Laboratory Tests To Improve Rigid Pavement Mechanical Properties Using Stone Dust And Brick Dust Mixtures

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ABSTRACT: 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. 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. Therefore it is enhanced 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

Keywords : Brick dust, Coarse aggregate, Compressive strength, Fine aggregate, flexural strength, Spilt tensile strength. Stone dust.

1 INTRODUCTION

Now a day the purpose of fine aggregate is very rapidly used in civil engineering constructions like apartments, water tanks, different types of roads etc. Fine aggregate was found from lakes, rivers, oceans etc. Will affect to the environment because it will be excavated and transported the fine aggregate with tones of load therefore there was a disturbance in below the layers of earth crest problem 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 of fine aggregate will also be reduced in rigid pavement construction and this material environmentally better to use. The waste material do not poured into the dumping yard, so that this material was helpful for partial replacement in fine aggregate but also it environmentally free. in fine aggregate there was a reduced quantity of fine aggregate and the total quantity of fine aggregate will also be reduced in rigid pavement construction and this material environmentally better to use. The waste material do not poured into the dumping yard, so that this material was helpful for partial replacement in fine aggregate but also it environmentally free. By replacing the brick dust and stone dust on rigid pavement construction would give better result. In cement concrete mix the percentage of fine aggregate was replaced 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 was four components so that the cost of rigid pavement is less when compared to the flexible pavement. The rigid pavement will be constructed at rural areas but in flexible pavement not suitable. Therefore finally it is very economical to use in rigid pavement construction.

1.1 Brick dust

The utilization of waste from different industrial sector is appreciable for the environment and for the economy of the state also. The waste from the brick production facilities is also a cause of concern as the brick Sector of India is unmanaged and has poor worker skill which causes high waste generation.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 is estimated to have more than 100,000 brick kilns, producing about 150-200 billion bricks annually, employing about 10 million and consuming about 25 million Tons of coal annually. For brick making availability of good soil is crucial. Recently number of additives are added and replaced with clay to increase the performance of bricks including fly ash, bagasse ash, rice husk ash etc. It was used in the concrete by sieving from 4.75mm sieve passed material has to be taken in cement concrete mix.

1.2 Stone dust

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 stone dust is produced every year, which is kept in great quantity. This used quantity of stone dust requires a suitable disposal site for its easy and safe discarding a large land area 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 used in concrete making as partial replacement of fine aggregate. Stone dust was collected from local stone crushing units. It was initially dry in condition when collected, and was sieved before mixing in concrete. It was used in the concrete by sieving from 4.75mm sieve passed material has to be taken in cement concrete mix

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1.3 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

2 MIX DESIGN

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.

Grade designation - M15
Type of cement - OPC 53 grade conforming to IS 8112
Max. Nominal size of aggregate - 20mm
Minimum cement content - 321.033kg/m³(IS-456:2000)
Maximum water cement ratio - 0.6
Exposure condition - Mild

2.1 Mix calculations

a) Vol. of concrete = $1m^3$

Mix	7days (MPa)	14 days (MPa)	28 days (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

b) Vol. of cement = (mass of cement/specific gravity of cement) × (1/1000)
= $0.176m^3$

c) Vol. of water = (mass of water/specific gravity of water) × (1/1000)
= $0.105\ m^3$

d) Vol. of all in aggregate = [a-(b+c)]
= $0.719m^3$

e) Mass of coarse aggregate = d× vol. of coarse aggregate × sp. Gr. of coarse agg. × 1000
= $1390\ kg/m^3$

f) Mass of fine aggregate = e × vol. of coarse aggregate × sp. Gr. of fine agg. × 1000
= $538.28\ kg/m^3$

2.1 Mix proportions

Cement = $321.033kg/m^3$
Water = 176.56 liters
Fine aggregate = $538.28\ kg/m^3$
Coarse aggregate = $1390.57\ kg/m^3$
Water-cement ratio =0.55

Figure 1: *Preparation of cube specimen*

Figure 2: *Preparation prism specimen*

3 EXPERIMENTAL TEST RESULTS

3.1 Compressive strength of SD&BD cube specimens

TABLE 1

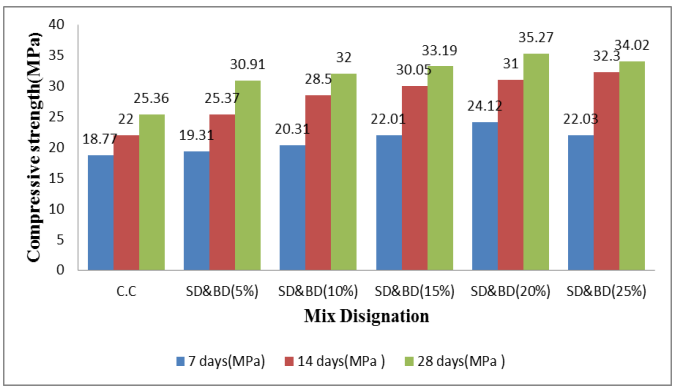

Figure 3 *Compressive strength values of C.C and SDBD at 7, 14 and 28 Days*

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3.2 Split tensile strength of SD&BD cube specimens

TABLE 2
TENSILE STRENGTH SD&BD CYLINDRICAL SPECIMENS

Mix	7days (MPa)	14 days (MPa)	28 days (MPa)
C.C	1.00	1.2	1.58
SD&BD(5%)	1.50	1.65	1.805
SD&BD(10%)	1.7	1.86	2.07
SD&BD(15%)	2.5	2.73	3.53
SD&BD(20%)	3.01	3.50	4.38
SD&BD(25%)	2.7	3.2	3.57

