces or flakes of bricks (brickbat) come out from these kilns and factories. So far, suchmaterials have been used just for filling low lying areas or are dumped as waste materabout and have

sufficient recycling values. The rest of the waste is being dumped onthe roadside or in land filling causing environmental concerns. It was used in theconcrete by sieving from 4.75mm sieve passed material has to be taken in cementconcrete mix.

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StoneDust

Stone dust is a waste material obtained from crusher plants during the process of making of coarse aggregate of different sizes, about 175 million tons stonedust is produced every year, which is kept in great quantity. This used quantity ofstone dust requires a suitable disposal site for its easy and safe discarding a large landarea is required to accomplish the requirement which would again be a great problem in a country of strongly populated like India. Stone dust, being final part of a coarse aggregate is a static material and may be use in concrete making as partial replacement of fine aggregate. Stone dust was collected from local stone crushingunits. It was initially dry in condition when collected, and was sieved before mixing inconcrete. It was used in the concrete by sieving from 4.75mm sieve passed materialhas to be taken in cementconcrete mix.**Figure1.2 Stonedust**

Objectives

1. To examine the mechanical properties of concrete by adding stone dust and brick dust in concrete mix.
2. To find the optimum percentage of stone dust and brick dust content to be added in concrete in relation to their mechanical properties.

3. To find strength properties like split tensile strength and compressive strength of concrete.
4. To decrease the fine aggregate content (sand)in cement concrete by replaced of stone dust and brick dust.

LITERATURE REVIEW

This chapter deals with the literature back ground for the report and it comprises of the topics, related to usage of brick powder and stone powder and their behavior in the conventional concrete.

Effect of using Stone Dust on the Strength Properties of ConcreteR.Ilangovana et. al. (2008) studied strength and durability properties of concrete containing quarry rock dust as fine aggregate. It represents the feasibility of the usage of Quarry Rock Dust as hundred percent substitutes for Natural Sand in concrete. Mix design has been developed for three grades using design an approach IS, ACI, USBR, RN.No.4 and BRITISH for both conventional concrete and quarry dust concrete. Tests were conducted on cubes and beams to study the strength of concrete made of Quarry Rock Dust and the results were compared with the Natural Sand Concrete. An attempt has also been made to durability studies on Quarry Rock Dust when compared with the Natural Sand concrete. It is found that the compressive, flexural strength, durability studies of concrete made of Quarry Rock Dust are nearly 10% more than the conventional concrete.

H. M. A. Mahzuz et. al. (2011) investigated use of stone powder in concrete and mortar as an alternative of sand. He was studied the main concern is to find an alternative of sand. Substitution of normal sand by stone powder will serve both solid waste minimization and waste recovery. From laboratory experiments, it was revealed that concrete made of stone powder and stone chip gained about 15% higher strength than that of the concrete made of normal sand and brick chip. Concrete of stone powder and brick chip gained about 10% higher strength than that of the concrete normal sand and stone chip concrete. The highest compressive strength of mortar found from stone powder which is 33.02 Mpa, shows that better mortar can be prepared by the stone powder. The compressive strength of concrete from stone powder shows 14.76% higher value than that of the concrete made of normal sand Effect of using Brick Duston the Strength Properties of Concrete **M. Kamal Uddin et. al.(2004)** studied Use of brick dust in concrete as mineraladmixture and partial replacement of cement. This study gives an overview of the physical and chemical properties of brick dust as a mineral admixture (BDMA), which is dumped as waste from brick and tile factories. Various

properties of brickdust have been studied. Experimental results indicate that brick dust could be used forpartial replacement of cement in concrete. Concrete cubes prepared with 20% cementreplaced by brick dust (BDMA) shows compressive strength comparable to concrete cube sprepared with Portl and cement only. Concrete prepared with 20% cement replaced by BDMA also shows good resistance to chemical attack, specially the sulfate attack. They also show better pore refinement after long period. Chemicalcomposition and lime reactivity strength of brick dusts have been found to be within the range given for good pozzolanic material. **R.Ranjodh Singh et. al. (2013)** investigated study of self compacting concrete using brick dust and marble powder. The use of fine materials such as brick dust, marblepowder and viscosity modifying agent can ensure the required concrete properties. Inthis experimental work attempt has been made to replace fine aggregate with brickdust and marble powder. Both brick kiln dust and marble powder are waste materialsand are dumped as waste, causing land scarcity and environmental pollution. Usingthesetypesofwastematerialforconcreteisabiggersteptowardssustainableinfrastructure development .Good hardened properties were achieved for the concreteswith 25% marble powder which can be considered as the optimum content for highcompressivestrength.Brickdustandmarblepowdercanbeefficientlyusedtoproduce good quality self compacting concrete with satisfactory slump and settingtimes.

