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"Parametric Study on Fractional Diversion Using Quarry Dust & Kota Stone for High Strength Concrete"

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Abstract —*Research study includes check the performance of quarry dust and waste kota stone in concrete as replacement of fine aggregate and coarse aggregate respectively. Experimental investigations are performed to evaluate concrete containing quarry dust and waste kota stone. Fine aggregate are replaced by 20% and 30%, quarry dust and coarse aggregate are replaced by 0%, 10%, 20%, 30%, 40% and 50% waste kota stone. The fresh property like slump test and hardened properties like compression strength test, split tensile strength test, flexural strength test are checked out at required days after curing for the grade of M70. In the experimental investigation it is found that there is increase in strength*.

Keywords- *Quarry Dust, Kota Stone, Fine Aggregate, Coarse Aggregate, High Strength.*

I. INTRODUCTION

Concrete is a mixture of cement, sand, aggregates, water, etc. which are economically available. Concrete is made up of granular materials. It looks like coarse aggregates embedded in a matrix bound together with binder or cement which fills the space between the particles and glues them together as a whole body. Almost two and half quarter volume of concrete is made of aggregates and one quarter volume of concrete is made of fine sand. The major source of sand is river beds which have been used extensively and depleted for construction purposes. This depletion may create shortage of sand and can cause a noticeable increase in the price of sand. Hence in the future, to meet the global demand of concrete, we are forced to think of alternative materials which are to be replaced in conventional concrete.

Aggregate materials are extracted mainly from quarrying operations and widely used for all construction applications. The production of these materials generated large quantities of fine by products as waste. Handling and disposal of these by products creates problems to the environment and disposal of these wastes becomes costly. Due to depletion of natural materials it is necessary to find some alternative materials such as quarry dust which use as partial replacement of fine aggregate and waste kota stone as replacement of coarse aggregate. In fact, the aggregates represent almost 80% of concrete, thus their replacement with recycled materials can help us to transform traditional concrete into a sustainable material.

II. SIGNIFICANCE OF THE WORK

The present work is aimed to study the behavior of concrete in presence of Kota Stone and Quarry Dust. Coarse Aggregate is replaced by Kota Stone by 0%, 10%, 20%, 30%, 40% and 50% and Fine Aggregate is replaced by Quarry Dust by 20% and 30% by weight. By the use of Kota Stone and Quarry Dust, the environmental problem of disposal of waste materials can be satisfied and also have the improvement in performance of concrete.

III. MATERIALS

A. Cement
Ordinary Portland Cement (OPC) of 53 grade was used. Confirming IS: 12269

B. Fly Ash
In this experimental work class F fly ash used.

C. Silica Fume
Silica fume improves properties of concrete.

D. Fine Aggregate
The size of aggregate is less than 4.75 mm as per IS 383.

Test	Result
Specific Gravity	2.65
Water Absorption	1%

Table 1 Physical properties of fine aggregate

E. Quarry Dust

Quarry dust is a by-product made in the crushing process of ornamental stones (Blue metal) which is available from rock quarries at low cost in many areas can be an economical alternative material to the river sand.

Test	Result
Specific Gravity	2.58
Water Absorption	1.8%

Table 2 Physical properties of quarry dust

F. Coarse Aggregate

Aggregate confirming IS: 383, maximum 20 mm size of aggregate used. Coarse Aggregate used in 40:60 proportion blending. 40% aggregate is size of 20 mm and 60% aggregate is size of 10 mm.

Test	Result
Specific Gravity	2.74
Water Absorption	0.5%

Table 3 Physical properties of coarse aggregate

G. Kota Stone

It is naturally available stone and easily available at any local store. It is crushed by hammer and maximum size of 20 mm is used.

Test	Result
Specific Gravity	2.7
Water Absorption	Nil

Table 4 Physical properties of kota stone

H. Admixture

Super plasticizer is used. It is based on carboxylic ether polymer.

IV. MIX PROPORTIONING

Design of concrete mix as per the water cement ratio of 0.263 conventional batch of M70 grade was casted and then compared with percentage replacement of Kota Stone and Quarry Dust.

Cement	-	431.88 kg/m^3
Fly Ash	-	86.37 kg/m^3
Silica Fume	-	57.58 kg/m^3
Water	-	163.59 kg/m^3
Fine aggregate	-	664.06 kg/m^3
Coarse aggregate 20 mm	-	414.04 kg/m^3
10 mm	-	621.07 kg/m^3
Chemical Admixture	-	8.67 kg/m^3

Table 5 Mix proportion for M70

V. EXPERIMENTAL WORK

A. Casting, Curing, and Testing of specimen

Casting of specimens was done by proper batching of materials, preparation of moulds and placing of concrete into moulds. Then all moulds are kept into curing tank for 7 and 28 days.