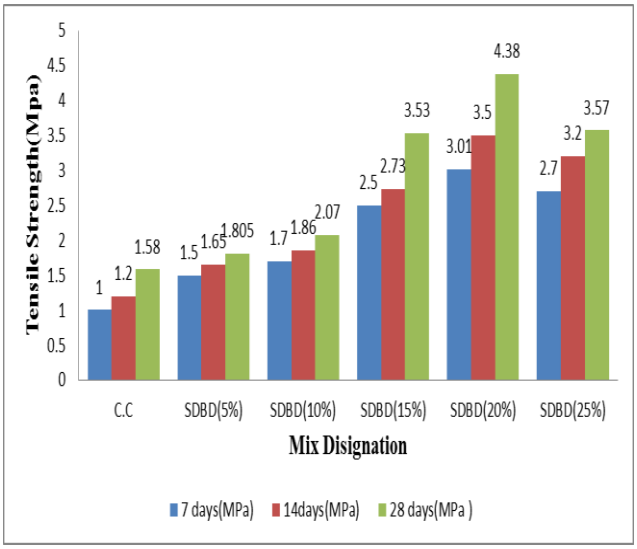

Figure 4 *Tensile strength values of C.C and SD&BD at 7, 14 and 28 Days*

3.3 Flexural strength of SD&BD cube specimens

TABLE 3
FLEXURAL STRENGTH SD&BD BEAM SPECIMENS

Mix	7days (MPa)	14days (MPa)	28 days (MPa)
C.C	3.9	4.2	4.9
SD&BD(5%)	4.1	4.7	5.5
SD&BD(10%)	4.5	5.0	6.45
SD&BD(15%)	4.9	5.3	6.66
SD&BD(20%)	5.5	6.2	7.00
SD&BD(25%)	5.2	5.8	6.05

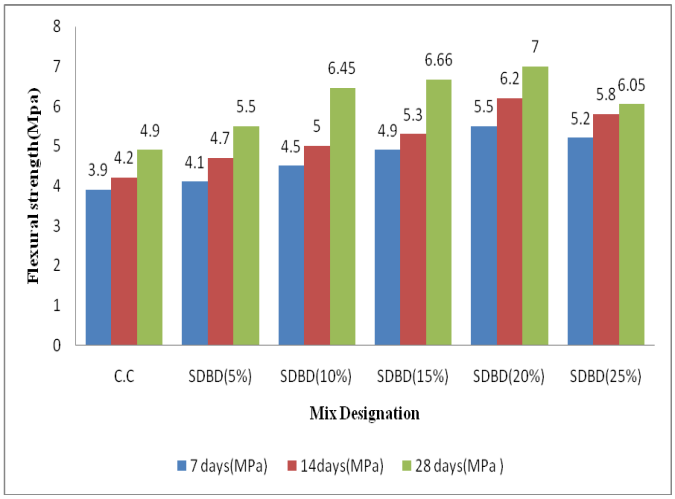

Figure 7 *Flexural strength values of C.C and SD&BD at 7, 14 and 28 Days*

4 COST COMPARISON

A cement concrete pavement is to be laid with following dimensions. Quantity and cost of each material for that stretch is calculated and compared for conventional concrete and brick dust and stone dust concrete in this section.

4.1 Cost for conventional concrete

Length of the pavement = 1m.
Width of the pavement = 3.75m.
Thickness of the pavement = 31cm.
Total volume of concrete required to fill the surface course
=L×b×h.
= 1m×3.75m×0.31m.
=1.162m³

TABLE 4
ESTIMATION OF MATERIALS FOR CONVENTIONAL CONCRETE

S.no	Material	Quantity (kg)	Rate per kg in Rs.	Cost in Rs.
1	Cement	373.04	7.14	2663.50
2	Fine aggregate	625.48	0.75	469.11
3	Coarse aggregate (20mm)	1615.84	1.00	1615.00

Total cost in Rupees for 1.16m^3 of concrete for a stretch of 1m×3.75m×0.31m = 4747.11 /-

4.2 Cost for SD & BD concrete

Length of the pavement = 1m.
Width of the pavement = 3.75m.
Thickness of the pavement = 25cm
Total volume of concrete required to fill the surface course
=L×b×h.
= 1m×3.75m×0.25m.
=0.9375 m^3

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TABLE 5
ESTIMATION OF MATERIALS FOR SDBD CONCRETE

S.no.	Material	Quantity (kg)	Rate per kg in Rs.	Cost in Rs.
1	Cement	300.968	7.14	2148.91
2	Fine aggregate	400.504	0.75	300.378
3	Coarse aggregate (20mm)	1303.65	1.00	1303.65
4	Stone dust	50.063	0.25	14.12
5	Brick dust	50.063	0.26	15.00

Total cost in Rupees for 0.937 m^3 of concrete for a stretch of 1m×3.75m×0.28m = 4052/-

From the above calculation we can save 694.94/- Rs per 1m length by using stone dust and brick powder mixture. Thus the construction cost of the pavement is reduced by 14.64% by using stone dust and brick powder mixture.

5 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.

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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.
7. Addition stone dust and brick dust mixture in cement concrete, the pavement thickness is decreased from 31cm-28cm.
8. Construction cost of the pavement is reduced by 14.64% by using stone dust and brick dust mixture.

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