METHODOLOGY

This chapter presented in the step by step order in which they were performed with the help of flow chart.The outline of methodology adopted is described in the flowchart given below

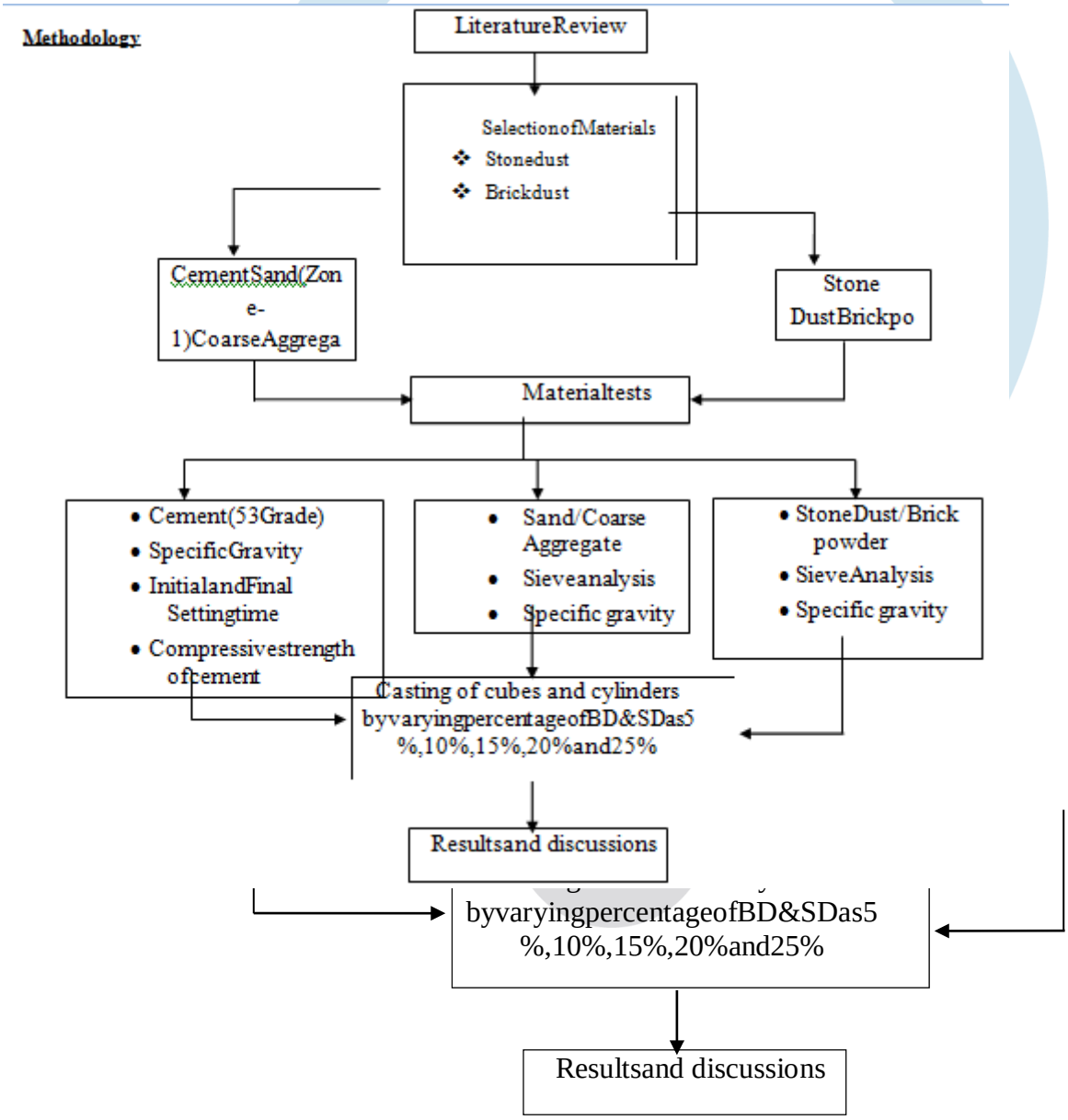


Figure 3.1 Flow chart for the methodology adopted

Experimental studies are carried out for determination of mechanical properties of concrete. Concrete mix is produced by mixing Cement, Fine aggregate, Coarse aggregate, Water, and admixtures (stone dust, brick powder) in a definite proportion. The particulars of materials and their properties are discussed below.