Mix	NFA	QD	NCA	KS	Slump (mm)	Compressive Strength		Split Tensile Strength	Flexural Strength
						7 Days (N/mm^2)	28 Days (N/mm^2)	28 Days (N/mm^2)	28 Days (N/mm^2)
0	100%	0%	100%	0%	90	52.68	78.70	4.45	6.10
1	80%	20%	100%	0%	88	51.94	78.52	4.41	6.09
2	80%	20%	90%	10%	86	51.48	78.50	4.43	6.09
3	80%	20%	80%	20%	85	54.83	81.12	4.52	6.15
4	80%	20%	70%	30%	80	55.51	84.32	4.63	6.28
5	80%	20%	60%	40%	78	54.65	82.97	4.57	6.23
6	80%	20%	50%	50%	75	51.26	79.62	4.47	6.14
7	70%	30%	100%	0%	86	52.52	79.25	4.47	6.12
8	70%	30%	90%	10%	83	55.16	84.52	4.62	6.29
9	70%	30%	80%	20%	81	55.90	86.00	4.67	6.35
10	70%	30%	70%	30%	79	58.09	88.02	4.73	6.49
11	70%	30%	60%	40%	75	57.47	85.21	4.64	6.34
12	70%	30%	50%	50%	73	55.31	83.23	4.59	6.26

Table 6 Calculated mix design result

Keywords: NFA – Natural Fine Aggregate, QD – Quarry Dust, NCA - Natural Coarse Aggregate, KS- Kota Stone