Material Characteristics

- **Cement:** The cement used in this experimental work is 53 grade jayapee ordinary Portland cement.
- **Fine aggregate:** Locally available sand passed through 4.75mm IS sieve is used.
- **Coarse aggregate:** The aggregate used for this study was 20mm single size coarse aggregates. The aggregate was collected from kommadi in Visakhapatnam.
- **Water:** water was obtained from the college of SITAM at Visakhapatnam.
- **Stone dust:** The stone dust obtained from the major crushing units.
- **Brick powder:** The brick dust obtained from the brick kiln industry at yellamanchili.

TestsOnMaterials

Laboratorytestswereconductedtoknowthepropertiesofcement,fineaggregateandcoarse aggregate and those arediscussed below.

Tests on Cement

- Cement used in the present project is of 53 grade jayapee Ordinary Portland Cement.

➢ **Specific Gravity**

- Specific gravity of cement used is 3.0
- The specific gravity of cement as per IS requirements is in between 3-3.5.

➢ **Fineness of Cement**

- Fineness of cement is tested by sieving of cement.
- Fineness of cement is 95.00%.
- The residue of cement should not exceed10%bymassasperIS4031: 1968.

➢ *NormalConsistency*

The standard consistency of a cement paste is defined as that consistency which will permit a Vicat's plunger to penetrate a depth of 5-7 mm from bottom of the mould.

The percentage of water required to produce a cement paste of standard consistency is 27%.

As per IS recommendations the standard consistency of cement should be in the range of 26% -33%.

➢ Initial Setting Time

The time elapsed between the moment water is added to cement to the time that paste starts losing its plasticity is called initial setting time.

The initial setting time of the cement used is 50 minutes. > 30 minutes (As per IS 4031- part5-1988 code).

➢ *FinalSettingTime*

The time elapsed between the moment of adding water to the cement, and thetime when the paste has completely lost its plasticity is called final settingtime.

The final setting time of cement is 4hours 42minutes< 10 hours (As per IS4031-part5-1988code).

➢ **Specific gravity**

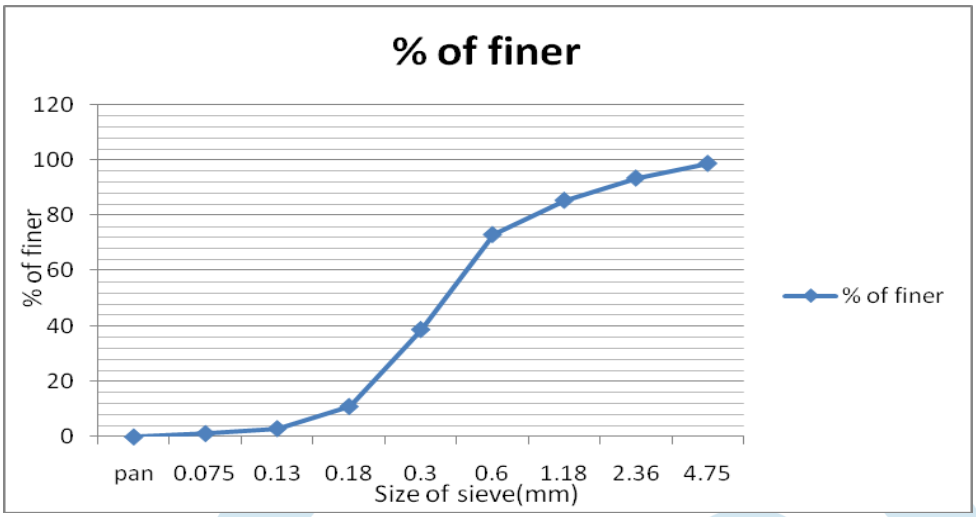
Specific gravity of fine aggregate is 2.64.

The specific gravity of fine aggregate as per IS requirements is in between 2.6-2.8.

➢ **Sieve analysis**

S.no	Size ofsieve(mm)	IndividualWeight retained(gm)	Cumulativeweight retained	Cumulativeweight retained(%)	% offiner	Standard% weightpassing forzone-III
1.	4.75	15	15	1.5	98.8	90-100
2.	2.36	50	65	6.5	93.5	85-100
3.	1.18	80	145	14.5	85.5	75-100
4.	0.6	124	269	26.9	73.1	60-79
5.	0.3	343	612	61.2	38.8	12-40
6.	0.18	278	890	89.0	11	-
7.	0.13	80	970	97.0	3.0	-
8.	0.075	18	988	98.8	1.2	-
9.	Pan	10	998	100	0	-
			Total=494.6			

Table3.1 Sieveanalysisforfineaggregate
Figure3.2Grainsizeanalysisof sand



II. PREPARATION OF SAMPLES

This chapter deals with preparation of Mix design to cast the samples andexperimental methodology for carrying out compressive and split tensile strength ofconcrete samples.Different types of concrete mixes were prepared and casted for different dosages of admixtures

Mix Design

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All the concrete mixes in the project are prepared as per IS: 10262- 2009.This standard was first prepared in the year 1982 and later revised in the year 2009. The Indian standard was adopted by the Bureau of Indian standards, after the draft finalized by the cement and the concrete sectional committee has been approved by the civil engineering division council.