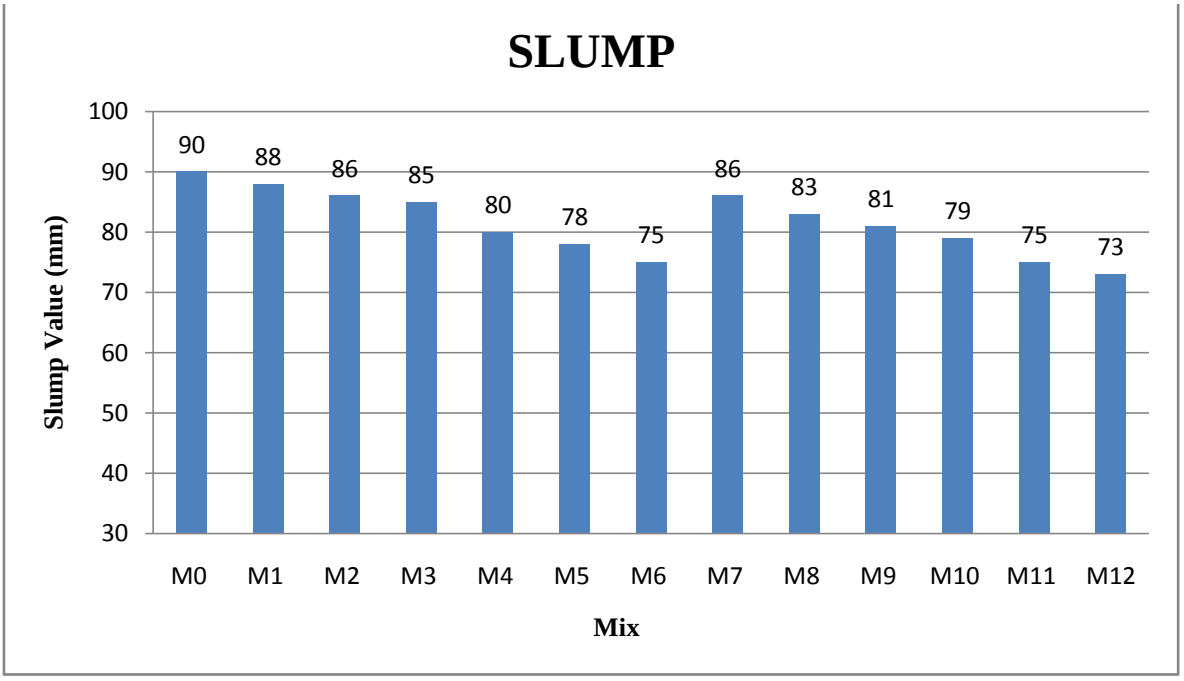

Fig.1 Slump Test Result

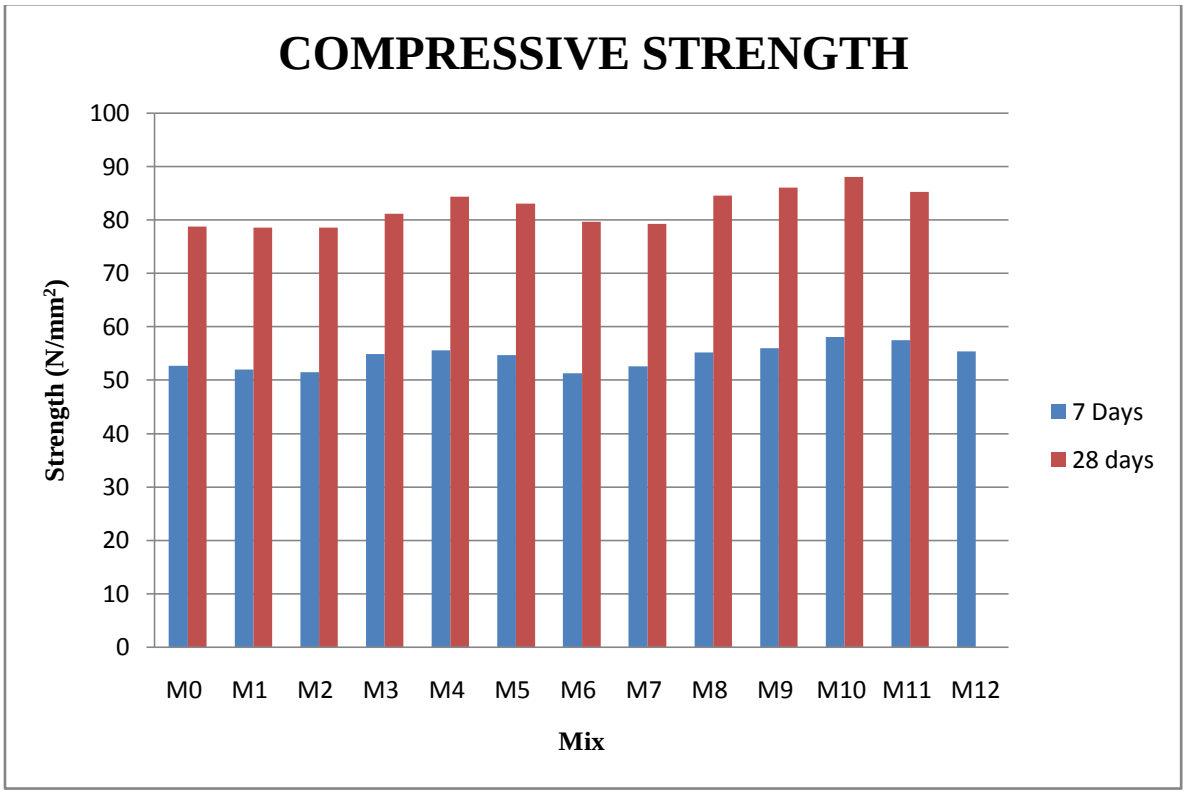

Fig.2 Compressive Strength Result

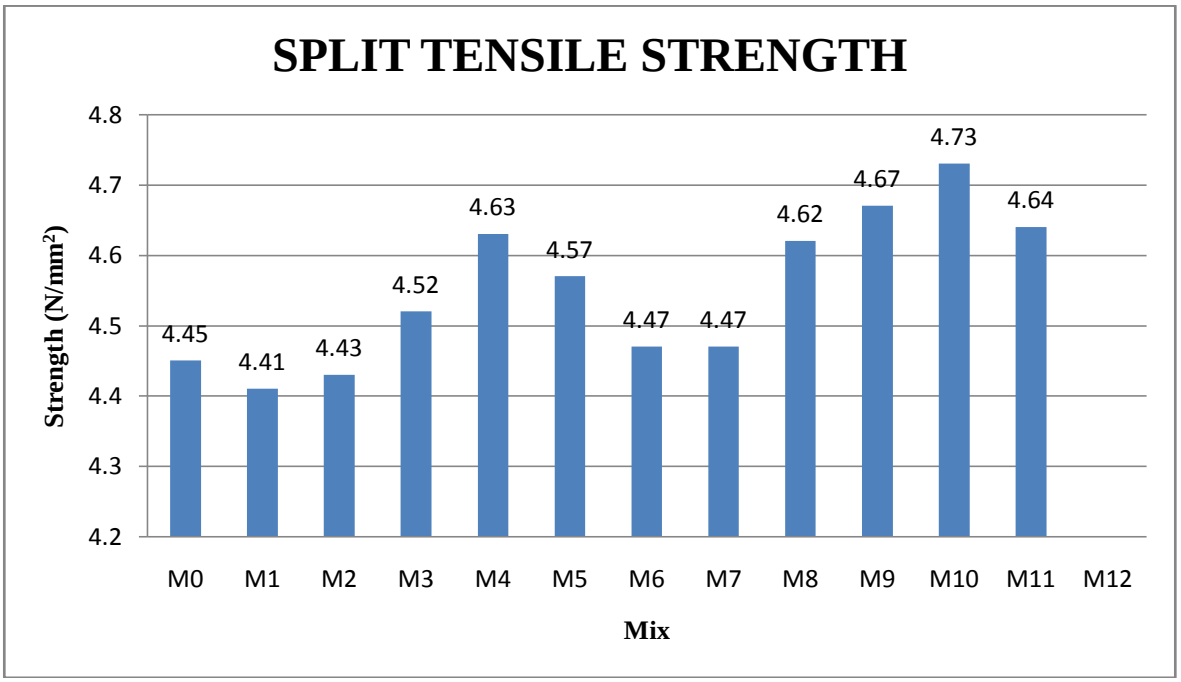

Fig.3 Split Tensile Strength Result

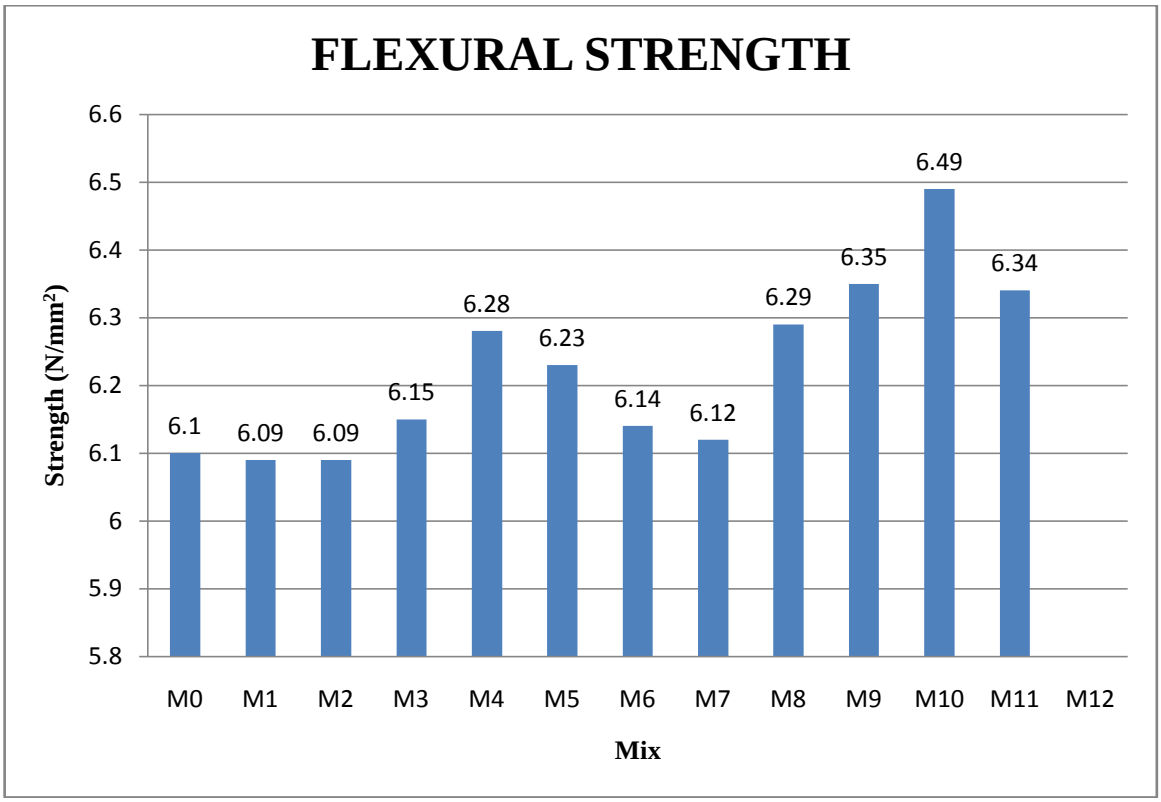

Fig.4 Flexural Strength Result

VI. CONCLUSION

The various experiments have been performed with the comparative study of Kota Stone with Coarse Aggregate and Quarry Dust with Fine Aggregate. Kota Stone were used in the replacement of 0%, 10%, 20%, 30%, 40% and 50% with CA. Quarry Dust used with the replacement of 20% and 30%, with FA. From various experiments and results, the following conclusions were made.

- By replacing 30% of Quarry Dust and 30% Kota Stone, it gives maximum compressive strength than other mixes. There is an increment of 11.84% after 28 days in mix M10 compared to normal concrete.
- In split tensile strength there is an increment of 6.29% in mix M10 compared to normal concrete.
- In flexural strength increment of 6.39% noticed in mix M10 compared to normal concrete.
- By increasing various percentage replacement of kota stone and quarry dust in concrete, the workability of concrete decreases, but workability criteria is satisfied.

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