The following prerequisites are to be taken into consideration before designing a concrete mix:

a) Characteristic compressive strength of concrete at 28 days (fck),
b) Degree of workability desired,
c) Limitations on the water cement ratio and the minimum cement content to ensure adequate durability,
d) Type and maximum size of aggregate to be used,

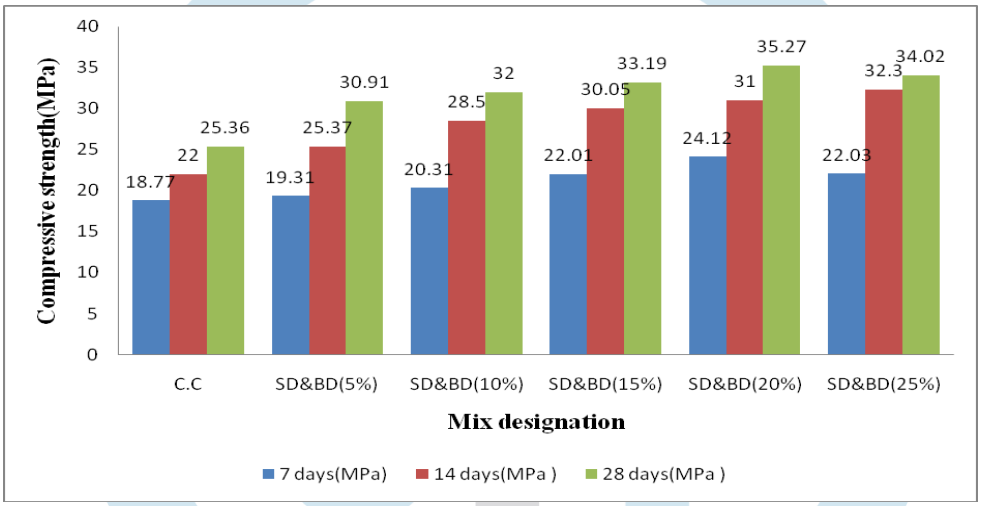
Figure4.2 Preparation ofcubespecimen

EXPERIMENTAL TEST RESULTS

Compressive Strength Of Sd & Bd Cube Specimens

Table5.1 compressive strength SDBD cube specimens

Mix	7days(MPa)	14days(MPa)	28days(MPa)
C.C	18.77	22.00	25.36
SD&BD(5%)	19.31	25.37	30.91
SD&BD(10%)	20.31	28.50	32.00
SD&BD(15%)	22.01	30.05	33.19
SD&BD(20%)	24.12	31.00	35.27
SD&BD(25%)	22.03	32.30	34.02



.CONCLUSIONS

This chapter describes about brick dust and stone dust mixture used for casting samples and they are tested for compressive, flexural and split tensile with varying percentages. From the tests conducted on various samples and results obtained as follows.
It is observed that Slump values of the concrete are decreasing as the admixtures percentage increasing. The reduction in slump with the increase in the admixture will be attributed to presence of admixture which causes obstruction to the free flow of concrete.
Compressive Strength enhancement ranges from 5.55% to 9.91% when % of admixture increases from 5% to 20% when compared to the conventional concrete at 28 days. 20% is observed as the optimum value. Split tensile Strength enhancement ranges from 0.225% to 2.8% % when % of admixture increases from 5% to 20% when compared to the conventional concrete at 28 days. 20% is observed as the optimum value. Flexural Strength enhancement ranges from 0.6% to 2.1% when % of admixture increases from 5%to 20% when compared to the conventional concrete at 28 days. 20% is observed as the optimum value. From the results it is observed that 20% is the optimum dosage of addition of stone dust and brick dust admixture increases the compressive strength, flexural strength and split tensile strength. Addition of more than 20% of brick dust and stone dust admixture would result decreasing the values of compressive strength, split tensile strength and flexural strength. Addition stone dust and brick dust mixture in cement concrete, the pavement thickness is decreased from 31cm-28cm.Construction cost of the pavement is reduced by 14.64% by using stone dust and brick dust mixture.

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